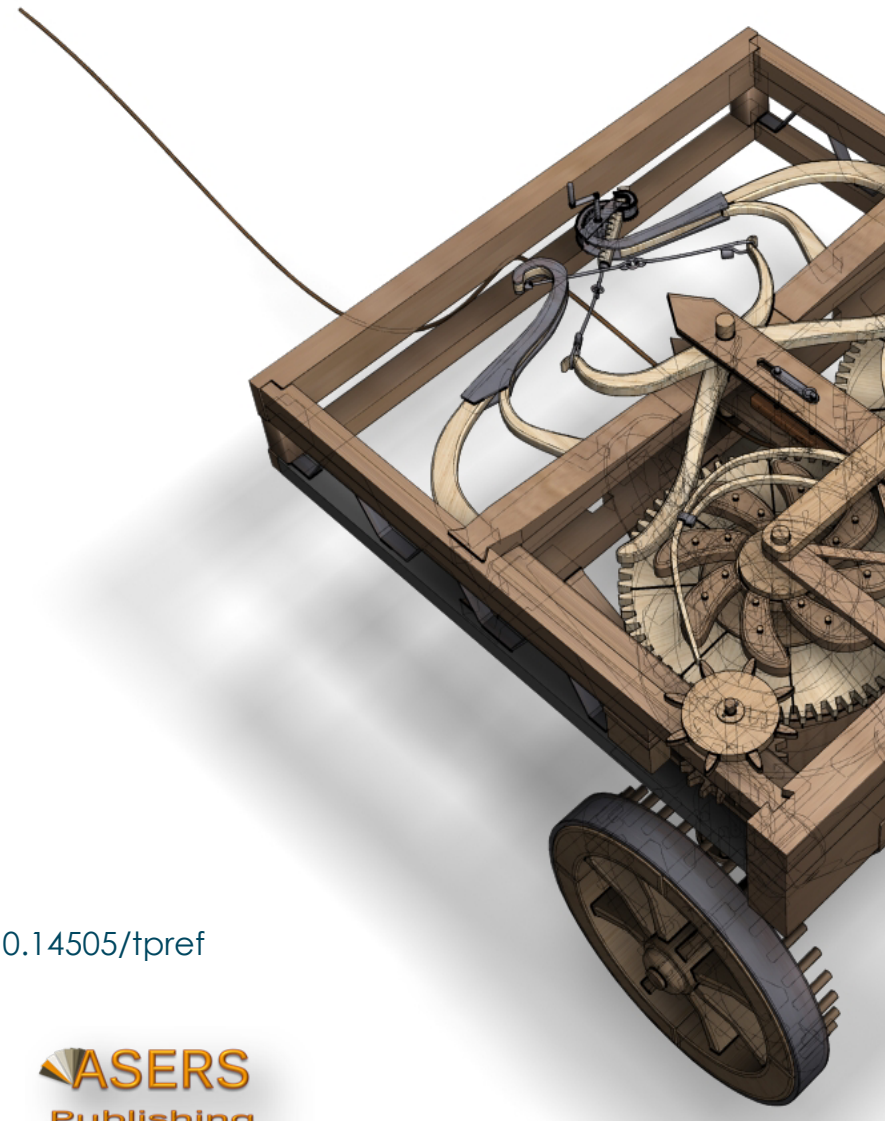
Theoretical and Practical Research in Economic Fields



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Theoretical and Practical Research in Economic Fields

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Exploring Profitability in Albanian Banks through Decision Tree Analysis

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Abstract: This study intends to predict Return on Assets (ROA) and assess the significance of several key dependent variables, including Profit per Outlet, Profit per Employee, Natural Logarithm of Assets (ln(assets)), and Loan to Deposits Ratio. In this respect, decision tree regression is employed as the major analytical tool. Within the scope of quarterly data sourced from some leading Albanian banks, such as American Bank of Investments, Banka Kombëtare Tregtare, Credins Bank, Fibank, Intesa Sanpaolo Bank, ProCredit Bank, Raiffeisen Bank, Tirana Bank, and Union Bank, data spanning from January 2016 to December 2022 were taken and used in this analysis. Data collection was done through the website of the Albanian Association of Banks. The following section presents all the relevant information on the selected model, mean squared error (MSE) for training data at 0.5988 and for test data at 0.8912, mean absolute error (MAE) of 0.4764 for the training data and 0.6257 for the test data, and R-squared (R^2) at 0.7706 for training data and 0.4244 for test data. All the findings clearly show that decision tree regression is very effective in the prediction of ROA and also helps in elucidating the relative importance of the selected dependent variables within the context of Albanian banking institutions.

Keywords: Albanian banks; feature importance; machine learning; return on assets.

JEL Classification: C87; E44; G21; G28.

Introduction

The financial health of the banking sector is an important sign of economic progress; it reflects not only the health of financial systems but also more general global economic trends. As concerns on predicting profitability rise for investors, central banks, and other stakeholders over time, since banks come to be regarded as the platform for more capital allocation and growth, predicting bank profitability has become a matter of great concern among all stakeholders. While revenue generation and risk management are central to profitability, the array of macroeconomic conditions, regulatory policies, and innovative technological advancements among others all carry their own subtleties. An important profitability statement is the forecasting of bank profitability that may help in strategic decision-making, investment evaluation, regulatory oversight, and policy formulation. If one examines the banking landscape and even beyond with technological innovations and regulatory changes, forecasting profitability becomes quite important to navigate uncertainties and seize opportunities. The originality of this research lies in the fact that it applied these innovative decision tree methodologies to the Albanian banking sector, which is relatively unexplored in the literature.

This research makes a more detailed contribution to the literature with respect to targeted statistical methods in analyzing bank profitability through the application of decision tree analysis in discovering intricate patterns and relationships that might have been overlooked by conventional methods applied earlier in previous studies. Of importance to this work, therefore, is the fact that if successful, it will help both policymakers and banks to obtain more accurate and actionable insights for making informed decisions aimed at improving profitability and sustainability in one of the world's most dynamic financial environments.

1. Literature Review

Bank profitability has been a subject of extensive scholarly interest, with many researchers focusing on the different aspects of this complicated issue. The present study uses a cross-sectional framework, combining the Operational Model and the MLR techniques, to create a flexible, well-specified regression model able to predict and explain bank profitability at high accuracy. Numerous studies have made efforts towards deriving the determinants of bank profitability, using various methods and frameworks.

Based on the results of Elamir (2020), the investment decision-making issue is solved through prediction models with machine learning methods such as linear regression, regression tree, pruned regression tree, conditional inference tree, and cubist regression. The study was conducted on eight MENA countries for the analysis of sixty-three banks, comprising 630 observations of data. The dataset was divided into training (2008-2017) and testing (2018) sets for model development and validation, respectively. Evaluation metrics used for model assessment are Root Mean Square Error, R-squared, and Mean Absolute Error. It is noted that out of the many models tested, the best one was the cubist regression one and it outperformed all others with a tremendous margin. This cubist regression has attained a 96% R-squared for training data, providing very good predictive performance compared to other models. It is interesting that total assets, bank book value, and total liability have emerged as the major determinants of the earnings per share, therefore pointing the way for bank managers to strengthen financial market stability. The research thus highlights the need for the application of multiple techniques to face multidimensional data, leaving a scope for future research involving further use of financial and non-financial data sources.

Wei *et al.* (2021) did research work on the prediction of various features for the measurement of performance in commercial banks with boosting regression trees. It is different from the previous studies focusing on singular characteristics and involved a more comprehensive view by exploring multidimensional attributes. They introduced an adaptively reduced step size gradient boosting regression tree algorithm well-suited for the bank data and performed better than existing classification methods, like BIRCH. Data from 30 provinces in China was used to conduct a hierarchical cluster analysis, which identified four distinct groups of banks. Particularly, they found that NPLR has a relatively higher coefficient than many other performance evaluation items, indicating that NPLR itself has a better ability of discriminating between good and poor performance.

Atiku and Obagbuwa's (2021) takes an informative look at the performance contribution in the competitive banking industry. They are interested in strategic human resource management by aligning organization’s goals with HR strategies. They employed machine learning algorithms to predict bank performance using data collected from 305 respondents via survey-based quantitative data. The results showed how skills, attitude, and behavior of employees are important for better organizational performance, with accuracies between 74% and 81% when using machine learning models. Employee attitude ranked supreme above other factors. Therefore, the research shows that it is essential to focus on improving employee attitudes if one is to enhance performance within Nigeria’s banking sector.

The Hamzeh F. Assous (2022) study tried to study the ratio in traditional and Islamic banks' efficiency in Saudi Arabia. Using data from 2014 to 2018, from 11 Saudi banks, including 4 Islamic ones, which are annual financial reports, research focuses on the different financial ratios regarding profitability, management practices, assets, loans, and capital adequacy. In the beginning, the relationships between these financial measures and the efficiency of the banks are assessed by means of regression analysis. Then, machine learning prediction models like Support Vector Machine (SVM), CHAID, linear regression, and neural networks are used, where feature selection techniques are applied. The study establishes that profitability, liquidity, and managerial practices significantly affect the efficiency of both types of banks. The CHAID model was hence identified as the best prediction model, and capital adequacy ratios, specifically CAR total and CAR tier 1, emerge as the most important predictors of cost efficiency. The results can be significant for academia, investors, and policymakers because they enable the development of early warning systems to anticipate financial distress scenarios.

Nguyen Minh Tuan's (2022) puts forward that the critical role played by financial deposits is most important in the course of global health crises and economic downturns. Banks still wonder how to differentiate their

customers, and some even go so far as to undergo a significant transformation in order to attract and retain customers while others try to hold onto existing clientele. This calls for a more innovative approach rather than just enthusiasm. In responding to this challenge, it requires more than just the use of basic tools; it needs advanced tools like deep neural network models. By using these approaches, Nguyen will reveal a new methodology through the models like LSTM, GRU, BiLSTM, BiGRU, and SimpleRNN to extend analysis of customer descriptions. Many prior research efforts have indeed concentrated more on the direction of algorithmic models, although Nguyen's research only praises the contribution of deep machine learning. The outcomes present GRU as attaining the highest accuracy of 90.08% at the 50th epoch, closely following BiLSTM with 90.05%. These results are worth for banks to validate the fit of customers towards deposit products within a highly competitive financial sector, with the aim of making wise choices.

According to the study by Hong Hanh Le and Jean-Laurent Viviani (2018), in order to predict the failure of banks, both traditional statistical methods and machine learning techniques were compared. In analyzing the results, they used data of around 3000 US banks for a time frame of five years. Within the provided period, they noted that out of 3000, 1438 banks failed while 1562 survived. Among key aspects such as the quality of loans and profitability, 31 financial ratios were introduced using methods such as discriminant analysis, logistic regression, artificial neural networks, support vector machines, and k-nearest neighbors. The results indicated that artificial neural networks and k-nearest neighbors had the most accuracy in predicting bank failures.

In their work, Appiahene *et al.* (2020) used Data Envelopment Analysis (DEA) with three machine learning models in assessing and forecasting the efficiency of bank branches in Ghana. To this end, they analyzed the efficiency of 444 bank branches at both deposit and investment stages using the criteria for the model application. Efficient or inefficient classification of these banks was based on an 80% cutoff point. Three machine learning algorithms were then used to predict efficiency; 70% of the bank branches were randomly selected for model training and validation. The decision tree (DT) model, specifically using the C5.0 algorithm, performed exceptionally, with the potential for practical application within Ghanaian banking. However, it stresses the need for further improvement in deposit collection and investment efficiency. Appiahene *et al.* suggest in their work that the best way to measure the efficiency of a bank is not simply by using the overall performance metric but by using a comprehensive approach. The study also concludes that among the existing models, decision tree model stands out as the most effective predictive tool. Future studies may need to explore other variables and algorithms to further improve the accuracy in prediction.

Gržeta *et al.* (2023) investigate the effects of the Basel III regulatory framework, which operates at a global level and is incorporated into the law of all member states of the European Union, on bank efficiency and profitability. Their study has particularly tried to answer the following question: How is the performance of banks affected by the introduction of Basel II and Basel III? Bank performance variables that have been checked in this research relating to bank performance are bank size and bank-specific and macroeconomic factors. The two-step empirical approach was based on an analysis of data collected for 433 European commercial banks for the period from 2006 to 2015. In the first step, the relative efficiency is estimated by applying the non-parametric data envelopment analysis. In the second step, it applies the generalized method of moments in order to examine the impact of various bank-specific variables, along with regulatory changes and macroeconomic variables, upon bank performance in terms of both profitability and efficiency measures. The findings indicate that the effect of regulation is very significantly related to bank size. For large and medium banks, the increased effect of new regulation increases efficiency and profitability. Not so with the smallest banks, as added administrative and regulatory challenges bring down their performance. Well, the findings indicate that big banks easily adapted to the changing environment brought about by regulation, while for the smaller ones, such added pressure from the new framework was unbearable. Therefore, it is postulated in this study that a one-size-fits-all approach to regulation is not ideal and thus proposes a differentiated regulatory framework in pursuit of a level playing field and systemic risk mitigation.

Prenaj *et al.* (2024) set up a research study that evaluated the various drivers of commercial banking profitability for Western Balkans countries during the period 2010–2020. They took the return on assets and the return on equity as the primary indicators of bank performance, and these were further evaluated in terms of their determinants: non-performing loans, the number of banks, growth in real GDP, the unemployment rate, and consumer price inflation. Their output showed that real GDP growth, the rate of unemployment, and inflation had positive impacts on the performance of banks, whereas non-performing loans and the number of banks had negative effects. The banking system in Kosovo also had an outstanding ROE performance, almost three times higher than the regional average, with the highest percentage of unemployment. Further, Montenegro was weak

at the beginning but showed year-by-year ROE improvements. The findings of this research study have very important implications for the policy framers and regulators, especially in the Kosovo case.

Abu Khalaf and Awad (2024) assess how the liquidity risk impacts the profitability of banks in the Middle East and North Africa region. Utilizing data compiled using Refinitiv Eikon for the 11-year period from 2012 to 2022, this research paper takes the dependent variable to be Return on Equity and the independent variable to be liquidity risk, with controls for bank size, loan quality, inflation, GDP, income diversification, operational efficiency, capital adequacy, and growth, in the context of 71 banks in MENA. In this case, the investigation is conducted using OLS and panel regression estimates, both fixed and random effects, to assess the impact of liquidity risk on the banks' profitability. As the results demonstrated, the bank size, the operational efficiency, and the extent of non-performing loans all negatively affect the level of profitability, indicating that possibly larger banks have higher operating costs and hence reduced levels of profitability, for the MENA region. On the other hand, liquidity risk, capital adequacy, income diversification, and growth positively influence ROE, thus providing support to the risk-reward theory that banks with better growth opportunities, higher capital adequacy, diversified income sources, and higher liquidity risk experience greater profitability. The GMM is used to confirm the robustness of these results.

The panel data regression model developed for Jigeer and Koroleva (2023) research contains variables that measured and compared various internal and external factors affecting the commercial banks' profitability in China's cities. The study pinpoints 16 listed city commercial banks, and these employ unbalanced data in the period between 2008 and 2020. Use various panel data estimation methodologies like fixed effects, random effects, and comparing them with pooled OLS to find the best-fitted model via statistical hypothesis testing. The results of the study, in this respect, indicated that the said factors- bank size, capital adequacy, credit quality, and operational efficiency- and external factors, in the form of provincial GDP, and inflation, significantly impact profitability, while liquidity does not. The current study contributes to the existing literature on the identification of key determinants of the situation related to Chinese bank profitability in the creation of practical insights for banking management, regulators, as well as municipal and state authorities.

In their study, Doğan and Yildiz (2023) tried to find both internal and external factors which affect banks' profitability in Turkey. The data was derived from 23 public, private, and foreign banks from 2007 to 2020 for the analysis. ROE and ROA indicators are applied for profitability measures, and Dynamic GMM and Fixed Effect Model methods used in trying to enhance model reliability. The results show a positive and significant relationship between inflation and GDP growth rates with both ROA and ROE. In addition, the GMM results depict a positive relationship of ROA and ROE with their respective 1-year and 2-year lags that evidence consistency in profitability in the Turkish banking sector.

O'Connell (2022) examined the impact of bank-specific, industry-specific, and macroeconomic factors on the profitability of the UK banks using an extended analysis period and pioneering econometric methods. This paper emphasizes that good capital ratios along with increased shares of short-term liquid assets determine bank profitability. It is, in addition, revealed that banks with efficient funding strategies and increased labor productivity tend to perform profitably - while operating expenses negatively influence it slightly. They could not establish any economies of scale or did any evidence back structure conduct performance (SCP) hypothesis. This implies that, all matters being constant, concentration does not influence profitability. Macroeconomic variables such as pair, also are essential variables, that add up to bank performance. The study suggests that macro-UK banks thrive well in a high interest environment together with high loan growth; though of late, the UK economy has been shaky because of Brexit and COVID-19, which has seen reduced rates of loan growth. Moreover, the recent growth in the economy of the UK and rising expectations for interest rates might eventually increase the profitability risks of the banks.

Amaral (2024) examined the profitability of Portuguese and Spanish banks for the period 2014 - 2019, which has remained low despite partial recovery in recent years. The research assesses the factors impacting bank profitability by using two econometric models with return on assets and return on equity as dependent variables, and seven independent variables: size, loans, credit risk, and solvency. The findings of the study established that credit risk had the most negative impact on profitability in both banking systems, while solvency positively influenced profitability in the Portuguese banking sector. Moreover, operating efficiency has a negative effect on profitability in Portuguese banks, hence revealing the influence of internal factors on bank performance. Although the study offers valuable insights for bank decision-makers and regulators, it puts forward a self-constraining view with respect to limitations owing to small sample size and the relatively short period of time in the analysis. Further studies should expand samples and periods of analysis and further test additional financial and non-financial indicators that affect bank profitability.

By using a sample of 125 local Italian banks for the period 2006-2018, Cocozza and Curcio (2024) investigated drivers of net interest margin and interest rate risk exposure. They stress two different sub-periods, 2006-2011 and 2012-2018, underlining in particular the impact of unconventional monetary policies by the ECB. In this regard, the study finds that net interest margin increases with the intensity of maturity transformation-particularly from 2012 to 2018-and with exposure to interest rate risk. Although several studies have analyzed the effect of interest rate risk on net interest income, this paper innovates by considering explicitly three sources of this risk: loan and deposit activities, securities portfolios, and derivatives positions. Correspondingly, their estimations indicate that maturity transformation enhances the interest rate risk, in particular during the latter period. More importantly, while ECB funding initially tended to increase interest rate risk exposure between 2006 and 2011, afterwards it decreased the interest rate risk exposure, suggesting that the long-term refinancing operations by the ECB improved funding stability and the capability of banks to manage interest rate shocks, in contrast to deposits held at the ECB.

2. Data and Methodology

This study will utilize quarterly data from Albanian banks including American Bank of Investments, Banka Kombëtare Tregtare, Credins Bank, Fibank, Intesa Sanpaolo Bank, ProCredit Bank, Raiffeisen Bank, Tirana Bank, and Union Bank. The dataset spans from January 2016 to December 2022, comprising a total of 252 data points. The data were obtained from the official website of the Albanian Association of Banks.

The dependent variable being analyzed is Return on Assets (ROA), which is a financial metric used to evaluate a bank's efficiency in generating profits from its assets. The independent variables being considered in the study are:

1. Profit per Outlet: This variable represents the profitability of each branch or outlet operated by the bank. It measures the amount of profit generated by each outlet individually, providing insight into the performance of different operational units.
2. Profit per Employee: This variable denotes the profitability of the bank per employee. It assesses the efficiency of human resource utilization in generating profits and can indicate the productivity of the workforce.
3. Natural Logarithm of Assets (ln(assets)): This variable involves taking the natural logarithm of the total assets of the bank. Transforming the assets in this way can help in dealing with the potential skewness or variability in asset sizes across different banks, making comparisons more meaningful.
4. Loan to Deposits Ratio: This variable represents the ratio of loans held by the bank to its total deposits. It is a measure of the bank's liquidity risk and its reliance on borrowed funds compared to deposits. A higher ratio typically indicates higher risk but also potentially higher returns.

These independent variables are being examined to understand their relationship with the dependent variable, ROA. The study aims to determine how variations in Profit per Outlet, Profit per Employee, ln(assets), and Loan to Deposits Ratio affect the bank's Return on Assets. By analyzing these relationships, we can gain insights into the factors influencing the financial performance and efficiency of the bank.

As a model in this study we will use decision tree regression which is a machine learning algorithm used for regression tasks, where the goal is to predict a continuous target variable. The process of building a decision tree regression model involves recursively partitioning the feature space into regions (represented by the leaf nodes) using decision rules based on feature thresholds. The predicted value at each leaf node is calculated as an aggregation of the target variable values of the data points falling into that region. The algorithm aims to minimize a chosen splitting criterion (MSE) at each step. Below is a breakdown of the components and mathematical formulas involved in decision tree regression:

1. Splitting Criterion: Let Q(X,y) represent the splitting criterion function, where X is the feature matrix and y is the target variable vector. For example, Mean Squared Error (MSE) can be represented as:

$$Q(X,y)=\frac{1}{n}\sum_{i=1}^{n}\left(y_i-\hat{y}_i\right)^2$$

where n is the number of data points, y_i is the actual target value, and $\hat{y}_i$ is the predicted target value.

2. Decision Rule: At each node, the decision rule is based on selecting a feature j and a threshold value t that minimizes the splitting criterion:

$$j,t=\arg\min_{j,t}\left[Q(X,y)-\frac{N_{left}}{N}Q\left(X_{left},y_{left}\right)-\frac{N_{right}}{N}Q\left(X_{right},y_{right}\right)\right]$$

where N_{left} and N_{right} are the number of data points sent to the left and right child nodes after the split, respectively.

3. Leaf Node Prediction: The predicted value at each leaf node is the mean (or median) of the target variable values of the data points assigned to that leaf node.

$$\hat{y}_{leaf} = \frac{1}{N_{leaf}} \sum_{i \in leaf} y_i$$

where N_{leaf} is the number of data points in the leaf node.

4. Model Prediction: To make a prediction for a new data point x, the algorithm traverses the tree from the root node down to a leaf node based on the feature values of x. The predicted value for regression is then the value associated with the leaf node reached.

3. Research Results

In this section, we will explore the descriptive statistics of the variables: Loan/deposits (%), ln(assets), Profit per Employee, and Profit per Outlet. This analysis will include measures such as the mean, standard deviation, minimum, 25th percentile, median (50th percentile), 75th percentile, and maximum values, which will be presented in Table 1 to provide a comprehensive understanding of the data distribution and central tendencies.

Table 1. Descriptive Statistics

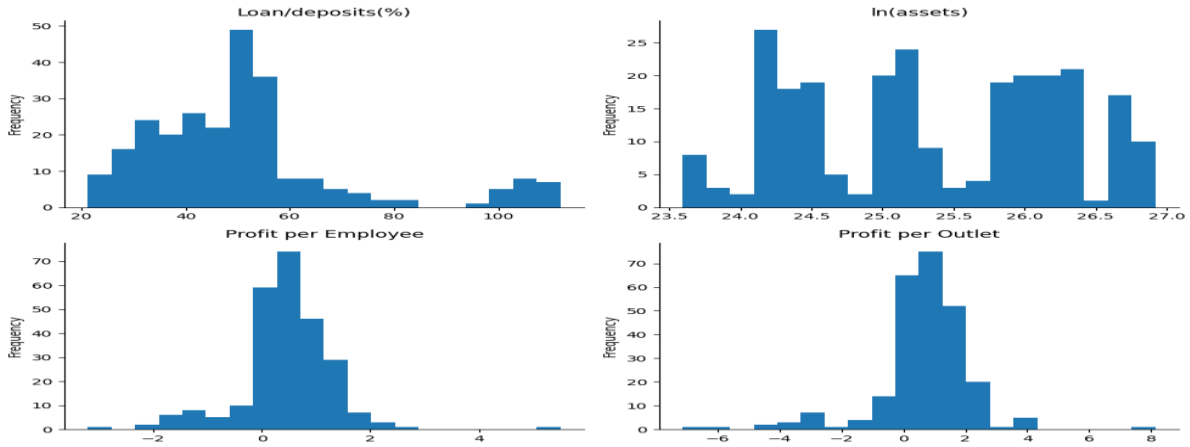
index	Loan/deposits(%)	ln(assets)	Profit per Employee	Profit per Outlet
mean	51,26	25,34	458928,45	6667054,21
std	20,12	0,92	862348,66	15069761,89
min	21,26	23,59	-3206685,08	-71188408,80
25%	38,55	24,45	108718,03	1681646,55
50%	49,29	25,24	458449,99	7252827,55
75%	55,73	26,15	880625,89	13916463,57
max	111,90	26,92	5502258,34	81311150,97

Source: Author's calculations

The findings suggest that, on average, the loan-to-deposits ratio stands at 51.26%, with a standard deviation of 20.12%. The natural logarithm of assets averages at 25.34, with a narrow standard deviation of 0.92. Profit per employee is reported at an average of $458,928.45, but with a considerable standard deviation of $862,348.66, indicating significant variability across institutions. Profit per outlet follows a similar pattern, with an average of $6,667,054.21 and a substantial standard deviation of $15,069,761.89. The distribution of data shows wide ranges, from negative profits to high positive values, indicating diverse performance levels within the sample. The median values provide a more robust measure of central tendency, showing a loan-to-deposits ratio of 49.29%, ln(assets) of 25.24, profit per employee of $458,449.99, and profit per outlet of $7,252,827.55. These statistics illustrate the dispersion and central tendencies of key financial indicators in the dataset, offering insights into the financial performance and operational efficiency of the institutions surveyed.

The histograms depicted in Figure 1 illustrate the distribution of independent variables within the dataset. Each histogram encapsulates the frequency distribution of a distinct variable, showcasing the range and spread of values it encompasses. These visual representations provide valuable insights into the underlying data patterns and characteristics, aiding in understanding the variability and tendencies within the variables.

Figure 1. Histograms of independent variables



Source: Author's calculations

In Table 2, the decision tree regression model demonstrates moderate predictive performance, as indicated by the evaluation metrics. The Mean Squared Error (MSE) measures the average squared difference between the actual and predicted values, showcasing a value of 0.5988 for the training data and 0.8912 for the test data. Additionally, the Mean Absolute Error (MAE) presents a similar trend, with values of 0.4764 and 0.6257 for training and test data, respectively. These metrics provide insight into the magnitude of errors in the model's predictions, with lower values indicating better accuracy. The R-squared (R^2) coefficient, representing the proportion of the variance in the dependent variable that is predictable from the independent variables, suggests a reasonably good fit for the training data (0.7706), while the test data shows a lower but still significant R^2 value of 0.4244. This indicates that the model explains approximately 77.06% of the variance in the training data and 42.44% in the test data, respectively, implying that a substantial portion of the variance is captured by the model. Overall, while the model performs relatively well in explaining the variability in the data, caution should be exercised to ensure it generalizes effectively to unseen data.

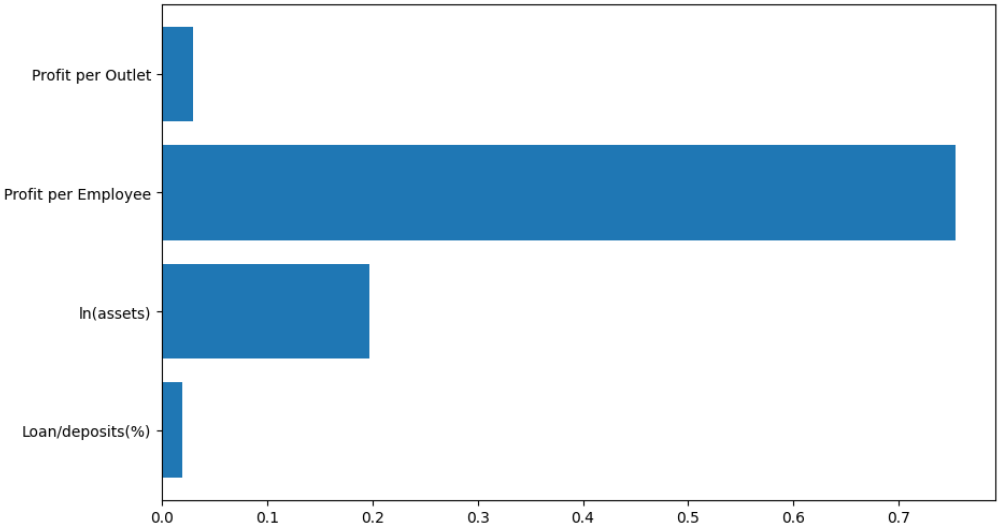
Table 2. Evaluation Metrics

Mean Squared Error (MSE) for Training Data	0.5988
Mean Squared Error (MSE) for Test Data	0.8912
Mean Absolute Error (MAE) for Training Data	0.4764
Mean Absolute Error (MAE) for Test Data	0.6257
R-squared (R^2) for Training Data	0.7706
R-squared (R^2) for Test Data	0.4244

Source: Author's calculations

In Figure 2, we present the feature importance analysis of the model, illustrating the significance of various input features.

Figure 2. Feature importance

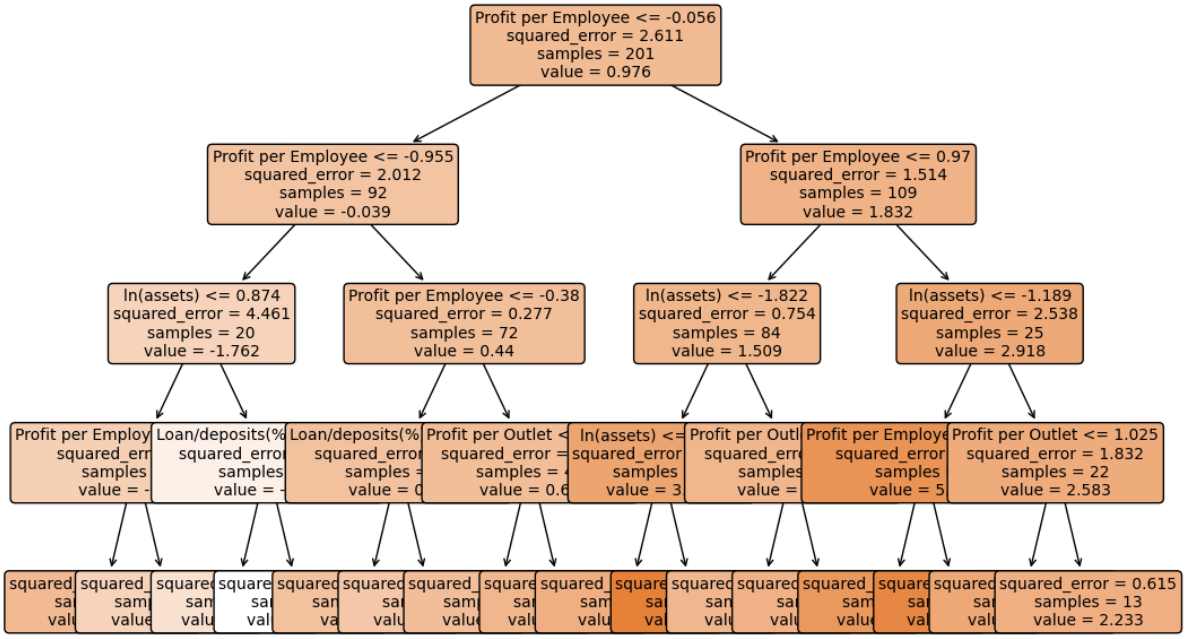


Source: Author's calculations

In analyzing the datas, four key features were assessed, each assigned an importance score indicating its significance in the evaluation. The first feature, measuring the ratio of loans to deposits, held a minimal importance score of 0.0196, suggesting it had a relatively minor impact on the overall assessment. Conversely, the second feature, the natural logarithm of assets, possessed a significantly higher importance score of 0.1968, indicating its greater relevance in the analysis. The third feature, profit per employee, stood out with a substantial importance score of 0.7637, implying its significant influence on the evaluation metrics. Lastly, the fourth feature, profit per outlet, had a relatively low importance score of 0.0199, suggesting it contributed minimally to the overall assessment compared to the other features. These importance scores provide insights into the relative significance of each feature in the financial analysis.

Meanwhile, Figure 3 showcases the decision tree visualization, offering insights into the decision-making process of the model.

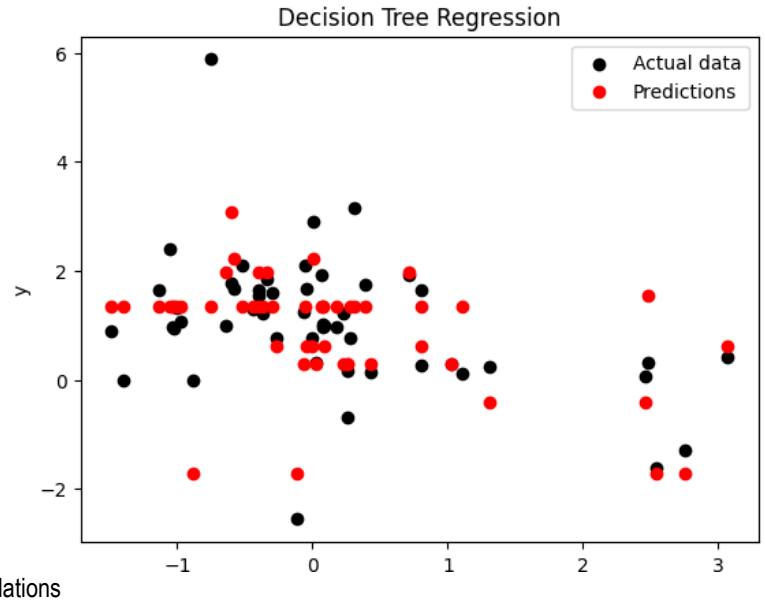
Figure 3. Decision tree visualization



Source: Author's calculations

In the figure provided below, we present the predictions made for the test data set. Through rigorous analysis and the utilization of advanced predictive models, we have endeavored to anticipate the outcomes of the test data with precision and accuracy. Each data point in the figure corresponds to a prediction generated by our model, based on the patterns and trends identified in the training data. Our objective is to assess the performance of the model in extrapolating from known data to predict the behavior of unseen data points. By comparing these predictions to the actual outcomes of the test data, we aim to evaluate the efficacy and reliability of our predictive methodologies. This figure serves as a visual representation of our predictive insights and offers valuable insights into the performance of our model in real-world scenarios.

Figure 4. Decision tree predictions



Source: Author's calculations

Conclusion

In conclusion, this study utilizes decision tree regression to predict Return on Assets (ROA) and assesses the significance of key dependent variables within the Albanian banking sector. Utilizing quarterly data from January 2016 to December 2022 sourced from prominent Albanian banks, the analysis encompasses a total of 252 data

points. The results demonstrate promising predictive accuracy, as evidenced by Mean Squared Error (MSE) and Mean Absolute Error (MAE) values, along with R-squared (R^2) coefficients. The R-squared (R^2) for the training data is 0.7706, indicating a strong fit of the model to the training data. For the test data, the R-squared (R^2) is 0.4244, suggesting that the model performs reasonably well on unseen data, though with a lower level of explanatory power compared to the training data.

Notably, decision tree regression proves effective in elucidating the relative importance of variables such as Profit per Outlet, Profit per Employee, Natural Logarithm of Assets (ln(assets)), and Loan to Deposits Ratio in determining ROA. In analyzing the datas, four key features were assessed, each assigned an importance score indicating its significance in the evaluation. The first feature, measuring the ratio of loans to deposits, held a minimal importance score of 0.0196, suggesting it had a relatively minor impact on the overall assessment. Conversely, the second feature, the natural logarithm of assets, possessed a significantly higher importance score of 0.1968, indicating its greater relevance in the analysis. The third feature, profit per employee, stood out with a substantial importance score of 0.7637, implying its significant influence on the evaluation metrics. Lastly, the fourth feature, profit per outlet, had a relatively low importance score of 0.0199, suggesting it contributed minimally to the overall assessment compared to the other features.

These findings are of paramount importance to bank shareholders, providing insights that can inform strategic decision-making and optimize returns on investment. Moreover, this study suggests that future research should consider incorporating additional dependent variables to further enhance the predictive power and explanatory capability of models in assessing banking performance. Such endeavors hold the potential to deepen our understanding of the multifaceted factors influencing ROA and contribute to more comprehensive risk management and value creation strategies within the banking industry.

Credit Authorship Contribution Statement

Authors have contributed equally to this research.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Declaration of Use of Generative AI and AI-Assisted Technologies

The authors declare that they have not used generative AI and AI-assisted technologies during the preparation of this work.

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Revolutionizing Finance: Decentralized Finance as a Disruptive Challenge to Traditional Finance

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Abstract: This paper examines the emergence and impact of Decentralized Finance (DeFi), between 2019 and 2024, as a disruptive agent opposing traditional finance (TradFi). By using blockchain technology to offer decentralized, open, and readily available financial services, the DeFi industry has seen explosive expansion Emphasizing DeFi's competitive advantage over TradFi, this study aims to investigate notable trends, developments, and market drivers in the toolkit. The main conclusions are the fast and significant rise in Total Value Locked (TVL), the clear increase in user adoption, the expansion in the number of transactions and trading volume on decentralized exchanges (DEXs), and the development of creative financial products. DeFi constantly changes the financial scene despite regulatory oversight and market volatility, so posing major problems and opportunities for established financial institutions.

Keywords: decentralized finance; traditional finance; cryptocurrencies; blockchain; web3.

JEL Classification: G20; G23; O33; K22; E44.

Introduction

Rising as a disruptive and transforming force in the financial sector in recent years, Decentralized Finance (DeFi) challenges the long-standing traditional finance (TradFi) institutions that have dominated for many decades (Hadi *et al.* 2023). Blockchain technology is used by DeFi to offer easily available, transparent, decentralized financial products (Mohd Fairoh *et al.* 2024). This is quite different from the regulated and sometimes vague character of traditional banks and financial institutions. DeFi's obvious difference has made it a well-known agent of financial transformation (Chen Bellavitis, 2022).

TradFi is the provision of services by centralized entities such banks, investment companies, and payment processors. These establishments act as middlemen, enabling financial transactions between consumers and the needed services. Particularly for those in underprivileged banking locations, these institutions control financial transactions, account management, and monetary policies, sometimes leading to outrageous costs, slow transaction speeds, and limited availability (Mishkin, 2004). Moreover, the focused approach of TradFi makes it susceptible to systematic hazards; this is shown by the broad effects of notable bank collapses during financial crises (Bernanke, 2004).

Unlike DeFi, which runs on decentralized networks like Ethereum using smart contracts to automatically and run financial transactions free from middlemen (Alamsyah *et al.* 2024). Among the various advantages of this approach include less transaction costs, faster settlement times, and more inclusiveness. Anyone with an internet connection can access DeFi services, therefore democratizing financial access and empowering individuals all around (Schär, 2021). From roughly 700 million USD in late 2019 to reaching 100 billion USD by mid-2021, the Total Value Locked (TVL) in DeFi protocols has surged remarkably. This shows how quickly these decentralized solutions (DeFi Pulse, 2020; DeFi Llama, 2021) were embraced and with confidence.

Novel financial products and services such yield farming, liquidity mining, and decentralized exchanges (DEXs) have emerged from the developments in DeFi (Ozili, 2022; Makridis *et al.* 2023). These systems have effectively attracted large investments and offer great returns. Platforms including Uniswap, Compound, and Aave saw notable increase in user engagement and transaction volumes over the "DeFi Summer" of 2020; occasionally, they exceeded those of traditional exchanges on particular days (Hayes, 2021). DeFi still has

certain difficulties, nonetheless, even with all the advancement achieved (Turillazzi *et al.* 2023). All of which can affect user confidence and stability is the ecosystem under regulatory scrutiny, technology weaknesses, and market volatility (Gudgeon *et al.* 2020).

Unlike TradFi, decentralized finance, or DeFi, marks a radical shift in the direction of a more inclusive and easily available financial system (Meyer *et al.* 2022). System of centralized control and regulatory scrutiny define TradFi. DeFi offers a decentralized alternative aiming at efficiency, openness, and general accessibility, in comparison. With the possibility to drastically change the future of worldwide banking, the continuous development of DeFi poses both significant challenges and chances for current financial organizations (Meyer *et al.* 2022).

The paper offers comprehensive research on the fast-changing DeFi ecosystem and how it will affect TradFi. By focusing on their fundamental ideas, operating systems, and effects on the global financial scene, it offers a thorough comparison between DeFi and TradFi. The paper advances a better knowledge of how these systems interact and differ by stressing the basic contrasts – such as DeFi's distributed, transparent, and accessible character vs TradFi's centralized, controlled, and occasionally opaque architecture. Capturing the dynamics of a fast-changing sector and its growing impact on the larger financial industry, the paper also follows the evolution of crucial measures inside the DeFi ecosystem, including Total Value Locked (TVL), transaction volumes, user growth, and protocol revenue. Examining how these technologies – which have driven DeFi's rise – smart contracts, yield farming, liquidity mining, and decentralized exchanges (DEXs) – have upended established financial models and opened new prospects for financial services and products, DeFi explores also.

The paper investigates the impact of DeFi on TradFi from 2019, the year before the third bitcoin halving. The paper aims to examine how developments in DeFi – including yield farming, liquidity mining, and decentralized exchanges – may affect the notable rise in user adoption, transaction volumes, and protocol profits. The study intends to examine the efficiency, accessibility, and systemic hazards of DeFi and TradFi in order to evaluate the possibility of DeFi to greatly change and reconstruct the worldwide financial ecosystem.

1. Traditional Finance

TradFi, or traditional finance, is the established financial systems and institutions that have been absolutely vital for generations in worldwide economies. It covers financial institutions with a wide range of financial services including banks, investment firms, insurance companies, and regulatory authorities. Based on relevant research and literature, this review offers a succinct description of the main ideas of TradFi together with their roles, purposes, and challenges.

Conventions and Purpose of Traditional Financial Institutions

Within the traditional financial system, banks and financial intermediaries play several vital responsibilities. Receiving deposits, lending money, and offering payment services help commercial banks – key financial intermediaries – to operate (Mishkin, 2004). These banks, by applying the fractional reserve banking system, play a crucial part in the process of money creation. By means of underwriting, mergers and acquisitions, and advisory services, investment banks help businesses create capital (Fabozzi, 2015). Furthermore, insurance companies manage risks by grouping them and covering a spectrum of possible outcomes (Black and Skipper, 2000).

In order to preserve financial stability, central banks – including the Federal Reserve and the European Central Bank – determine interest rates, monitor the volume of money in circulation, and act as a last source of borrowing (Bernanke, 2004). These organizations use reserve requirements, discount rates, and open market operations – among other tools of monetary policy – to regulate economic activity (Mishkin, 2004).

Financial Markets

Important for the buying and selling of financial securities, capital markets comprise stock and bond markets. Share trading finds venues in stock exchanges as the Nasdaq and the New York Stock Exchange (NYSE). Crucially in the financial ecosystem, these markets help to determine prices and enable the availability of liquid assets, therefore facilitating the process of development (Kurka, 2019). Bond markets let governments and businesses issue and trade debt instruments, therefore helping them to generate necessary money for various uses (Fabozzi, 2015).

Short-term debt instruments including Treasury bills, commercial paper, and certificates of deposit define money markets most of all. These tools help businesses to properly control their short-term financial needs and enable the availability of cash and funding for immediate financial demands (Mishkin, 2004).

Legislative System

Financial control is meant to protect consumers, ensure the integrity and stability of the financial system, and maintain market confidence by means of which it is guaranteed (Mishkin, 2004). Several authorities control these activities. While the Basel Committee on Banking Supervision (BCBS) has developed worldwide banking rules known as Basel III to support financial stability, the Securities and Exchange Commission (SEC) is in charge of controlling securities markets in the United States (BCBS, 2011).

A key element of financial control is consumer protection. To protect consumers against bank failures, the Federal Deposit Insurance Corporation (FDIC) and related initiatives grant deposit insurance (Mishkin, 2004). Moreover, rules against discriminating practices in lending under the Equal Credit Opportunity Act (ECOA) and the Fair Housing Act have been adopted to so guarantee fair availability of financial services to all people (Federal Reserve, 2021).

Conundrums in Traditional Banking

Events such as the 2008 global financial crisis exposed structural flaws in the financial system and the interdependence of the worldwide financial system as well as the likelihood of catastrophic collapse (Bernanke, 2004). Moral hazard is a serious threat since insured companies might take more risks knowing they are covered, hence perhaps upsetting the financial system (Mishkin, 2004).

Furthermore, lacking in terms of simplicity and inclusion are traditional financial systems. Strict requirements and high expenses cause financial institutions – especially in underdeveloped areas – to regularly exclude underbanked communities (Demirgüç-Kunt *et al.* 2018; Ryabov *et al.* 2021).

Terms of efficiency and expenditures abound absent in TradFi. The complex and bureaucratic character of traditional financial institutions can lead to higher operational expenses and inefficiencies that are then passed on to consumers as higher fees (Friedman, 1963). Furthermore, complex financial activity and cross-border transactions could be defined by slowness and high expenses resulting from many middlemen and legal responsibilities (Mishkin, 2004).

2. Decentralized Finance

Blockchain-enabled DeFi presents an open and permissionless ecosystem that marks a notable change from established financial institutions (Chen and Bellavitis, 2019; Chohan, 2021). By using decentralized protocols and smart contracts, DeFi systems eliminate the need of middlemen like as banks, hence increasing financial accessibility and lowering transaction costs (Schär, 2021; Aquilina *et al.* 2023). Directly with one another, these sites help consumers to engage in a variety of financial activities like lending, borrowing, trading, and investing. This guarantees openness and helps to reduce the risks related to centralized power.

DeFi stands out for using cryptocurrencies with limited supply, like Bitcoin, instead of fiat money under control by central banks (Makarov and Schoar, 2022). Because their total quantity is often set in advance, cryptocurrencies are naturally deflationary (Nakamoto, 2008). This feature may cause value to rise over time as demand grows, therefore preventing the normal inflation seen in traditional financial systems. Still, the deflationary character of the situation might also hinder economic growth since people might choose to save rather than use their assets (Selgin, 2015).

Smart Contracts and their Effects

Running on blockchain systems like Ethereum, smart contracts – which have the substance of the agreement directly coded – are self-executing contracts. By automatically enforcing and running agreements if particular criteria are met, smart contracts eliminate the need for middlemen and drastically reduce the likelihood of fraud or error (Buterin, 2014; Schueffel, 2020). DeFi's value proposition stems mostly from its capacity to automate and give openness, therefore enabling quick and safe execution of complex financial activities (Christidis and Devetsikiotis, 2016).

From decentralized exchanges (DEXs), lending platforms, and stablecoins to smart contracts provide the basis for many DeFi products (Ozili, 2022). Direct trading of cryptocurrencies between people made possible by decentralized exchanges (DEXs) removes the need for a central regulating agency (Yue *et al.* 2021). This improves the degrees of security and anonymity engaged in the transactions (Hayes, 2021). Lending platforms help users to create interest or borrow against their holdings by lending their assets, so promoting financial inclusion without involving traditional credit evaluations (Gudgeon *et al.* 2020). Linked to solid assets like fiat currencies, stablecoins provide consistency in the erratic bitcoin market and are therefore ideal for frequent transactions and deposits (Mnohoghitnei *et al.* 2022).

Problems and Dangers

DeFi and smart contracts provide a lot of risks and difficulties even if they have several advantages (Didenko, 2022). DeFi's decentralized architecture lacks a central authority to monitor or stabilize the system in times of crisis, therefore causing significant market volatility (Hayes, 2021). Regarding smart contracts, security is a major concern (Li *et al.* 2022). Smart contracts, for all their transparency, remain vulnerable to code errors and abuse, which could cause major financial losses (Gudgeon *et al.* 2020). Furthermore, the legislative scene for DeFi is still unclear since many countries find it difficult to adequately supervise these decentralized networks without stifling creativity (Schär, 2021).

DeFi and smart contract-based financial markets represent, all things considered, a significant development in financial technology that offers several benefits over traditional systems by improving accessibility, transparency, and efficiency. Still, they also bring fresh challenges and hazards that need careful control as ecology develops (Carapella *et al.* 2022).

3. Comparison of Decentralized Finance and Traditional Financial Systems

Examining DeFi from the standpoint of locked volume in US dollars helps one to better understand it than traditional financial systems. Unlike traditional financial organizations, this indication helps one understand the capital allocated and immobilized inside DeFi systems (Qin *et al.* 2021). Reflecting the general well-being and growth of the DeFi ecosystem, the TVL in DeFi is an important indicator of the degree of capital being used in DeFi systems.

Lock Volume and DeFi

In DeFi systems, TVL is the total amount of money currently kept on hand including cryptocurrencies staked in smart contracts for lending, borrowing, and trading (Carre and Gabriel, 2022). A measure of the collateral kept in DeFi systems, TVL, or Total Value Locked, It offers understanding on DeFi services' liquidity and utilization.

Over recent years, the TVL in the DeFi sector has grown significantly. From less than 1 billion USD in early 2020 to more than 100 billion USD by the end of 2021, DeFi Pulse finds that the TVL in DeFi systems rose (DeFi Pulse, 2021). Built on the Ethereum blockchain, Uniswap, MakerDAO, and Aave are somewhat well-known in the DeFi space and account for a sizeable portion of the TVL. Furthermore, mentioned by Hayes in 2021 are Binance Smart Chain (BSC), Solana, and Tron, which have shown notable increase.

DeFi's locked volume is used for stablecoins, lending and borrowing platforms, decentralized exchanges (DEXs), and yield farming among other purposes. Often offering lower rates and more accessibility, these apps give different choices to traditional financial services (Schär, 2021).

Traditional financial systems and locked volume

Furthermore, owning large amounts of capital are traditional financial systems including banks and financial institutions. Still, the capital in TradFi sometimes lacks openness and is under several regulatory systems.

Regulators mandate banks keep reserves. The Federal Reserve mandates banks retain a designated percentage of their deposits as reserves. This criterion affects the amount of money that can be applied for lending and other activities (Mishkin, 2004). Using investment funds, mutual funds, and pension funds, traditional financial institutions supervise significant volumes of assets. The assets are housed in several financial instruments including bonds, real estate, and stocks (Malkiel, 1990).

Concerning stability and protection of investor interests, TradFi operates with a centralized system of control and regulatory monitoring. Still, this concentration of power can lead to inefficiencies and higher costs due of middlemen fees and postponed transaction processes (Friedman, 1963).

Short Analysis of DeFi and Traditional Banking Systems

Public blockchains let DeFi platforms be built with openness and accessibility in mind (Gorkhali and Chowdhury, 2022). Recording all transactions on the blockchain helps to do this and hence improve openness (Patel *et al.* 2022). This openness makes it possible to get current information on the transfer of money and the TVL. DeFi also removes admission barriers, so allowing anyone with internet connection to participate (Gudgeon *et al.* 2020). On the other hand, as they are controlled by centralized entities that control the information distribution, traditional financial systems show less degrees of openness. Geographic distance, regulatory restrictions, and the need of middlemen all regularly impede access to financial services (Mishkin, 2004).

By removing middlemen, DeFi benefits in terms of cost and efficiency by lowering transaction costs and raising effectiveness (Grassi *et al.* 2022). Unlike traditional approaches, smart contracts expedite and cheap

transactions help to simplify procedures (Buterin, 2014). By contrast, TradFi involves many middlemen who each add to the cost and complexity of transactions. Dependency on manual processes and the presence of regulatory compliance criteria help to slow down operations and increase expenses (Malkiel, 1990).

DeFi offers some benefits regarding risk and stability, but it also raises possible issues including weaknesses in smart contracts, lack of government control, and market volatility. While traditional financial systems benefit from regulatory measures designed especially to protect consumers and maintain stability, cybersecurity breaches and illegal activity have caused significant financial losses within the DeFi industry (Li *et al.* 2022; Schär, 2021; Grigo *et al.* 2020). Still, these systems run the danger of bank collapses, financial crises, and systematic dangers (Bernanke, 2004).

4. Comparison of Decentralized Finance and Traditional Banking

Two different approaches to financial services with very different foundations are decentralised finance (DeFi) and traditional banking. These systems are thoroughly analyzed here, with specific focus on critical elements such accessibility, openness, efficiency, and risk.

Availability and Financial Inclusion

In terms of financial inclusion and accessibility, DeFi and traditional banking show somewhat different disparities. Accessible to everyone with an internet connection and a digital wallet, DeFi platforms provide financial services free from geographical limitations (Schär, 2021). Particularly for those who do not have access to financial services or have limited access to them, this inclusivity removes traditional barriers including minimum account balances, credit scores, and complex documentation so enabling greater involvement (Gudgeon *et al.* 2020).

On the other hand, traditional banks have certain criteria for clients, including the providing of identity, the maintenance of minimum balances, and the passing of credit checks (Mishkin, 2004), and are subject to rigorous rules as well. Policies that preclude some people from obtaining financial services, poor infrastructure, and high regulatory standards can limit banking services in underdeveloped areas (Demirgüç-Kunt, 2018.). The all-encompassing and global character of DeFi platforms contrasts sharply with the regulated access and limited scope of these platforms.

Openness and Faith

By means of a publicly available ledger where transactions are recorded on public blockchains, DeFi systems offer transparency and let anyone examine them (Nakamoto, 2008; Lu *et al.* 2021). They also rely on smart contracts, autonomous agreements with terms specifically included in computer programming language. This reduces the need of middlemen and lowers the possibility of dishonest behavior (Buterin, 2014).

On the other hand, traditional banking systems are generally opaque since transaction details usually only affect the parties engaged and the bank. For confidence, customers rely on the integrity and regulatory control of the bank (Mishkin, 2004). Furthermore, acting as mediators, banks handle fund movement and custody on behalf of their clients. The centralizing process could lead to lower speed of transactions and higher costs (Friedman, 1963).

Cost and efficiency

DeFi saves money by cutting middlemen, therefore lowering administrative costs and transaction fees (Habib *et al.* 2022). Furthermore, ensures quick settlement times by using blockchain technology (Hayes, 2021). Furthermore, smart contracts simplify many financial processes therefore reducing the need for human involvement and improving operational efficiency (Schär, 2021).

On the other hand, traditional banking involves higher fees since banks charge for multiple services like account maintenance, transactions, and overseas transfers, which could be rather expensive (Mishkin, 2004). Furthermore, because of the involvement of intermediate institutions and regulatory verifications, traditional banking transactions – especially cross-border transfers – can take several days to complete (Friedman, 1963).

Danger and Consistency

DeFi platforms run many hazards, including smart contract issues that unscrupulous people could manipulate and cause significant financial losses (Gudgeon *et al.* 2020; Piñeiro-Chousa *et al.* 2023). Furthermore, DeFi's asset volatility puts major hazards to customers and investors (Hayes, 2021). The rather unstructured DeFi terrain could lead to issues with fraud, security breaches, and insufficient consumer protection (Schär, 2021).

Conversely, traditional banking operations inside a framework of strict regulatory control seeks to ensure stability, protect consumers, and discourage dishonest behavior by means of rigorous control of their operations (Kaur *et al.* 2023). This control includes capital needs, deposit insurance, and regular audits among other aspects (Bernanke, 2004). Because they have regulatory support and have been established in the financial system for a long period, traditional banks are usually considered as steadier and more trustworthy (Mishkin, 2004). Still, traditional banks are vulnerable to systematic hazards even with these measures in place. Financial crises clearly show this; as Bernanke pointed out in 2004, the failure of banks can have broad effects.

5. Comparison of "Monetary Policy" in Traditional Finance and Decentralized Finance

TradFi, or traditional finance

Inflation and Central Banking

Through their regulation of the money supply and interest rates, central banks – like the Federal Reserve in the United States – play a vital part in traditional banking. To control economic stability and development, they apply instruments including reserve requirements, discount rates, and open market activities.

Through monetary policy, central banks try to lower inflation; but too much money production can cause inflation, so diminishing the value of fiat currencies (Fisher, 1911). Fiat currencies depend on confidence in the issuing government; they are not supported by actual commodities. Bad fiscal policies can destroy this confidence, which would cause hyperinflation like what Zimbabwe and Venezuela experience (Hanke and Krus, 2013).

Furthermore, affecting investments is inflation since it reduces actual returns. To fight inflation, TradFi provides bonds, equities, and derivatives among other tools. Still, these devices are sometimes complicated and call for intermediate services (Mishkin, 2004).

DeFi, or decentralized finance

Limited supply and deflationary nature

Operating on blockchain technology, DeFi makes use of often limited supply coins. With a fixed cap of 21 million coins, for instance, Bitcoin naturally tends to lose value over time.

The limited supply of many cryptocurrencies causes a deflationary impact, whereby as demand rises the value of the currency usually rises rather than falls. This deflationary quality can give people an incentive to save their assets rather than quickly consume them (Nakamoto, 2008). Built on publicly available blockchains, DeFi systems provide unlimited access to financial services free from middlemen's need (Pal *et al.* 2021). This degree of transparency reduces costs and improves openness (Schär, 2021). Automated and enforceable financial agreements with conditions buried straight into code are smart contracts (Kumar *et al.* 2020). This reduces the need for traditional legal systems and middlemen, therefore streamlining financial transactions (Buterin, 2014).

Comparative Study

Monetary Policy

By using a variety of policy tools, central banks in traditional banking control the money supply and influence inflation. Still, these policies could sometimes have unanticipated financial effects like asset bubbles or economic downturns (Bernanke, 2004). By contrast, DeFi runs on coins with decentralized control and set supply limits (Zetzsche *et al.* 2020). This arrangement could lead to more predictable financial effects. Still, the lack of a central authority produces the absence of an organization able to provide economic stabilization during crises (Hayes, 2021).

Inflation versus deflation

In the field of TradFi, inflation is a major issue that drives central banks to usually target a specific inflation rate. Too much inflation can progressively reduce the value of savings and deter investment activity (Friedman, 1963). On the other hand, the deflationary feature of many cryptocurrencies in DeFi can encourage the behavior of saving instead of consumption. While asset holders could gain from this, it can also have the negative impact of slowing down economic growth if people postpone their consumption (Selgin, 2015).

Availability and Investment

Although TradFi presents a wide spectrum of investment choices, these usually entail middlemen, which raises costs and limits access for the ordinary person. Although they protect investors, regulatory systems can sometimes create challenges for new market players (Malkiel, 1990). On the other hand, DeFi offers investment opportunities that are more readily available, with less barriers to access and less expenses as a result of middlemen removed. Still, without control, fraud and security lapses become more likely (Gudgeon *et al.* 2020; Raffaele *et al.* 2023).

6. Integration of Decentralized Finance and Traditional Finance

Combining TradFi with DeFi marks the meeting of modern blockchain technology with tried-through financial systems (Rajput *et al.* 2019). By using the stability and regulatory systems of TradFi, this cooperation aims to increase the effectiveness, availability, and openness of financial services.

Tokenizing Traditional Assets

Defi

DeFi systems allow traditional financial assets such stocks, bonds, and real estate to be tokenized so that they may be traded on blockchain networks (Naggar, 2023). For these assets, this procedure results in digital representations – known as tokens. Then these tokens can be traded on decentralized exchanges (DEXs) (Buterin, 2014; Karim *et al.* 2022). Tokenizing helps assets be more liquid and streamlines the purchase and selling procedure for fractional shares of valuable assets for investors (Laurent *et al.* 2018). Tokenized assets have lately started to be included into Synthetix and MakerDAO systems (Schär, 2021).

TradFi

Traditional banking institutions are starting to welcome tokenization as a way to streamline settling processes and cut costs. Using asset tokenization, JPMorgan's Onyx platform improves the trading and settlement process efficiency (JP Morgan, 2020). Furthermore integrating decentralized and traditional systems is banks and financial organizations who offer custody solutions and guarantee adherence to rules for tokenized assets (PwC, 2020).

Central Banks Digital Currencies (CBDCs)

DeFi

Central bank digital currencies (CBDCs) can be included into DeFi platforms to provide a safe and dependable digital money alternative approved by the government. Including this link helps to simplify transactions and reduce the normal volatility connected with cryptocurrencies (Auer and Böhme, 2020). Moreover, DeFi systems could use central bank digital currencies (CBDCs) as a means of decentralized payment solutions, therefore enhancing the efficiency and speed of global transactions (Nakamoto, 2008).

TradFi

To modernize and improve the financial system, central banks all around are actively looking at and implementing Central Bank Digital Currencies (CBDCs.). Prominent examples of actively advancing the evolution of their digital currencies include the European Central Bank (ECB) and the People's Bank of China (PBOC). CBDCs offer the regulatory oversight and stability of traditional fiat currencies while leveraging the technological advancements of blockchain (PwC, 2020).

Hybrid Financial Products

DeFi

Modern financial ideas such yield farming, liquidity mining, and decentralized insurance are offered by DeFi systems. These products can be mixed with traditional financial services to present new investment opportunities (Hayes, 2021). Furthermore, smart contracts allow the conditions of hybrid financial instruments to be automated and enforced, thereby reducing the need for middlemen and improving general efficiency (Buterin, 2014).

TradFi

DeFi products have the potential to be included into traditional financial institutions' offerings to appeal to consumers who are tech-savvy and provide a larger spectrum of investing options. Currently looking at the possibilities of DeFi ETFs and other investment products grounded on blockchain technology is Goldman Sachs (Goldman Sachs, 2021). Furthermore, these organizations can apply their expertise and abilities in risk management to develop hybrid financial products complying with laws and safe (Mishkin, 2004).

Compliance with Rules and Regulations

DeFi

Self-regulating systems and best practices followed by DeFi platforms help to strengthen security and protect users. For governance, this entails doing extensive code audits and building decentralized autonomous organizations (DAOs) (Schär, 2021; Aiden and Werbach, 2022; Sims, 2019). DeFi platforms are also gradually working with regulators to ensure adherence to anti-money laundering (AML) and know-your-customer (KYC) rules, therefore facilitating smooth connection with traditional financial systems (Gudgeon *et al.* 2020).

TradFi

With an eye toward protecting consumer interests and preserving market stability, authorities and regulatory bodies are developing frameworks to monitor the convergence of DeFi and traditional financial systems. For supervising virtual assets and service providers, the Financial Action Task Force (FATF, 2021) presents legislative guidelines. Establishing common protocols and guaranteeing safe and compliant operations depend much on the cooperation between DeFi platforms and established financial institutions (PwC, 2020).

Cross-platform financial services

DeFi

DeFi systems are developing interoperable solutions to let seamless connection with traditional financial systems possible. Projects include Polkadot and Cosmos aim to create a linked chain of blockchains (Hayes, 2021). Moreover, decentralized exchanges (DEXs) can work with traditional exchanges, therefore broadening the range of trading possibilities and financial services. Increasing market liquidity and higher user satisfaction follow from this cooperation (Schär, 2021; Bartoletti *et al.* 2022).

TradFi

TradFi: Decentralized lending and borrowing, among other DeFi services, can be included into platforms of traditional banks. For handling their financial matters, this would provide consumers with more options (Goldman Sachs, 2021; Pham and Trinh, 2022). Moreover, financial institutions can build relationships with DeFi systems by means of application programming interfaces (APIs). This improves the efficiency of service delivery and lets the real-time data flow unhindered (PwC, 2020).

7. Impact of Decentralized Finance on Global Finance

By providing creative ideas challenging the established financial systems, DeFi is transforming the worldwide financial sector. One may see the impact of this in many spheres, including financial inclusion, openness, accessibility, and efficiency. These effects are carefully discussed in this part.

Accessibility and Financial Inclusion

DeFi removes traditional barriers including regional limitations, lack of banking infrastructure, and strict regulatory prerequisites therefore enabling equal access to financial services. Without a regular bank account, those who have both an online connection and a digital wallet can participate in DeFi events like lending, borrowing, trading, and investing.

DeFi systems give global access, so allowing the availability of financial services from any place around the world. Those who lack access to banking services or have restricted access to banking services in underdeveloped countries or otherwise lack this benefit notably (Schär, 2021). Moreover, DeFi promotes inclusion by allowing people to participate in the global economy regardless of their socio-economic level by means of previously unavailability financial instruments and services (Gudgeon *et al.* 2020).

Cost-effective efficiency

DeFi uses smart contracts and blockchain technology to improve the efficiency of financial transactions by automating processes and so removing the need for middlemen (Trivedi *et al.* 2021). This speeds up the application of financial services and reduces the transaction costs.

DeFi removes middlemen, therefore minimising the connected costs associated with wire transfers, loan processing, and currency swaps when compared to traditional financial services (Hayes, 201). Furthermore, unlike in TradFi, which might span several days, transactions on DeFi networks are instantly finalized (Buterin, 2014).

Openness and Faith

Operating on public blockchains, DeFi systems record all transactions and make them accessible to the public (Truchet, 2022). This degree of openness builds trust and reduces the possibility of manipulation and dishonest behavior.

DeFi assures that all transactions are immutable and can be verified by using blockchain technology, therefore creating an easily available and clear financial system (Nakamoto, 2008). Furthermore, open source, the smart contracts used in DeFi let anyone check and validate the code. This helps to reduce the possibility of hidden diseases or evil deeds (Schär, 2021).

Creativeness and Novel Financial Products

DeFi is a hive of creative ideas constantly producing unique financial goods and services unaffordable in TradFi (Weingärtner *et al.* 2023). These pursuits cover synthetic assets, decentralized insurance, yield farming, and liquidity mining.

By providing liquidity to DeFi networks – a notion lacking a direct counterpart in traditional financial systems – yield farming helps users create profits (Xu, J. and Feng, 2022). Moreover, DeFi platforms like Synthetix let users create and trade synthetic assets that reflect the value of real assets, therefore offering fresh investment opportunities and risk reducing potential (Gudgeon *et al.* 2020).

Obstacles and Dangers

DeFi offers many advantages, but it also carries significant risks and challenges that need to be addressed if we are to guarantee its long-term acceptance and growth (Werner *et al.* 2022).

Because of flaws in smart contracts and blockchain technology, DeFi systems run security risks (Schär, 2021). Furthermore, the legislative environment for DeFi is still changing since many governments struggle to create systems that protect consumers while simultaneously encouraging invention (Hayes, 2021). Moreover, the assets inside the DeFi ecosystem can show notable volatility, thereby posing possible risks to consumers as well as investors (Buterin, 2014).

8. Applications of Decentralized Finance

DeFi is a broad spectrum of financial apps and services built on blockchain technology and run distributedly. These applications provide financial services free from the requirement for traditional middlemen by use of smart contracts, which enable decentralized functioning. The main DeFi use cases are listed here.

Decentralized Exchanges (DEXs)

Decentralized exchanges let consumers straight trade cryptocurrencies with one another, therefore removing the need for a centralized body to monitor the transactions. These transactions use smart contracts to execute deals, therefore offering more security and anonymity than centralized exchanges.

On the Ethereum blockchain, notables decentralized exchanges (DEXs) include Balancer, SushiSwap, and Uniswap. Decentralized exchanges (DEXs) enable users with improved fund management, help to reduce the vulnerability to hacks usually connected with centralized exchanges, and guarantee a higher level of anonymity (Hayes, 2021).

Lending and borrowing sites

DeFi lending systems let users borrow assets by offering collateral or lend their assets to others and get interest (Yan and Zhou, 2023). These systems run under smart contracts, which enforce loan rules and automate lending.

Among the notable lending and borrowing sites available in the DeFi domain are MakerDAO, Aave, and Compound. Usually without the necessity for credit checks or thorough documentation, these sites provide more easily available lending and borrowing tools. Moreover, they give lenders more interest rates than traditional savings accounts (Schär, 2021).

Stablecoins

Made to offer a continuous value by being connected to a reserve asset, such a fiat money (like USD) or a commodity (like gold), stablecoins are digital currencies. In the very erratic bitcoin market, cryptocurrencies provide a safe approach to store assets and a consistent means of exchange.

Mostly used stablecoins are DAI, USD Coin (USDC), and Tether (USDT). Stablecoins let consumers make daily purchases, remittances, and savings free from the notable price swings usually connected with other cryptocurrencies (Gudgeon *et al.* 2020).

Liquidity mining and yield farming

Usually in the form of more tokens, yield farming is providing liquidity to DeFi platforms in exchange for benefits. A particular feature of yield farming, liquidity mining is when users receive tokens unique to the network in return for supplying liquidity.

By means of yield farming and liquidity mining initiatives, platforms like Yearn.Finance and SushiSwap inspire consumers to contribute liquidity. These activities give customers the possibility to receive more returns on their money than with other investment choices. Hayes, 2021 is the source's cited year.

Insurance

DeFi insurance solutions address many risks in the DeFi ecosystem, including protocol problems, hacks, and smart contract failures. These systems cover claims and use decentralized pools of capital.

Notable DeFi insurers include Cover Protocol and Nexus Mutual. DeFi insurance protects users from possible financial losses resulting from unanticipated events, therefore improving the security and dependability of DeFi systems. (Schär, 2021)

Synthetic assets

Synthetic assets are virtual copies of real-world objects including stocks, goods, or fiat money. They let users access these assets without actually owning the tangible underlying good.

One well-known platform focused in the design and trading of synthetic assets is Synthetix. Synthetic assets enable simple worldwide trading (Gudgeon *et al.* 2020) and give investors more choices of investment options.

Markets of Prediction

Prediction markets let consumers stake money on the outcome of upcoming events including financial markets, sporting contests, or elections. These markets precisely predict the results of events by using the collective intelligence of a big population.

Popular systems for prediction markets are augur and gnosis. By means of market-driven forecasting, these prediction markets offer a fresh approach for reducing risks and acquiring understanding of future events. The reference is Hayes (2021).

9. Key Indicators of Decentralized Finance Activity

Different important indicators can be used to evaluate the degree of activity in DeFi, therefore providing insightful data on the growth, use, and overall welfare of the DeFi ecosystem. Policymakers, developers, and investors all need these measures to understand the complexities of DeFi markets. Here are some of the primary indicators. Based on important 2019 data, which corresponds to the year before the third bitcoin halving event, we give a quick summary of the DeFi sector.

Total Value Lock (TVL)

In the subject of DeFi, TVL is a frequently used statistic that measures the total value of bitcoin deposited under DeFi systems. It shows the degree of financial resources and confidence paid to the DeFi ecosystem.

Under DeFi systems, TVL measures the financial value of every item deposited, lent, or used in any other capacity. A reliable gauge of the liquidity, use, and confidence in DeFi systems is a larger TVL. It immediately shows the capital level actively engaged in the DeFi ecosystem (Schär, 2021). Many DeFi analytics products, notably DeFi Pulse and DeFiLlama (DeFi Pulse, 2021), allow one to access TVL data.

DeFi Pulse tracks many DeFi systems on the Ethereum blockchain's TVL. For many DeFi platforms on multiple blockchains, DeFi Llama offers TVL data.

With leading platforms like MakerDAO, Compound, and Uniswap leading the way in the DeFi space, it was still in its early years in 2019. By year's end, the TVL in DeFi systems showed a modest rise from over 300 million USD to over 700 million USD. Mostly driven by people who were enthusiastic about blockchain technology and among the first to investigate decentralized financial services, the user base comprised In 2020, the period known as "DeFi Summer" saw notable rise in capital as well as curiosity. From less than 1 billion USD at the start of the year to more than 15 billion USD at the end, the TVL – total value locked – gushed. Platforms like Uniswap, Aave, and Yearn Finance, which saw significant increase in TVL due of their innovative products and appealing yields on assets staked, drove the fast expansion (DeFi Pulse, 2020). By the middle of the year, the TVL in 2021 exceeded 100 billion USD, signifying a continuous expansion tendency. The growing interest of institutional investors helped to highlight this expansion even further. Layer 2 scaling solutions – such as Optimism and Arbitrum – resulted in lower transaction fees and higher transaction speeds, which in turn helped TVL to expand. DeFi Llama, 2021's higher involvement of institutions and their link with established financial systems increased the credibility and TVL of DeFi platforms. Though the DeFi market saw swings and changes between the years 2022 and 2023, overall TVL stayed hopeful. The smooth flow of assets between many blockchains made possible by improvements in cross-chain interoperability produced a very integrated and strong DeFi ecosystem. Notwithstanding more government scrutiny, efforts to create DeFi platforms following rules have effectively drawn more money into the ecosystem.

Driven by invention, profitable returns, and increasing acceptability, The Rise of DeFi's total value currently held has been exponential since 2019. The DeFi industry continues in its expansion and integration with

traditional financial systems despite the occurrence of market corrections and the presence of regulatory challenges, therefore showing a good and motivating future view.

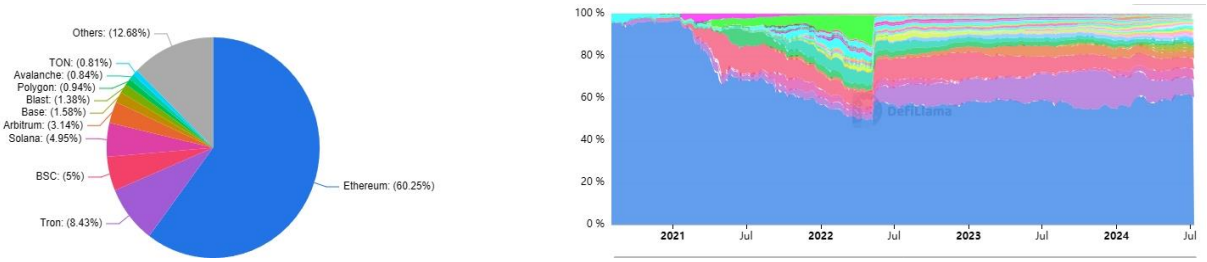
The key trends in the evolution of TVL over the investigated period are summed up in Figures 1, Figure 2, and Figure 3.

Figure 1. Total Value Locked - All Chains (2020 - 2024) (bil. USD)

Source: DefiLama

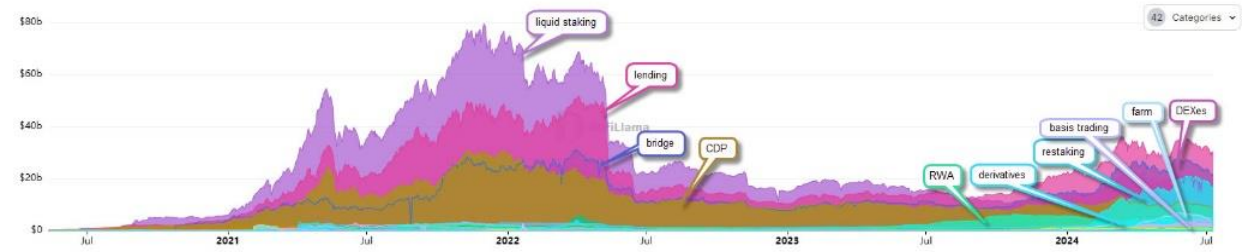
Note: TVL excluding staking, Pool2, government tokens, borrows, double count, liquid staking, vesting.

Figure 2. Total Value Locked - All Chains (July 2024 (left), 2020 - 2024 (right))



Source: DefiLama

Figure 3. Total Value Locked - Protocol Categories (2020 - 2024) (bil. USD)



Source: Authors processing based on data from DefiLama

Note:

Top ten protocol categories:

Liquid staking – Protocols that enable you to earn staking rewards on your tokens while also providing s tradable and liquid receipt for your staked position

Restaking – protocols that allows you to stake the same ETH natively and in other protocols

Lending – protocols that allow you to borrow and lend assets

CDP – protocols that mint its own stablecoins using collateralized lending

Bridge –

RWA – protocols that involve Real World Assets, such as house tokenization

Derivatives – protocols for betting with a leverage

Basis trading – projects simultaneously buying and selling crypto futures to profit from price differences between the spot and futures markets

Farm – protocols that allow users to lock money in exchange for a protocol token

Dexes – protocols where you can swap / trade cryptocurrencies

Number of Unique Users

Another important statistic is the total number of different users or addresses interacting with DeFi systems. This survey provides insightful data on the degree of DeFi application acceptability and degree of usage.

The count of distinct users shows the total number of individual wallets addresses that have interacted with DeFi systems over a designated period. The increasing number of different users indicates a boom in interest and adoption of DeFi services among a larger spectrum of customers (Hayes, 2021).

Configurable dashboards provided by Dune Analytics let users track unique user stats on many DeFi systems.

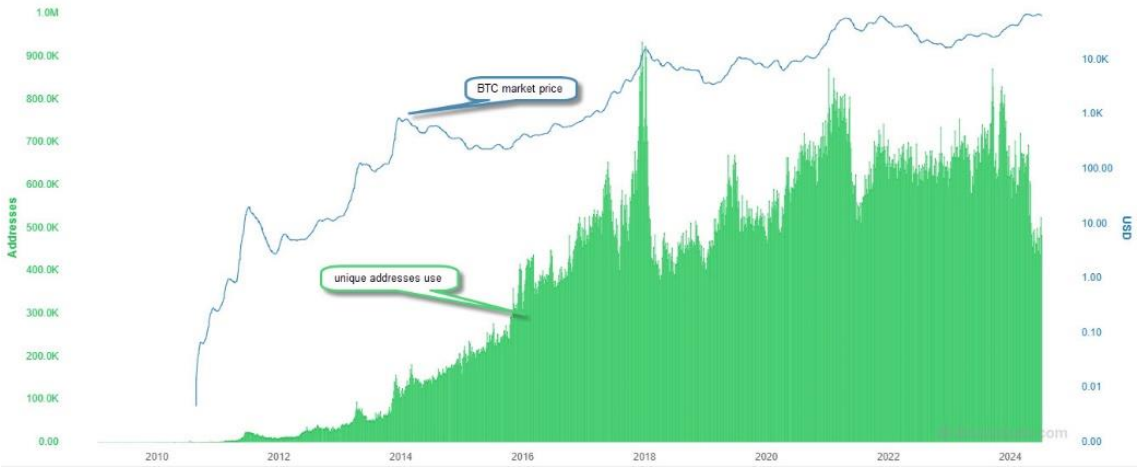
One interesting indicator of the popularity and spread of DeFi platforms over time is the number of different users in this field. Emphasizing notable trends and critical benchmarks, this paper offers a succinct summary of the expansion of DeFi user counts from 2019 onward. DeFi became somewhat well-known in 2019 mostly among people who were enthusiastic about blockchain technology and those who embraced fresh ideas right away. With the growing number of unique users, platforms including MakerDAO, Compound, and Uniswap have been becoming more and more well-known. Most of the platforms had at the end of the year - less than 100,000 unique users - indicating the quite small user base during that time.

DeFi involvement peaked in the summer of 2020, sometimes referred to as "DeFi Summer." Using yield farming and liquidity mining produced a notable rise in the total number of different DeFi users on platforms. Platforms like Uniswap claimed a user base of about 500,000 people at the end of 2020. Retail investors and traders among other more diverse groups began to show interest in the enticing returns produced by DeFi systems. The momentum created in 2020 continued into 2021 since DeFi platforms showed continuous expansion in the total count of unique users. The user base grew to include a more diversified mix of normal investors, professional traders, and institutional investors among other players. The overall count of unique users on all DeFi platforms as of mid-2021 exceeded two million (Dune Analytics, 2021). Although the DeFi market saw swings and changes between the years 2022 and 2023, user expansion stayed constant. Layer 2 solutions and cross-chain interoperability have been very important in the continual rise in user numbers by lowering transaction costs and improving user access. Dune Analytics projects that there will be more than 4 million different users on DeFi systems in 2023.

Advances, attractive returns, and a growing level of interest from both the general public and institutional investors have driven exponential expansion of the number of unique people using DeFi platforms since 2019. Though the sector has seen swings, generally the trend in user growth is positive, implying that more people are adopting and using DeFi products.

Figure 4 gives a general picture of the key trends in the evolution of distinct addresses utilized during the investigated period.

Figure 4. Unique Addresses Used (2020 - 2024) (number of addresses)



Source: Authors processing based on data from blockchain.com
Note: The total number of unique addresses used on the blockchain (30 day average).

Transaction Volume

Transaction volume measures the total value of all the DeFi platform-mediated transactions. Together with other financial activities, this includes loans and repayments performed on lending platforms as well as transactions done on decentralized exchanges (DEXs).

The whole value of all the DeFi-mediated transactions is known as transaction volume. High transaction volumes point to a notable degree of liquidity and use, which implies active market participation and great user involvement (Gudgeon *et al.* 2020).

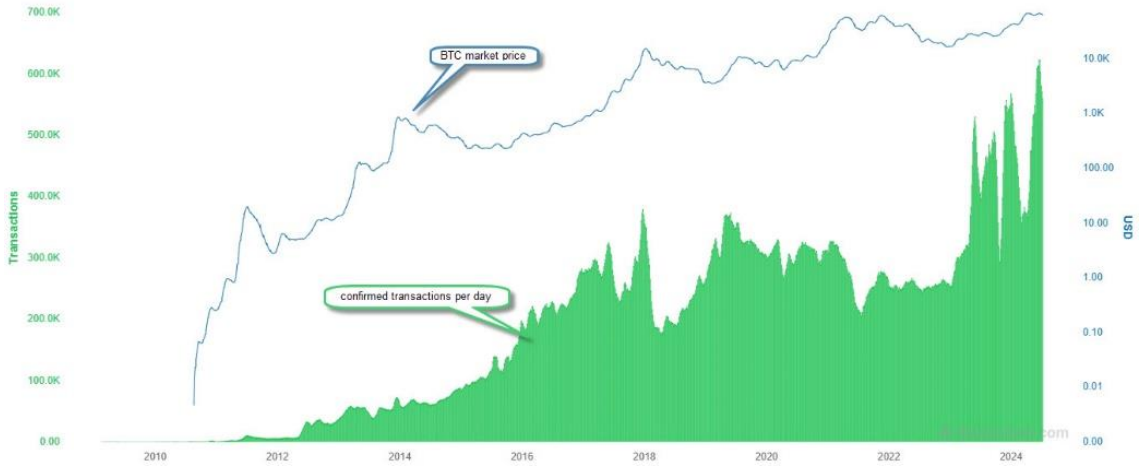
For DeFi services developed on the Ethereum blockchain, Etherscan offers thorough transaction data. Glassnode provides for multiple blockchain networks on-chain data analytics including transaction volumes.

Since 2019, the number of transactions on DeFi platforms has exhibited notable rise, signifying the quick acceptance and evolution of DeFi systems. The important trends and noteworthy events in the evolution of DeFi transaction volumes are succinctly summarized in this overview. Those who were fast to adopt new technologies and very interested in blockchain drove much of DeFi's expansion in 2019. Notable sites including MakerDAO, Compound, and Uniswap began to acquire popularity at this period. The transaction volumes were somewhat modest during this period; monthly values ranged from a few hundred million USD. DeFi participation surged noticeably in the summer of 2020, sometimes referred to as "DeFi Summer." Innovations like liquidity mining and yield farming attracted large sums of money that raised transaction volumes. The monthly transaction volumes rose significantly by the end of 2020 and now stand at several billion USD. Prominent DeFi platforms as Uniswap, Compound, and Aave had notable trading volumes; Uniswap sometimes ranked first among the transaction volumes of big, centralized exchanges (Hayes, 2021). As the transaction volumes in the DeFi industry showed consistent rise all year long, the momentum created in 2020 stayed with us into 2021. As new platforms and Layer 2 solutions like Optimism and Arbitrum surfaced, the ecosystem saw a boost in diversity and lower prices and better throughput followed. Additionally contributing to the surge in transaction volumes and improved liquidity in DeFi markets was the increased attention institutional investors paid. DeFi Pulse (2021) claims that the monthly transaction volumes as of mid-2021 exceed tens of billions of USD. Although the DeFi market had swings and changes over the years 2022 and 2023, overall, the direction stayed positive. Improvements in cross-chain interoperability enabled seamless transactions between several blockchain systems, hence raising transaction volumes. Increased regulatory scrutiny and attempts to combine with TradFi drove the transaction volumes and platform operations.

Since 2019, the transaction volume in the DeFi market has surged fast and significantly. New financial instruments, more acceptability and use, as well as institutional investor growing interest could all help explain this increase. Though the market is always changing, and laws provide challenges, overall transaction volume is always rising. This shows how DeFi is developing and finding a place in the larger financial system.

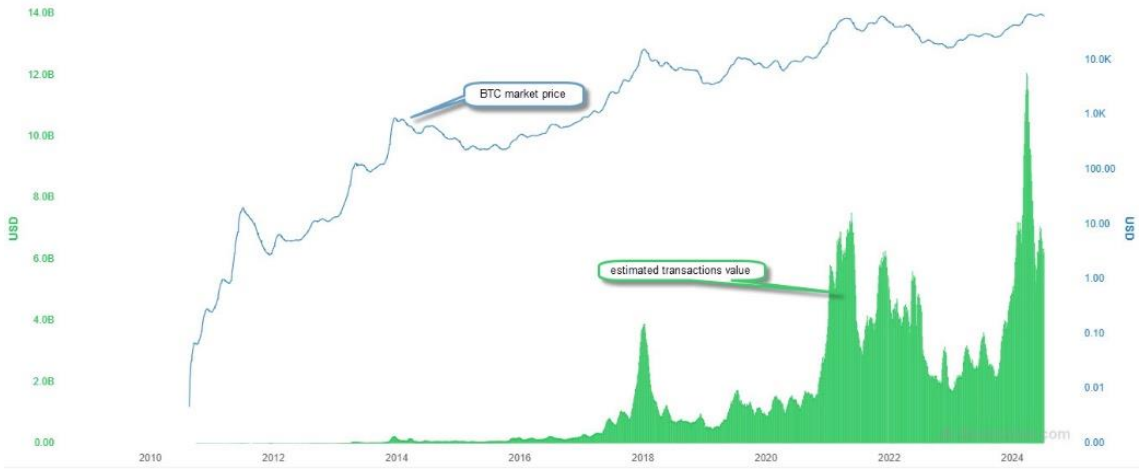
Figures 5 and 6 give a general picture of the key trends in the evolution of confirmed daily transactions and projected transaction value over the investigated period.

Figure 5. Confirmed Transactions Per Day (2020 - 2024) (number of transactions)



Source: Authors processing based on data from blockchain.com
Note: The total number of confirmed transactions per day (30 day average).

Figure 6. Estimated Transaction Value (2020 - 2024) (bil. USD)



Source: Authors processing based on data from blockchain.com
Note: The total estimated value in USD of transactions on the blockchain (30 day average). This does not include coins returned as change.

Trading Volume on Decentralized Exchanges (DEXs)

A separate subset of transaction traffic, DEX trading volume is the total value of transactions made on decentralized trading systems.

The total value of purchase and sale events conducted on decentralized exchanges (DEXs) is trading volume. Important trading volumes on decentralized exchanges (DEXs) point to active market participation and liquidity, which are absolutely vital for the process of price determination and guarantee of effective markets (Buterin, 2014).

Up-to- current data on the trading volume of the Uniswap decentralized exchange (DEX) is available from Uniswap Info. Multiple dashboards housed by Dune Analytics track trading volumes on several decentralized exchanges (DEXs).

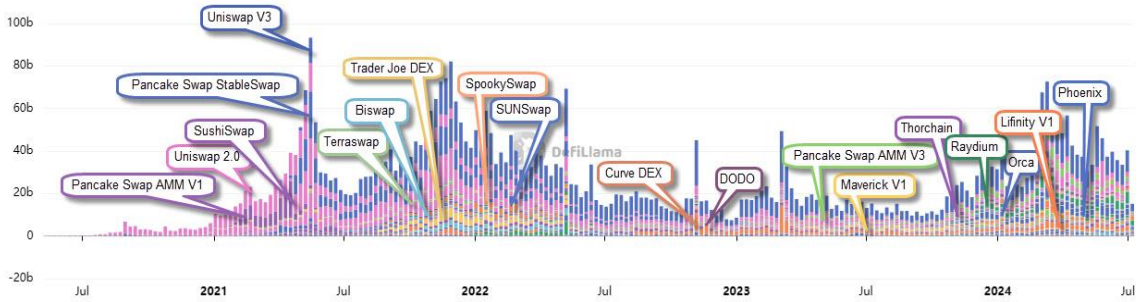
The growth of DeFi has been much aided by decentralized exchanges (DEXs). Thanks to increased acceptance, developments, and more knowledge of DeFi systems, the trade volume on decentralized exchanges (DEXs) has seen a notable rise since 2019. With systems like Uniswap, Kyber Network, and Bancor leading the way as early adopters, decentralized exchanges (DEXs) began to gather very significant popularity in 2019. Usually ranging in tens of millions of USD every month, the trade volumes were somewhat low. This represents the early stage of user adoption and the developing character of decentralized trading. Referred to as "DeFi Summer," the summer 2020 saw notable increase in growth for decentralized exchanges (DEXs). The adoption of creative ideas like liquidity mining and yield farming brought about a significant cash flow into platforms. From roughly 1 billion USD at the beginning of 2020 to surpass 20 billion USD by the year's conclusion, the monthly trade volumes on decentralized exchanges (DEXs) saw a notable surge. Leading the way in this development, Uniswap and Sushiswap drew a varied clientele comprising institutional participants as well as private traders (Hayes, 2021). Following the pattern from 2020, by middle of the year the trading volumes in 2021 usually exceeded 50 billion USD per month. By means of Layer 2 scaling techniques including Optimism and Arbitrum, transaction costs have been efficiently lowered and processing capacity has been improved, therefore fostering trade activity. Larger trading volumes followed from institutions' growing interest in DeFi since more institutional capital was poured into decentralized exchanges (DEXs). With Uniswap alone managing more than 100 billion USD in trade volume during months, Uniswap V3, Sushiswap, and Curve had high degrees of trading activity (DeFi Pulse, 2021). Although the DeFi market saw swings and shifts between the years 2022 and 2023, trade volumes on decentralized exchanges (DEXs) stayed robust. Consistent trade activity resulted from easier asset exchange across several blockchains made possible by improvements in cross-chain interoperability. Trade volumes and platform operations were affected by growing regulatory control and the necessity to include DeFi into current financial systems. The overall direction of trading volumes stayed positive despite market volatility, which emphasizes the dependability and adaptability of decentralized exchanges (DEXs).

Since 2019, the trading volume on decentralized exchanges (DEXs) has surged rapidly and significantly mostly due to technological developments, wider acceptance and use, and increasing interest from institutional investors. The general trend of trading volume shows growth despite the erratic fluctuations in the market and the

challenges presented by legislation, therefore showing the resilience and opportunities of decentralized exchanges (DEXs) in the always shifting DeFi environment.

The Figures 7 give a general picture of the key trends in the volume of DEXs development during the investigated period.

Figure 7. DEXs volume (protocol breakdown) (2020 - 2024) (bil. USD)



Source: Authors processing based on data from DefiLama

Total Borrowed and Total Supplied

The metrics of total borrowed and total provided inside DeFi lending platforms respectively measure the quantity of cryptocurrencies borrowed and the overall amount deposited for loan.

Whereas total offered denotes the whole value of assets that are accessible for loan, total borrowed is the total value of assets that are presently being borrowed from lending platforms. These factors, which reflect both loan demand and capital availability, help to indicate the activity of the lending market (Schär, 2021).

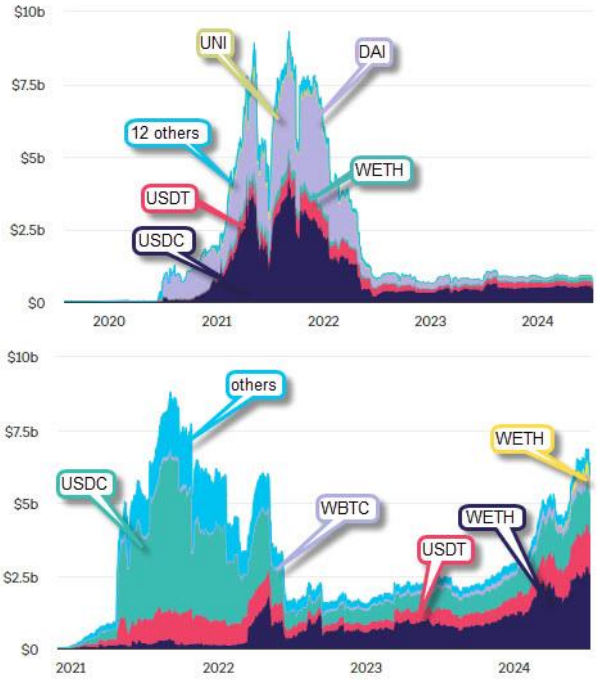
Two well-known sites that provide complete information on the total borrowed and delivered number of compounds and Aave are While Aave also provides significant market statistics, such the overall amounts borrowed and supplied, Compound's market website allows in-depth study of these criteria.

Since 2019, the lending platforms in the field of DeFi have shown notable rise in both the overall amount borrowed and the overall amount issued. These metrics show the increasing use of DeFi for lending and borrowing, therefore reflecting the greater adoption and evolution of DeFi protocols (Metelski and Sobieraj, 2022). Beginning in 2019, DeFi lending platforms such MakerDAO, Compound, and Aave began to draw interest and popularity. During this first phase of growth, the total borrowed and given amounts were somewhat small. Compound had borrowed 20 million USD overall and added about 100 million USD by the end of 2019. Early adopters – mostly crypto enthusiasts and early DeFi users – were investigating the sites most of all. DeFi participation surged in 2020 under the moniker "DeFi Summer," as liquidity mining and yield farming significantly raised the total values of assets supplied and borrowed. By the end of 2020, compound's overall supply had grown to more than 2 billion USD; the total borrowed amount above 1 billion USD (DeFi Pulse, 2020). Attractive high yields and incentives drove a notable rise in capital for the DeFi lending systems. Following the encouraging trend from 2020, 2021 saw a considerable increase in the total amount borrowed as well as supplied. By use of Layer 2 solutions like Optimism and Arbitrum, transaction costs were lowered, which in turn encouraged lending and borrowing behavior. Rising institutional interest produced a boom in trading volume. Platforms like Aave and Compound have amassed by mid-2021 over 10 billion USD in total money given and several billion in total loans borrowed (DeFi Llama, 2021). Though market corrections in 2023 and 2022, the fundamental trend stayed positive. The simple transfer of assets between different blockchains made possible by developments in cross-chain technologies helped to promote and increase lending and borrowing operations. Rising regulatory scrutiny and more attempts to interact with TradFi drove the lending and borrowing volumes. DeFi Pulse estimates that the combined supply on top of the main DeFi platforms in 2023 exceeded 50 billion USD and that the overall borrowed amounts also showed notable increase.

Since 2019, the total sums of money borrowed and given on DeFi platforms have seen a fast and notable rise largely due to technological developments, tempting rewards, and a rising interest from mainstream and institutional participants. Though market corrections and legal challenges are inevitable, the general trend is still positive, implying a bright future for DeFi lending and borrowing.

Figure 8 give a general picture of the key trends in the growth of outstanding debt on DeFi over the investigated period.

Figure 8. DeFi outstanding debt – Compound (2020 – 2024) (left), Aave (2020 – 2024) (right))



Source: Authors processing based on data from theblock.co
Note: Lending Platforms / protocols:
Aave is a lending protocol where users can borrow and lend assets. Interest rates are determined algorithmically. AAVE token holders govern the Aave protocol.
Compound is a money market protocol where users can borrow and lend assets. Interest rates are determined algorithmically. COMP token holders govern the Compound protocol.

Yield Rates

Important markers of the profits users can get from engaging in DeFi activities are yield rates—that is, interest rates provided by DeFi protocols for lending and staking.

For staking, lending, or providing liquidity, yield rates are the interest rates charged to consumers. While also showing the risk and return profile of DeFi investments, high yield rates can draw additional users and capital into the DeFi ecosystem (Hayes, 2021).

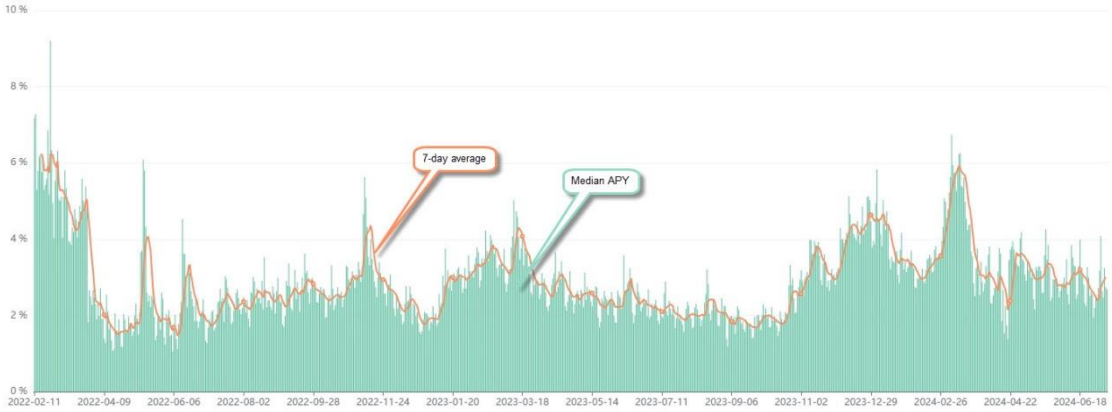
Zapper lets customers control their DeFi portfolios and collects yield rates for several DeFi platforms.

Since 2019, the yield rates on DeFi platforms have changed significantly. Showcasing the changing dynamics and appeal of DeFi as an investment choice, these rates indicate the earnings users may get by lending, staking, or providing liquidity on DeFi platforms. The early growth of DeFi platforms such Compound, MakerDAO, and Aave in 2019 helped to produce quite moderate yield rates. Early adopters, ranging from 2% to 5%, primarily affected the first yield rates for lending stablecoins and cryptocurrencies. Often referred to as "DeFi Summer," the summer of 2020 saw notable increase in growth for the DeFi industry. Using yield farming and liquidity mining methods produced remarkable rise in yield rates; some platforms provide annual percentage yields (APYs) exceeding 1000% at the greatest periods. Attractive profits on platforms including Yearn Finance, Compound, and Uniswap helped them to become well-known. For instance, the COMP token incentives given by Compound significantly raised the effective APY (Annual Percentage Yield) for lenders and borrowers respectively. When the very high returns of DeFi Summer dropped in 2021, the interest rates remained somewhat attractive. For notable cryptocurrencies and stablecoins, the average annual percentage yields (APYs) ranged from 5% to 20%. Using Layer 2 scaling techniques like Optimism and Arbitrum has helped to lower gas prices, therefore indirectly improving net yields for consumers. Better institutional players produced better stability and predictability of yield rates. This resulted from the notable cash flow, which enhanced the trading venues and raised liquidity. Market corrections caused variations in the DeFi yield rates between 2022 and 2023, although generally the direction stayed positive. Competitive yields have come from newly emerging technologies such cross-chain yield farming and automated yield optimization. For those looking for yield, the rather low-risk potential presented by stablecoin deposits remained enticing, generally falling between the range of 5% to 15%.

Advances like yield farming and liquidity mining, market pressures, and increasing institutional interest have prompted significant changes in the yield rates on DeFi platforms from 2019. DeFi still offers attractive returns, especially for stablecoins and well-known cryptocurrencies, even if the very huge gains of DeFi Summer have become more consistent.

The figures 9 give a general picture of the key trends in the evolution of the Median APY trend on all monitored pools over the investigated period.

Figure 9. Median APY trend (2022 - 2024) (%)



Source: Authors processing based on data from DefiLama
Note: APY (annual percentage yield) calculated over all tracked pools on given day

Protocol Revenue

Protocol income includes DeFi protocol charges from numerous operations - including trading, lending, and staking.

Protocol revenue is the total charges a DeFi protocol generates from its running operations. Higher protocol revenue indicates not only the capacity of the protocol to generate stable money but also its effective acceptance and consumption (Gudgeon *et al.* 2020).

Token Terminal provides thorough financial data including protocol income for DeFi systems. Monitoring daily fees generated by multiple DeFi platforms, CryptoFees provides insightful analysis of protocol earnings.

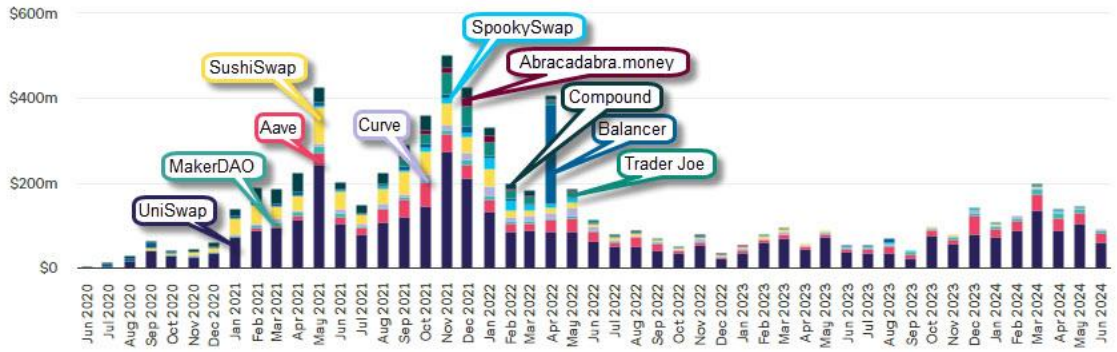
Revenue from the DeFi systems comes from fees and extra charges paid by DeFi platforms. This data provides insightful analysis on the financial situation and growth of DeFi systems. The evolution of protocol income on DeFi platforms from 2019 forward is succinctly summarized below. DeFi systems were in their early years in 2019, and income generation was rather modest. Starting to establish themselves were MakerDAO, Compound, and Uniswap. Mostly through transaction fees, loan interest, and trading fees on decentralized exchanges (DEXs), the protocol produced small income. DeFi participation increased significantly during the period sometimes referred to as the "DeFi Summer" in 2020, which clearly affected protocol income. Innovations in yield farming and liquidity mining have drawn a sizable number of users, which has clearly increased transaction volumes and fee generating. Leading DeFi protocols such Uniswap, Aave, and Compound saw a notable rise in monthly income from a few hundred thousand dollars to several million dollars by the end of 2020, according DeFi Pulse (2020). As protocol income reached hitherto unheard-of heights in 2021, the impetus created in 2020 continued in that direction. DeFi platforms have diversified and increased their income sources by adding fresh financial products and services, therefore broadening their offers. As these companies poured significant funds into the DeFi ecosystem, institutional involvement increased, and revenues followed. By mid-2021, notable platforms including Uniswap and Aave produced monthly sales exceeding 50 million USD, via DeFi Llama (2021). The DeFi market saw swings and changes between 2022 and 2023 that affected protocol revenues. Still, the general trend stayed hopeful. The developments in cross-chain technology helped to enable seamless transactions between several blockchains, hence supporting ongoing income growth. Increased regulatory scrutiny and the effort to link DeFi with existing financial systems changed income sources. The aggregate monthly income of well-known DeFi platforms has steadily shown great increase as of early 2023, therefore proving the adaptability and endurance of DeFi systems (CryptoFees, 2023).

Since 2019, the income brought in by DeFi platforms' protocols has been quite notable and fast rise. Innovations, more acceptance, and more institutional investor interest help to explain this development. The basic

direction of protocol income is still positive even if the market may fluctuate and rules create challenges. This underlines the financial viability and opportunities for DeFi protocol expansion.

The numbers 10 give a general picture of the primary trends in the monthly DeFi income growth during the examined period.

Figure 10. Monthly DeFi revenue (protocol breakdown) (2020 - 2024) (mil. USD)



Source: Authors processing based on data from theblock.co

Conclusion

Over the past four years, DeFi has drastically changed the finance sector and presented both clear opportunities and challenges to the TradFi systems. Originating from blockchain technology and smart contracts, DeFi offers decentralized, transparent, and readily available financial services that significantly deviate from the centralized and sometimes confusing character of traditional banking and financial institutions (Buterin, 2014; Nakamoto, 2008).

Emphasizing the importance of a balanced approach to control that can reduce risks without limiting innovation, the paper emphasizes the regulatory problems and hazards connected with DeFi, including smart contract vulnerabilities, market volatility, and lack of regulatory monitoring. Key areas of the research are also represented by the growing interest from institutional investors and the possible integration of DeFi into conventional financial systems, exploring the possibility for DeFi to go from a niche market to a mainstream financial system, and, as a result, profoundly influencing traditional finance. Based on both the chances for additional innovation and expansion as well as the issues that must be resolved to guarantee the stability and sustainability of the ecosystem, the paper emphasizes the future direction of DeFi. Highlighting DeFi's ability to transform the worldwide financial system, it is a vital tool for academics, legislators, and business leaders interested in the junction of technology and money.

TradFi is in great part dependent on established financial institutions including banks, investment businesses, and insurance organizations. They guarantee monetary stability, provide vital financial services, and help to foster economic development. Still, it runs against major challenges like operational inefficiencies, financial exclusion, and structural risks (Mishkin, 2004; Bernanke, 2004). The 2008 financial crisis revealed flaws in TradFi, therefore highlighting the likelihood of broad repercussions should major institutions fail (Bernanke, 2004). Furthermore underlined by the high costs and slow processing times of traditional financial systems are the need of more simplified and efficient substitutes (Friedman, 1963).

DeFi uses blockchain technology to cut middlemen, lower transaction costs, and increase openness, therefore addressing these challenges. Rising from over 700 million USD in late 2019 to more than 100 billion USD by mid-2021, the exponential rise in Total Valuelocked (TVL) in DeFi protocols emphasizes the quick adoption and confidence in these decentralized systems (DeFi Pulse, 2020; DeFi Llama, 2021). Attractive to both personal and institutional investors, yield farming and liquidity mining have resulted in significant increase in user involvement and transaction volumes (Hayes, 2021).

Still, DeFi has hazards as well. The decentralized character of DeFi raises fresh systemic questions like market volatility and smart contract susceptibilities (Gudgeon *et al.* 2020; Hayes, 2021). Furthermore, the legislative environment for DeFi is still unclear since increased scrutiny can hinder its growth and inclusion into TradFi (Schär, 2021). Notwithstanding these risks, DeFi is clearly able to democratize money, improve efficiency, and inspire creativity.

In essence, the interaction between TradFi and DeFi marks a major and transforming transformation in the financial sector. DeFi's inventions challenge accepted wisdom in traditional banking by offering a decentralized substitute with guaranteed improved access, efficiency, and openness. The global financial ecosystem might be

greatly disrupted and changed as DeFi grows. For established financial institutions, this offers opportunities as well as challenges (Buterin, 2014; Demirgüç-Kunt *et al.* 2018). For people and companies engaged in the financial sector navigating this dynamic and fast changing terrain, a thorough awareness of the influence and possibilities of DeFi is very necessary.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Declaration of Use of Generative AI and AI-Assisted Technologies

The authors declare that they have not used generative AI and AI-assisted technologies during the preparation of this work.

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Regional Trade and Financial Mobilisation as Preconditions for Economic Growth: The Case of ECOWAS

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Abstract: This empirical study delves into the Economic Community of West African States (ECOWAS) and its impact on economic growth through regional trade and financial mobilisation amongst its 15 member states. Through examination of data from 2005 to 2022, the study took into consideration a blend of static and dynamic panel data econometrics to explore nuances of trade openness, foreign direct investment (FDI), Domestic Credit to the Private Sector (CPS), and other factors influencing Real Gross Domestic Product (RGDP). The findings highlight a positive relationship between trade openness, FDI and economic growth, emphasising the importance of regional trade integration and foreign investment in driving economic development. Conversely, domestic credit shows a negative association with economic growth, thereby indicating the need for cautious assessment of credit allocation and financial sector efficiency. The study also reveals the important role of institutional quality in fostering economic growth, thereby recommending for policy reforms that strengthen governance frameworks and promote institutional resilience. Astonishingly, the analysis shows no significant relationship between inflation, transportation infrastructure, and economic growth. Theses insights contribute to a clear understanding of the dynamics between regional trade, financial mobilisation, and economic development within ECOWAS, thereby offering valuable implications for policymakers, with the aim of enhancing economic growth and integration in the region.

Keywords: regional trade; ECOWAS; financial mobilisation; economic growth.

JEL Classification: F15; F36; C01; O16; O40.

Introduction

The Economic Community of West African States (ECOWAS) was initially setup in 1975 with the primary goal of fostering economic cooperation and integration among West African nations. Arising from a common vision to promote economic development and political stability, ECOWAS has been prominent in addressing common challenges and improving collaboration across its 15 member states. The rudimentary principles set by the Treaty of Lagos surround the establishment of a common market, the advancement of economic stability, and the facilitation of free movement of goods, services, and people (Ogbebor and Ohiomu, 2018). As years gone by through the implementation of different protocols and initiatives, ECOWAS has played important role in promoting regional integration, thereby providing a platform for member countries to promote collaborative ventures for economic development.

In view of the context, a critical research question is hereby proposed: How do regional trade and financial mobilisation in the ECOWAS impact the economic growth of its member states? An understanding of the historical development and operational framework of ECOWAS is important for grasping the complexities of its

economic landscape. While various studies, such as those produced by Juma and Mangeni (2018) have explored the organisational structure and governance mechanisms of ECOWAS, there seem to be a potential gap in comprehensively understand the contributions of regional trade and financial mobilisation to the economic growth of the member states. This research aims to drill down into the historical context of ECOWAS, thereby setting the stage for a detailed analysis of its economic dynamics.

The importance of regional trade within ECOWAS extends far beyond simple exchanges of goods and services; it is indeed considered a very important driver of economic growth in the region. Baita (2020) assumes that improving intra-regional trade can significantly increase GDP, create jobs, and reduce poverty. Through fostering collaboration among its member countries, ECOWAS have sought to establish synergies that boost economic productivity and competitiveness on a global scale. Simultaneously, financial mobilisation, including initiatives sucha s investment promotion and capital market development, is also considered important in providing the necessary resources to sustain economic activities. Sanusi (2012) stressed that an effective financial system is very important for promoting capital allocation, which invariably serves as a catalyst for investment and ultimately promoting economic growth.

This research has two primary objectives: (i) To assess the impact of regional trade on the economic growth of ECOWAS member states, and (ii) To examine the effectiveness of financial mobilisation strategies within the region. Through examination of these objectives, the research aims to disentangle the nuance relationship between regional trade patterns, financial structures, and overall economic growth, thereby providing valuable insights to both the academia and policymakers interested in enhancing economic growth within the ECOWAS framework.

Despite ECOWAS's notable progress in promoting regional integration, there also remains a noticeable gap in research concerning the complex interplay between regional trade, financial mobilisation, and sustained economic growth. Plethora of studies have tended to focus attention on isolated aspects of economic development without providing an overarching view of how these elements interact within the distinct context of ECOWAS. This research plans to bridge this gap by conducting a thorough analysis that surpasses superficial examinations of regional economic dynamics.

Identification of the research gap is very important as it acts as a crucial support for research objectives. It highlights the need for an intricate understanding of how regional trade and financial mobilisation jointly contribute to the all-embracing goal of economic growth within ECOWAS. Through recognition of this void in the current body of knowledge, this research not only seeks to fill the gap, but also aims to make considerable contribution to the academic discourse on regional economic integration. This effort aligns well with the broader goal of improving the effectiveness of policy decisions and strategies aimed at fostering sustainable economic development in the ECOWAS region.

The remaining part of the study is therefore outlined as follows: Section 2 is focused on the Literature Review, sub-divided into theoretical and empirical review, with emphasis on West African Economic and Monetary Union (WAEMU) and the West African Monetary Zone (WAMZ). Section 3 discusses the Methodology, incorporating background information on major Monetary and Economic Zones, also introducing Panel Data Econometrics to address heterogeneity within ECOWAS countries. Section 4 provides an analysis and description of the results. Finally, Section 5 summarises the findings, with proposed recommendations based that emanated from the research outcomes.

1. Literature Review

1.1. Theories on Regional Trade and Financial Mobilisation

Theoretical foundations play a very important role in understanding the complex dynamics of regional trade and financial mobilisation. To start with, the Gravity Model is often applied to explain trade flows; it posits that the intensity of trade between two regions is directly proportional to their economic size and conversely proportional to the geographical distance that separates them. The Gravity Model in the context of the ECOWAS offers awareness into the potential determinants of regional trade by taking into consideration factors such as economic size, proximity, and the impact of financial mobilisation strategies in promoting trade relationships among member states (Anderson, 1979). In addition, the New Trade Theory promoted by Paul Krugman emphasises economies of scale and product differentiation as drivers of international trade. This theory when applied in the context of ECOWAS suggests that a coordinated approach to financial mobilisation can facilitate the development of industries with economies of scale, thereby fostering specialisation and trade within the region (Krugman, 1980). Moreover, Institutional Theory provides a lens to examine how the regulatory frameworks and institutions within the ECOWAS influences regional trade and financial mobilisation. Institutional effectiveness relating to the

promotion of trade liberalization and economic cooperation is considered crucial in shaping the success of regional economic efforts (North, 1990).

Nonetheless, the theory of Financial Repression introduces caution by highlighting potential drawbacks of certain financial mobilisation strategies. The theory specifically argues that policies restricting financial markets may result in misallocation of resources, thereby hindering prospects for economic growth. This, therefore, prompts a critical examination of financial mobilisation approaches within ECOWAS, invariably urging policymakers to balance the benefits of increased capital with the potential risks associated with regulatory constraints (Shaw, 1973). Collectively, these theoretical perspectives provide a robust framework for understanding the nuance relationships between regional trade, financial mobilisation, and economic growth in context of the ECOWAS.

On a critical note, theoretical foundations are considered important for understanding the complexities of regional trade and financial mobilisation, with various theories offering valuable insights into the dynamics within the ECOWAS region. The Gravity Model, as clearly explained by Anderson (1979), is considered vital in explaining trade flows worldwide. Its application to ECOWAS demonstrates the significance of economic size, proximity, and financial mobilisation strategies in promoting intra-regional trade relationships. Furthermore, the New Trade Theory, originally championed by Krugmn (1980), draws attention to the role of economies of scale and product differentiation in driving international trade. When applied to the ECOWAS, this theory proposes that coordinated financial mobilisation efforts can serve as a stimulant to industrial development and specialisation within the region. In addition, Institutional Theory, initially proposed by North (1990), demonstrates the influence of regulatory frameworks and institutions on regional trade dynamics. Collectively, these theoretical frameworks provide the foundation for understanding the complex relationships between regional trade, financial mobilisation, and economic growth in ECOWAS.

1.2. Empirical Review on Regional Trade and Financial Mobilisation Strategies in the ECOWAS

Research produced by Olofin, Salisu, Ademuyiwa and Owuru (2014) assesses ECOWAS's effectiveness in promoting regional grade from 1995 to 2010 by utilising a modified gravity model, with the findings indicating that economic size, distance, geographical factors, and socioeconomic variables significantly influencing regional trade in West Africa. The study also revealed that the francophone-dominated region (WAEMU) is export trade-creating, while the anglophone-dominated region (WAMZ) is trade-diverting, thereby emphasising the need for ECOWAS to foster close cooperation between the two blocs, while at the same time promoting an open approach to trade regardless of colonial origin for successful intra-regional trade facilitation.

In subsequent years, Ogbebor and Ohiomu (2018) empirically explore the impact of foreign direct investment (FDI) and trade openness on economic growth in the ECOWAS sub-region, presenting mixed results. Addressing the crucial challenge of poor living conditions in developing countries, the study covers the period 2000 to 2016, employing panel data. The analysis confirms series stationarity and co-integration, indicating long-run relationships among variables. Utilising panel regression, the study reveals significant and positive relationships between FDI, trade openness, and economic growth, suggesting the importance of consistent policymaking in ECOWAS member countries to enhance FDI inflows and trade openness for sustained economic growth.

Panel Unit Root and Cointegration Tests, with dynamic panel data study undertaken by Sissoko and Sloboda (2020) on economic development in the ECOWAS from 1996-2016 identifies Total Factor Productivity (TPF), law, and to some extent corruption as determinants of economic growth under the Arellano-Bond estimator. This further shows that inflation, Gross Domestic Savings (GDS), and TFP significantly impact economic growth in ECOWAS. The study emphasises that improving economic growth in ECOWAS countries demonstrates the importance of pro-growth policies and strengthened institutions, ultimately urging governments to prioritise these for sustained economic growth.

Continuing the chronological exploration, in 2020, Appiah, Li and Frowne's (2020) empirical study spanning 1996-2017 on 15 emerging economies within ECOWAS, using two-step SYS GMM estimators, reveals that financial development lacks a significant positive impact on economic growth in the region. The study also highlights conflicting effects of institutional quality variables, with control of corruption reducing growth and regulatory quality increasing it. Furthermore, the results indicate a positive association between capital formation and growth, while the labour force has a negative influence, leading to the conclusion that insufficient corruption control systems and underdeveloped financial sectors impede growth in the ECOWAS region.

Most recently, in 2023, the study by Olayemi and Fajimolu on the ECOWAS regional trade agreement investigates trade creation and trade diversion effects, particularly focusing on the period before the Nigerian

government-imposed importation bans. Employing an augmented gravity model, the research analyses bilateral trade flows, trade creation, and trade diversion within the region using data from 2008 to 2018. The study identifies factors such as GDP, population, and political stability in exporting countries as significant promoters of intra-regional bilateral trade flow, while variables like land area, being landlocked, and distance act as significant inhibitors. This research also shows the effect of membership in the Global System of Trade Preferences and the WAEMU on trade diversion and establishment within ECOWAS, thereby stressing the potential for enhanced trade creation provided member states hold steadfastly to the agreement terms.

More critically, the selected empirical studies provide valuable discernment into the effectiveness of regional trade and financial mobilisation strategies within the ECOWAS, thereby providing evidence-based guidance for policymakers. Olofin et al's (2014) assessment of ECOWAS's effectiveness in promoting regional trade shows the influence of economic size, distance, and colonial legacies on intra-regional trade dynamics. On a similar note, Ogbebor and Ohiomu (2018) show the positive effect of FDI and trade openness on economic growth within the sub-region, thereby emphasising the significance of consistent policymaking. In addition, study carried out by Sissoko and Sloboda (2020) identifies TPD, institutional quality, and corruption control as key determinants of economic growth within ECOWAS countries, which is also an indicative outcome from a study produced by Jackson (2017). On the other hand, Appiah, Li and Frowne (2020) study reveals challenges association with limited positive impact of financial development on growth and conflicting effects of institutional quality variables. Olayemi and Fajimolu (2023) research outcome emphasises the factors influencing intra-regional trade flow and the potential for enhanced trade creation within ECOWAS on account of the strict adherence to regional trade agreements. Collectively, these empirical findings provide crucial understanding into the problems of regional trade and financial mobilisation in ECOWAS, which is also indicative of informing policymakers' decisions and strategies towards fostering economic integration and growth within the region.

2. Methodology

Theoretically, economic growth in a closed economy relies on several factors, which includes macroeconomic stability, government spending, domestic investment, financial development, and institutional quality (Ciccone and Jarocinski, 2010; Butkiewicz and Yanikkaya, 2006; FitzGerald, 2006; Iqbal and Zahid, 1998; Sanchez-Robles, 1998; Barro, 1990). Collectively, these factors shape a nations' growth trajectory. However, when the economy is open, the dynamics of international trade becomes a critical component for growth expansion. The prevailing wisdom suggests that the volume of international trade between two regions is directly proportional to their economic size and inversely proportional to the geographical distance separating them. This implies that closer proximity tends to engage in more extensive trade relationships, leveraging their economic might and geographical advantages to drive commerce and exchange. This study expends on the normal traditional model by integrating regional trade and financial mobilization into a holistic growth function mathematically expressed as:

$$Real\ GDP = f(regional\ trade, financial\ mobilisation, other\ factors) \quad (1)$$

Unlike existing studies that focuses on isolated aspects of economic developments, this study diverges by using both comprehensive model that includes both regional trade dynamics and international financial mechanisms. Furthermore, this research provides new insights into how these factors collectively affects economic growth within the context of the Economic Communities of West African States (ECOWAS).

Utilizing a sample of panel data on the 15 countries[1] in ECOWAS over an 18-year period (2005 – 2022), the empirical model of the study is specified as follows:

$$RGDP_{it} = \alpha_0 + \alpha_1 Trade\_Openness_{it} + \alpha_2 DOT_{it} + \alpha_3 FDI_{it} + \alpha_4 CPS_{it} + \sum_{j=3}^{k} \alpha_j X_{it} + \varepsilon_{it} \ldots \quad (2)$$

Regional Trade Variables — Financial Mobilisation Variables

where: $RGDP_{it}$ is the dependent variable representing Real Gross Domestic Product for country *i* at time *t*; $Trade\_Openness_{it}$ (Trade Openness) and DOT_{it} (Direction of Trade) are the regional trade variables and; FDI_{it} (Foreign Direct Investment) and CPS_{it} (Domestic Credit to Private Sector) represents the financial

[1] Benin, Burkina Faso, Cote d'Ivoire, Cabo Verde, The Gambia, Ghana, Guinea, Guinea-Bissau, Mali, Niger, Nigeria, Senegal, Sierra Leone, Liberia, Togo.

mobilisation variables. The vector of control variables (including transportation Infrastructure, Inflation and Institutions) is represented by X_{it}. The model intercept is measured by α_0; $\alpha_{j'}$ (j'=1,2,…,k) are the estimated parameters and; ε_{it} is the error term which is assumed to be random with zero mean and constant variance.

The variables considered were meticulously chosen based on theory and existing empirical research. Economic growth is measured by RGDP (Gammadigbe, 2021), representing the average annual economic output in a nation. The variable Trade_Openness gauges the extent of economic integration among countries within a region and with the global economy. Higher levels of trade openness are generally anticipated to correspond with increased trade volumes, making it a reliable proxy for estimating overall trade volume within a region (Fetahi-Vehapi, Sadiku and Petkovski, 2015; Sakar, 2008). Direction of Trade (DOT) reflects the value of merchandise exports and imports disaggregated according to a country's primary trading partners[2], accounting for cost, insurance, and freight (CIF) for imports and Free on Board (FOB) for exports. This measure enables policymakers to tailor trade agreements, revise tariff policies, and enhance export promotion strategies to support industries with growth potential, thereby improving competitiveness in regional and global markets and potentially fostering long-term economic growth.

Foreign Direct Investment (FDI) entails the transfer of capital from an investing firm/company in one country to a host country to establish a lasting interest in an enterprise or business. This capital inflow directly contributes to the recipient country's economy and may stimulate development and growth (Kumari *et al.* 2023; Gherghina, Simionescu, and Hudea, 2019). Domestic Credit to the Private Sector (CPS) plays a crucial role in financial mobilization by granting businesses access to capital that can be invested productively, thereby contributing to economic growth (Mbate, 2013). Transportation Infrastructure (Trans_Inf) measures the extent of road, railway, and air connectivity. Enhanced infrastructure networks reduce transportation costs, improve logistical efficiency, and facilitate market access for businesses, thereby stimulating trade and economic activity (Zhang and Cheng, 2023). Inflation (Inflation) serves as a gauge of macroeconomic stability. Excessive inflation can lead to uncertainty, diminish purchasing power, distort price signals, and reduce investment incentives, all of which can adversely affect economic growth (Sekwati and Dagume, 2023; Tamuke, Jackson and Sillah, 2018). The institution (Institution) variable assesses a country's political stability and efficiency through regulatory quality, effectiveness in combating criminality, corruption, and terrorism, and protection of citizens' freedom of expression and association. Higher-quality institutions are associated with a greater likelihood of sustained economic growth, as they provide a stable and conducive environment for investment (Ragmoun, 2023).

2.1 Static Estimator

Employing a static panel estimation approach, three primary estimators warrant consideration: Pooled Ordinary Least Squares (POLS), Random Effect Model (REM), and Fixed Effect Model (FEM). Assuming the absence of country-specific unobservable effects, POLS represents a linear regression technique that amalgamates all observations across units and time periods to derive a unified set of regression coefficients. Consequently, POLS attains efficiency solely when such effects are minimal. However, in the presence of substantial country heterogeneity, the POLS estimator may generate biased estimates, rendering it inefficient and unreliable.

In instances where POLS proves inefficient, FEM and REM emerge as alternatives. FEM encompasses controls for unobserved country-specific attributes that remain constant over time. By incorporating fixed effects, the model accommodates country-specific influences and emphasizes variation within each unit across time (Wooldridge, 2010). Consequently, the model effectively addresses concerns pertaining to endogeneity by managing time-invariant unobservable factors that could potentially correlate with the independent variables. Expanding equation (1) to accommodate the country fixed effect, the following equation is derived:

$$RGDP_{it} = \alpha_0 + \alpha_1 Trade\_Openness_{it} + \alpha_2 DOT_{it} + \alpha_3 FDI_{it} + \alpha_4 CPS_{it} + \alpha_5 Trans\_Inf_{it} + \alpha_6 Inflation_{it} + \alpha_7 Institution_{it} + \vartheta_i + \varepsilon_{it} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

where: ϑ_i is the individual-specific effects of country *i*.

In contrast to FEM, REM operates under the assumption that the time-invariant individual-specific effects are uncorrelated with the explanatory variables, expressed as Cov (Z_{it}, ϑ_i)=0. In such circumstances, REM is deemed more suitable; otherwise, FEM is favored. However, the definitive selection between FEM and REM

[2] In this study, the trading partner region was taking to be Sub-Saharan Africa.

hinges on the Hausman test. The null hypothesis posited in the Hausman test suggests that the preferred model is REM, whereas the alternative hypothesis proposes that the preferred model is FEM.

2.2. Dynamic Estimator

Although analysis of results will be primarily based on the Fixed effect estimator, often, Static, and dynamic models are used to cross-validate findings (Nathaniel *et al.* 2020; Khadraoui and Smida, 2012). This helps to enhance the robustness and reliability of results. In this study, a System Generalised Method of Moments (GMM) dynamic estimator was employed. The methodology relies on moment conditions derived from the first-differenced equation and the levels equation (Arellano and Bover, 1995; Blundell and Bond, 1998), allowing for efficient estimation of the parameters while controlling for unobserved heterogeneity and autocorrelation in the data. System GMM extends the basic GMM framework by instrumenting lagged levels of endogenous variables with lagged differences to capture both the short-run and long-run effects in dynamic panel models. The estimation process of System GMM involves two main steps: first, the system is differenced to eliminate individual-specific effects, and second, lagged levels are used as instruments to address endogeneity.

To implement System GMM, several diagnostic tests are commonly conducted to assess the validity of the model assumptions and the reliability of the estimates. These tests include testing for the presence of serial correlation, instrument validity, and over-identifying restrictions. Accordingly, and as suggested by Arellano and Bover (1995) and Blundell and Bond (1998), over-identification restriction was tested using both the Sargan test and Hansen statistic, which are test on the null hypotheses of instrument validity. For instruments to be valid, the null hypothesis must not be rejected. Additionally, the assumption that the error term is not serially correlated is also tested using first-order (AR1) and second-order (AR2) serial correlation. To meet this assumption, the null hypothesis of no-autocorrelation for AR1 must be rejected while that of AR2 must not be rejected.

Summary of data description is provided in Table 1.

Table 1. Variable Description

Variable	Source	Measure
RGDP	UNCTAD	Annual growth rate
Transportation infrastructure	UNCTAD	scale of 1 (worst) to 100 (best)
Institutions	UNCTAD	scale of 1 (worst) to 100 (best)
Inflation	UNCTAD	Annual average growth
Foreign Direct Investment	World Bank – WDI	FDI inflows (% GDP)
Domestic credit to private sector	World Bank – WDI	Domestic credit to private sector (%GDP)
Trade Openness	UNCTAD	Sum of export and import as a share of GDP
Direction of Trade	IMF	Goods, value of imports, cost insurance, freight (US dollars)

Source: Authors computation

3. Results and Discussion

3.1. Descriptive Statistics

The summary statistics reveal across several key indicators is presented in Table 2. The statistics provide insights into the central tendency, variability, and range of each variable in the dataset. Real Gross Domestic Product (RGDP) exhibits moderate variability, with a mean of 4.50 and a standard deviation of 3.94, showcasing a wide range of values from -20.49 to 21.08. Inflation rates are notably volatile, ranging from -3.23% to 34.70%, with a mean of 5.97 and a standard deviation of 6.31. Foreign Direct Investment (FDI) demonstrates considerable variability, with a mean of 5.01 and a standard deviation of 10.59, spanning from -2.79 to 103.34. Domestic credit to private sector (CPS) reveals moderate variability, ranging from 0.00 to 66.39, with a mean of 16.77 and a standard deviation of 12.79. Trade openness, Direction of Trade (DOT), transportation infrastructure, and institutional quality also display substantial variability across observations.

Table 2. Summary Statistics

Variable	Obs	Mean	Std. dev.	Min	Max
RGDP	270.00	4.50	3.94	-20.49	21.08
Inflation	270.00	5.97	6.31	-3.23	34.70
FDI	270.00	5.01	10.59	-2.79	103.34
CPS	266.00	16.77	12.79	0.00	66.39
Trade_Openess	269.00	63.26	32.52	21.12	270.62
DOT	270.00	455.49	1469.04	-976.76	7707.63
Trans_inf	270.00	24.30	13.80	1.10	61.50
Institution	270.00	42.07	10.55	22.10	69.00

Source: Authors Computation

3.2. Presentation of Empirical Findings

Table 3 presents three sets of static estimation outcomes for empirical scrutiny and discussion. These encompass the entire sample period (2005-2022) and are further divided into pre (2005-2006) and post (2008-2022) Global Financial Crisis (GFC) sub-samples. Utilizing Hausman test statistics for our analysis, the Fixed Effect estimator was identified as the most apt and efficient method for analysing both the Full Sample and the period following the Global Financial Crisis (GFC), while the Random Effect model was found to be more suitable for the Pre-GFC period. It's notable that during the Pre-GFC analysis, only the “Institution” variable displayed significant positive effects on economic growth, underscoring the differential impact of institutional quality in varied temporal contexts. Each estimation considered country-specific effects, effectively addressing potential issues of cross-sectional independence. When comparing the results, findings from the full sample closely aligned with those observed in the Post-GFC period, both in direction and significance. However, the Pre-GFC period displayed distinct results, potentially attributable to a significant reduction in sample size, thus impacting the statistical power of the analysis.

Referenced in Section 3, a System GMM estimation was applied to the entire dataset to corroborate the findings obtained from the Fixed Effect estimator. The outcomes of this ancillary analysis are documented in Appendix 1. The robustness and validity of these results are supported by the acceptance of the Sargan and Hansen tests, alongside the rejection of the AR(1) test for autocorrelation and acceptance of the AR(2) test, indicating no second-order autocorrelation and thus employing a lag instrument of 14, which falls below the number of cross-sectional units. Any deviations from these test outcomes could indicate potential specification bias. Analogous to the Post-GFC observations, the System GMM results consistently underpin the inferences made from the Fixed Effect model.

However, it's crucial to acknowledge that GMM estimators may yield suboptimal performances with smaller sample sizes due to their reliance on asymptotic properties, which may not be fully applicable in such scenarios, potentially leading to biased or imprecise estimates. Given our cross-sectional unit count is 15, and it is generally recommended to employ GMM for cross-sectional units exceeding 25, our findings utilizing System GMM may not hold valid, prompting our preference for the Fixed Effect model post-Hausman test application. The Fixed Effect model excels by accounting for unobserved heterogeneity that is constant over time but varies across the 15 selected countries. Furthermore, this model does not necessitate the use of instruments to control for unobserved heterogeneity, relying instead on within-entity changes—a significant advantage when suitable instruments are scarce or challenging to justify.

Table 3. Full Sample (2005- 2022) Pre_ GFC (2005- 2006) and Post_GFC (2008-2022) for RGDP in the 15 ECOWAS Countries

	RGDP			RGDP_Post GFC			RGDP_Pre GFC		
VARIABLES	**POLS**	**FE**	**RE**	**POLS**	**FE**	**RE**	**POLS**	**FE**	**RE**
Inflation	-0.0815*	-0.0302	-0.0817*	-0.147***	-0.0625	-0.145***	0.089	0.0139	0.0834
	(0.0423)	(0.0577)	(0.0437)	(0.0519)	(0.0688)	(0.0523)	(0.0698)	(0.247)	(0.0847)
FDI	0.0448*	0.0747***	0.0482**	0.0377	0.0695**	0.0391	-0.346	-0.209	-0.229
	(0.024)	(0.0257)	(0.0241)	(0.0256)	(0.0275)	(0.0257)	(0.282)	(0.562)	(0.318)
CPS	-0.0605**	-0.122**	-0.0654**	-0.0742**	-0.158*	-0.0749**	-0.0603	0.0518	-0.0608
	(0.0282)	(0.0615)	(0.0297)	(0.0323)	(0.0823)	(0.0329)	(0.0973)	(0.386)	(0.123)
Trade_Openness	0.0218**	0.0417***	0.0234***	0.0309**	0.0490***	0.0312**	0.0315**	-0.0109	0.0261
	(0.00857)	(0.0112)	(0.00876)	(0.0124)	(0.0152)	(0.0124)	(0.0147)	(0.0759)	(0.0179)
DOT	0.000442***	0.000592*	0.000464***	0.000505***	0.000632*	0.000507***	0.00122	-0.00189	0.000984
	(0.000169)	(0.00031)	(0.00018)	(0.000184)	(0.00034)	(0.000187)	(0.00071)	(0.0033)	(0.0009)
Trans_inf	-0.0404**	-0.0862	-0.0415*	-0.0552**	-0.118*	-0.0558**	0.0294	0.569	0.023
	(0.02)	(0.0552)	(0.0214)	(0.0228)	(0.0601)	(0.0233)	(0.0515)	-1.44	(0.0679)
Institution	0.0677**	0.253***	0.0748**	0.049	0.273***	0.0505	0.229**	0.499	0.230**
	(0.0301)	(0.0711)	(0.0323)	(0.0349)	(0.0935)	(0.0357)	(0.0845)	(0.341)	(0.103)
Constant	2.322*	-5.101	2.005	3.525**	4.815	3.448**	-7.219*	-30.62	-7.035
	(1.217)	(3.679)	(1.32)	(1.36)	(4.727)	(1.397)	(3.818)	(37.13)	(4.69)
Observations	266	266	266	221	221	221	30	30	30
R-squared	0.097	0.152		0.121	0.165		0.372	0.378	
country effect	NO	YES	YES	NO	YES	YES	NO	YES	YES
date effect	NO	NO	NO	NO	NO	NO	NO	NO	NO
rmse	3.822	3.723	3.798	3.893	3.8	3.885	2.82	1.937	1.767
F-test	3.947***	6.246***		4.174***	5.604***		1.862	0.694	
Number of CrossID		15	15		15	15		15	15
F-test(u_i=0)		1.984**			1.757**			2.761*	
chi-squared			28.68***			29.19***			8.206
chi-squared (u_i=0)			0			0.1			3.84**
HausmanTest[Chi-Square]			17.62**			33.55***			3.24

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. (Source: Authors computation)

The results in Table 3 reveal a divergent impact of regional trade, financial inclusion measures, and other factors on economic growth across different time periods. Specifically, findings from the full sample and post-GFC periods indicate a positive effect of regional trade, measured by Trade openness and the Direction of Trade (DOT), on economic growth. Conversely, the pre-GFC period exhibits an opposite and statistically insignificant relationship. All else equal, on average a percentage increase in Trade openness increases economic growth by 0.042% and 0.049% in the full sample and post-GFC respectively. In terms of DOT, on average a percentage point increase leads to a 0.001% increase in economic growth in both the full sample and post-GFC ceteris paribus.

Regarding financial inclusion, the results are mixed based on the measure. For Foreign Direct Investment (FDI), a statistically significant positive association is observed in both the full sample and post-GFC periods, while a contrasting negative relationship is evident in the pre-GFC period. The results revealed that a one percentage point increase in FDI for both the full and post-GFC samples, economic growth increases by 0.075% and 0.070% respectively, having other factors held constant. Similarly, Domestic credit to private sector (CPS) shows a statistically significant negative association in the full sample and post-GFC periods, but a positive relationship in the pre-GFC period. A one percentage point increase in CPS for both the full and post-GFC samples, economic growth decreases by 0.122% and 0.158% respectively, all else constant.

Inflation and transportation infrastructure, however, do not demonstrate any statistically significant associations with economic growth across all estimated samples. Notably, institutional quality shows a consistent positive and statistically significant association with economic growth in both the full sample and post-GFC sub-sample. The results showed that holding other factors constant, on average, a unit point increase in institutional quality increases economic growth by 0.253% and 0.273% for the full sample and post-GFC sample.

3.3. Discussion, Implications and Relevance to Economic Growth

The finding that increased trade between ECOWAS member countries would accelerate economic growth highlights the critical role of regional trade integration in fostering economic development within the West African region. Accepting the open trade policies within the ECOWAS is very important for removing trade barriers, fostering economic integration, and enhancing productivity growth. Supported by earlier studies (Ogbebor and Ohiomu, 2018; Olayemi and Fajimolu, 2023), this evidence highlights the necessity for policymakers to focus on trade liberalisation and introduce supporting policies. Such measures will seamlessly accommodate an environment conducive to continuous economic growth and widespread prosperity among its members nations.

Overall, the strong positive correlation between Foreign Direct Investment (FDI) and economic growth strongly suggests the need for policies that attract and facilitate foreign direct investment to sustain growth. Bekoe *et al.* 2021 and many other studies have all indicated that FDI inflows are crucial catalyst for economic expansion, trigger and enhance job creation, technology transfer and productivity within recipient economies. This also aligns with findings from Ogbebor and Ohiomu 2018. However, the findings from our own study unexpectedly identify a negative impact of Credit to the Private Sector (CPS) on economic growth. The outcome of this research will serve as a catalyst for policymakers to meticulously assess the quality, allocation, and supervision of domestic credit to guarantee its beneficial impact on the economic growth of ECOWAS countries. If domestic credit is solely used for consumption or channeled towards unproductive sectors, it may not effectively contribute to long-term economic prosperity. In addition to, such obstacles such as inadequate banking regulations, elevated interest rates and high levels of non-performing loans (NPLs) can undermine the potential of domestic credit to spur economic growth.

Furthermore, our analysis reveals that the impact of financial inclusions on economic growth significantly varies depending on the specific measured used.

Additionally, the data underscores that enhanced institutional quality is curtail for growth indicating the need for policymakers to focus on institutional reforms that strengthen governance and improve institutional resilience and effectiveness. The well-established institutions reduce risks, lower transaction costs, boost market efficiency, facilitate a better resource allocation and productivity and growth (Ragmoun, 2023). In the same vein a robust institution marked by transparent governance, strong rule of law, protected property rights, and efficient public services foster an environment that supports investment, innovation, and broader economic activities.

4. Conclusion

4.1. Summary of Key Findings n Relation to the Research Gap

This research has prudently tried to address the identified gap in the complex interaction between regional trade, financial mobilisation, and economic growth within the ECOWAS. Through the integration of the all-

inclusive analyses of the regional trade dynamics and financial mobilisation strategies, this study has focused on how these elements jointly influenced the economic prosperity of ECOWAS member states. The findings revealed that enhanced trade openness and directional trade positively affect economic growth, drawing attention to the pivotal role of intra-regional trade in facilitating economic growth.

In addition, the effect of FDI is proven to be significantly positive, emphasising its importance as a key driver of economic expansion through capital inflow, technology transfer, and job creation. Astoundingly, the study also discovers a negative association between CPS and economic growth, implying slackness in financial mobilisation mechanisms that can likely limit their contribution to economic development. The study's outcome further confirms a positive correlation between institutional quality and economic growth, implying the crucial role of robust governance structure in improving economic performance.

In a nutshell, these findings certainly address the research objectives by making clear the means through which regional trade and financial mobilisation contribute to economic growth, thereby satisfying the earlier identified research gap and offering a clear understanding of the economic dynamics within ECOWAS.

4.2. Implications for Policymakers and Stakeholders

The findings of this study carry significant implications for policymakers and stakeholders within the ECOWAS region. Firstly, the positive impact of trade openness and directional trade on economic growth underscores the necessity of advancing policies that foster trade liberalisation and regional integration. Policymakers are encouraged to remove trade barriers, streamline customs procedures, and promote infrastructure development to facilitate easier movement of goods and services across borders. Secondly, the beneficial role of FDI in economic development highlights the importance of creating a conducive investment climate through policy stability, legal certainty, and efficient administrative processes. The negative association found between CPS and economic growth calls for a re-evaluation of financial sector policies to ensure that credit is efficiently allocated to productive sectors of the economy, enhancing financial inclusion, and supporting sustainable development. Moreover, the significance of institutional quality in driving economic growth underscores the need for ongoing reforms aimed at strengthening governance, enhancing transparency, and combating corruption. For stakeholders, including investors, businesses, and development agencies, these findings provide valuable insights for strategic decision-making, investment planning, and program development aimed at capitalizing on the growth opportunities within the ECOWAS region.

4.3. Suggestions for Future Research

Future research should extend the insights of this study by investigating various key areas to understand and enhance the economic development within the ECOWAS region and potentially, beyond. The suggestions include:

- **Longitudinal studies**: There's a significant need for research that monitors the changing impacts of regional trade and financial mobilisation over time, especially considering an evolving economic landscape and potential external shocks like global financial crises.
- **Micro-level impacts**: Investigating the specific effects of trade and financial policies on individual sectors within ECOWAS member states could yield deeper understanding of economic growth drivers and inform sector-specific strategies.
- **Digital technologies**: Exploring how digital technologies can improve trade facilitation and financial inclusion is crucial, given the growing importance of the digital economy in regional and global markets – highlight of this was recently explored by Jalloh and Jackson (2023), which relates to Domestic Resource Mobilisation (DRM).
- **Comparative studies**: Conducting comparisons with other regional blocs could reveal valuable insights and effective practices in regional trade facilitation, financial mobilisation, and economic integration.

These areas of focus promise not only to enrich academic discourse but also to provide actionable insights for policymakers and stakeholders working towards economic advancement in the region.

Credit Authorship Contribution Statement

Authors have contributed equally to this research.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Declaration of Use of Generative AI and AI-Assisted Technologies

The authors declare that they have not used generative AI and AI-assisted technologies during the preparation of this work.

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Appendices

Appendix 1: System GMM

VARIABLES	(1) SGMM1	(2) SGMM1-CL-a	(3) SGMM2	(4) SGMM2-CL-b	(5) SGMM2-CL-a
L.RGDP	0.0912*	0.179***	0.0632	0.237	0.175**
	(0.0495)	(0.0667)	(0)	(0.230)	(0.0681)
Inflation	-0.0953**	-0.0616	-0.0755	-0.0541	-0.0501
	(0.0409)	(0.0377)	(0)	(0.0454)	(0.0664)
FDI	0.0383***	0.0346***	0.0370	0.0384***	0.0345**
	(0.0123)	(0.00761)	(0)	(0.0130)	(0.0146)
CPS	-0.0645**	-0.0826**	-0.103	-0.0457	-0.0848**
	(0.0308)	(0.0396)	(0)	(0.0290)	(0.0367)
Trade_Openness	0.0235***	0.0277**	0.0276	0.0256*	0.0373*
	(0.00677)	(0.0113)	(0)	(0.0145)	(0.0224)
DOT	0.000453***	0.000354***	0.000598	0.000304**	0.000343***
	(0.000125)	(6.02e-05)	(0)	(0.000120)	(8.46e-05)
Trans_inf	-0.0355***	-0.0362***	-0.00859	-0.0350	-0.0293**
	(0.00829)	(0.0121)	(0)	(0.0229)	(0.0130)
Institution	0.0595**	0.0769**	0.180	0.0373*	0.0674**
	(0.0297)	(0.0370)	(0)	(0.0222)	(0.0316)
Constant	2.232***	1.037	-3.511	1.919*	0.703
	(0.860)	(1.274)	(0)	(1.059)	(1.172)
Observations	251	251	251	251	251
Number of CrossID	15	15	15	15	15
country effect	YES	YES	YES	YES	YES
date effect	NO	NO	NO	NO	NO
Hansen_test	11.60	8.172	11.60	4.745	8.172
Hansen Prob	1	0.147	1	0.191	0.147
Sargan_test	215.9	5.630	215.9	16.20	5.630
Sargan Prob	0.000229	0.344	0.000229	0.00103	0.344
AR(1)_test	-2.913	-2.432	-2.028	-1.832	-2.492
AR(1)_P-value	0.00358	0.0150	0.0426	0.0669	0.0127
AR(2)_test	-0.776	-0.524	-0.692	-0.197	-0.435
AR(2)_P-value	0.438	0.600	0.489	0.844	0.663
No. of Instruments	157	14	157	12	14

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
SGMM1 and SGMM2 denote One-Step and Two-Step GMM respectively. Also
Regressions with suffix CL follow Roodman(2009b
and collapse the instrument matrix. a and b denote lag(1 5
and lag(2 4
respectively.

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Digital Content Marketing in Brand Management of Small Business Enterprises, Trading Companies and Territorial Marketing

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Abstract: Purpose: The research aims at a practical evaluation of the influence of digital content marketing in the system of brand management on the examples of small businesses, trading companies and territorial marketing.

Methodology: To achieve the aim, the See-Think-Do-Care strategy was used, and a matrix of correlation of digital content and the object of realisation of digital content marketing in brand management was developed. Mathematical methods such as correlation analysis and regression analysis were used as well.

Findings: The results of the study demonstrated that the type of digital content management is affected by the size and activity kind of the company, enterprise or organisation, which proves the necessity for diverse digital content. Correlation analysis enabled the proof of a tight correlation (0,98) between digital content marketing and brand management. A parameter indicating the influence of digital content marketing, was found to be expenses for digital content marketing. The parameter, illustrating the efficiency of brand management for small businesses and trading companies was determined to

be average annual income, and for territorial marketing - number of tourists per year. Three types of models were built to determine the quantitative influence of digital marketing on brand management. The results of Model 1 have the most significant effect as the influence of digital content marketing on income increase, and thus, brand development amounts to from 8324 USD to 13571 USD. While talking about Model 2, income increase fluctuates from 3030 USD to 3600 USD per year. Evaluation results on Model 3 illustrate the insignificant influence of digital content marketing on income and brand management.

Originality: In further studies, it is proposed to divide small businesses based on activity kinds and study digital content marketing in brand management depending on activity kinds.

Keywords: digital content marketing; correlation; regression; see-think-do-care strategy; expenses; digital advertising.

JEL Classification: M00; C01; M30.

Introduction

Relevance

The modern entrepreneurial environment is becoming more and more digital, which is reflected in digital technology distributions in the sphere of business and marketing. Digital branding becomes an important direction for enterprises as it helps to improve brand recognisability and image, enhance customer loyalty and increase the efficiency of the activity of a company. Using digital resources, customers can independently find information about products and services, compare their characteristics and prices, as well as find reviews and recommendations from other users (Salonen *et al.* 2024). The development of digital marketing is an essential aspect of modern business. This process is characterised by permanent changes and a rapid pace of development, which requires permanent studying and analysis. For enterprises conducting their activity in conditions of the modern market, the development of strategies of digital content marketing is essential to increase the efficiency of their commercial activity (Arivazhagan *et al.* 2023).

One of the key advantages of digital marketing is the possibility to accurately target advertising messages to the target audience (Byelikova *et al.* 2024). Due to the use of digital platforms and instruments, companies can develop personalised advertising campaigns, which will engage more customers and increase conversion. Moreover, digital content marketing enables measuring campaign effectiveness in real-time, which enables operative strategy correction to achieve better results (Berezovska and Kyrychenko 2023).

With the use of digital content marketing, a brand can deliver its messages to the target audience faster and more accurately, which contributes to the formation of long-term relations with customers (Al-Sherman 2024). For the successful development of digital content marketing, companies should systematise various instruments and establish interrelations between objectives and tasks of branding and digital instruments to achieve success in a long-term perspective.

As an object, a brand exists due to sustainable components and conditions, as well as very dynamic elements (Veloutsou and Delgado-Ballester 2018). This dichotomous approach enables a brand to stay known and recognized for a long period, but at the same time to adapt to market changes and customer desires. Therefore, traditional approaches to marketing gradually lose their relevance in modern conditions.

Increased competition and limited purchasing power in the market require companies to make radical changes in their marketing strategies. Considering the increasing number of Internet users and the pace of mobile technology development, digital marketing has become a key instrument in increasing the efficiency of commercial activity and brand management. Therefore, a rusty first year of work demands companies to engage not only in support of relevant digital technologies but also in the correct approach to business development. Such an approach should combine both the passion and vision of the entrepreneur, as well as specific strategic steps in digital marketing.

A detailed study of this sphere will enable enterprises to preserve stable sales volume, marginality and income in the modern conditions of market competition.

Unconcealed Questions

Our study considers the influence of digital content marketing on brand management of three groups of objects - small business enterprises, trading companies, as well as territorial marketing. The development of digital content marketing has raised new challenges for companies. The change in algorithms of search engines, increasing competition in the online space and changing consumer preferences require constant analysis and updating of marketing strategies. Hence, it is important to consider ethical aspects of digital marketing such as the protection of the personal data of customers and the responsible use of advertising technologies (Dubovyk *et al.* 2022).

These three objects equally use common methods of creating digital content. However, the issues of evaluation of the influence of digital content marketing, in particular in brand management depending on the size and type of the activity of the study object remain unconcealed. Herewith, there is no analysis of the distribution of digital content according to the See-Think-Do-Care strategy from the position of companies and territorial marketing. Thus, the development of digital content marketing requires constant study and analysis with the purpose of developing effective strategies in the brand management of companies.

Purpose

The research aim is a practical evaluation of the influence of digital content marketing in the system of brand management on the example of small business enterprises, trading companies, and territorial marketing.

Tasks /Questions

To achieve this purpose, the following tasks were set:

- to determine differences in digital content marketing in brand management of small business enterprises, trading companies and territorial marketing
- to evaluate the presence of interrelation between digital content marketing in brand management of companies;
- to analyse the quantitative influence of expenses on digital content marketing in brand management of small business enterprises, trading companies and territorial marketing.

1. Literature Review

While considering territorial marketing, attention should be given to the size of the city or region, which plays a key role in brand management. The larger coverage is usually an indication of the larger variety of resources, which makes them more attractive to various target groups (Cudny 2019). Smaller cities compete with each other on the local level. Small municipalities can copy the marketing methods of large cities, but instead of copying, the best option is to make marketing strategic and comprehensive, involving all, in particular, local instruments (Confetto *et al.* 2023). The mentioned scientists studied the phenomena of territorial marketing on the basis of modelling and adaptation of digital marketing strategies of large cities for small municipalities. In this relation, the appropriateness of such adaptation requires additional research.

The other study question was the issue of brand management. Many responses, some of which relate to the purpose and philosophy of an entrepreneur, were provided. The other - is pragmatic solutions, such as brand creation and development of the digital marketing strategy (Barrett *et al.* 2015), Aminova and Marchi (2021), Rafiq *et al.* (2021). Thus, researchers considered universal strategies of brand creation and development of the digital marketing strategy. Within this context, the structure of digital content for enterprises of a specific type and size was left without attention. Sakas *et al.* (2023), who indicated the importance of digitalization (Hörner 2023) and online markets, tried to solve this issue. Online markets are new challenges and become especially important in the logistics operations sector for both businesses and organisations. Thus, based on the statistical modelling the strategy of digital content for logistic companies is described. They influence traditional frameworks, corporate structures and industry boundaries. The researchers concluded on the necessity of active content marketing strategy during the first year of logistic company functioning. At the same time, this conclusion may be considered to be the main limitation of the study.

Xiuli and Xue (2024) analysed the influence of digital economics on e-commerce companies. They study the transformation of digital economics in marketing mode to further advance the reform of marketing strategy for e-commerce companies. The researchers offer improvement of the marketing strategy of e-commerce companies in digital economics using a genetic algorithm. Compared to the current marketing strategy of e-commerce companies, the marketing strategy of e-commerce companies, developed using a genetic algorithm, was more sophisticated.

Chandy *et al.* (2021) indicate that companies and their corporate brands undergo pressure from numerous stakeholders, who require them to take wider liabilities beyond profit. This led to a change in the competitive environment in different fields, including within the context of business-to-business (B2B). Iglesias *et al.* (2023) present and test hypotheses on the presence of four interrelated factors that contribute to these changes.

Business customers more frequently require sustainable and responsible solutions, which include, for example, search for more sustainable supply chains (Brindley and Oxborrow 2014) and packaging (Keränen *et al.* 2021). At the same time, employees encourage their organisations to more conscientious approaches to doing business (Girschik 2020). Based on the substantiated surveys, the authors study the potential of internal activists

to transform their companies, which stems from their unique boundary position. In such a situation, company activists can be mediators between foreign stakeholders and internal policy. However, attention should be also given to the level of competence development and the stage of the company's life cycle (Gruzina *et al.* 2024). Such a focus enables effective work with the company's activists and will expand the study area.

For example, in recent years Google faced pressing pressure from employees concerning managing the issues of inequality, diversity and transparency. Many start-ups arise in the B2B sphere, and they change the method of work of traditional players, creating valuable offers, which are based on ethics, sustainability and responsibility (Ćorić *et al.* 2020). Within this context, modern start-ups which appear on the market take dominating positions in the development of digital economics in general, and digital content marketing in particular.

Analysed studies only partially cover the questions of our study in the area of territorial marketing, formation of digital content marketing and brand management. This encourages and stipulates conducting our study and determining the role of digital content marketing in brand management.

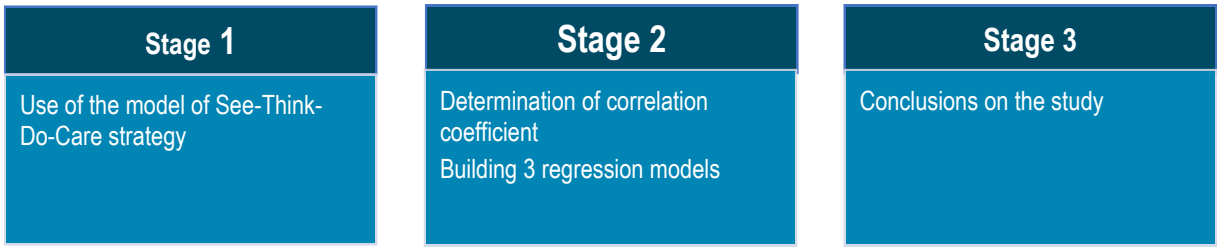
2. Methods

2.1. Study Procedure

The study procedure involves three stages. 1 stage - determination of correlation of digital content and object of realisation of digital content marketing in brand management. 2 stage - evaluation of the influence of digital content marketing on brand management by small business enterprises, trading companies and territorial marketing. 3 stages involve summarising the results of the study.

The scheme of the study is presented in Figure 1.

Figure 1. Study Procedure



Source: graphed by the author

2.2. Sample Formation

The sample included enterprises from five countries: Canada, USA, Great Britain, Germany and Australia. These five countries were selected for the study as they are leaders in the amount of expenses for the development of digital economics and digital content globally. The limitation of the study is the selection of only one small business enterprise, one territorial company and one territorial marketing company in every country. Such a sample was formed to analyse the role of digital content marketing on the specific examples and compare the results in relation to the activity type of the company and its size. To form the sample, the annual income of one small business enterprise in 2017-2023 in Canada, the USA, Great Britain, Germany, and Australia, was used as an increase in the company's income is the main indicator of brand success. The key factor, demonstrating the efficiency of territorial marketing, is the number of tourists who visited a certain region in Canada, the USA, Great Britain, Germany, and Australia in 2017-2023. The indicator illustrating the efficiency of digital content marketing use is the average annual expenses on digital content marketing. The collection of data on the analysis of digital instruments by companies was conducted based on marketing budgets and the structure of expenses on brand management. The data were taken from STATISTS (https://www.statista.com/aboutus/) and presented in Table 1.

Table 1. Sample for Analysis

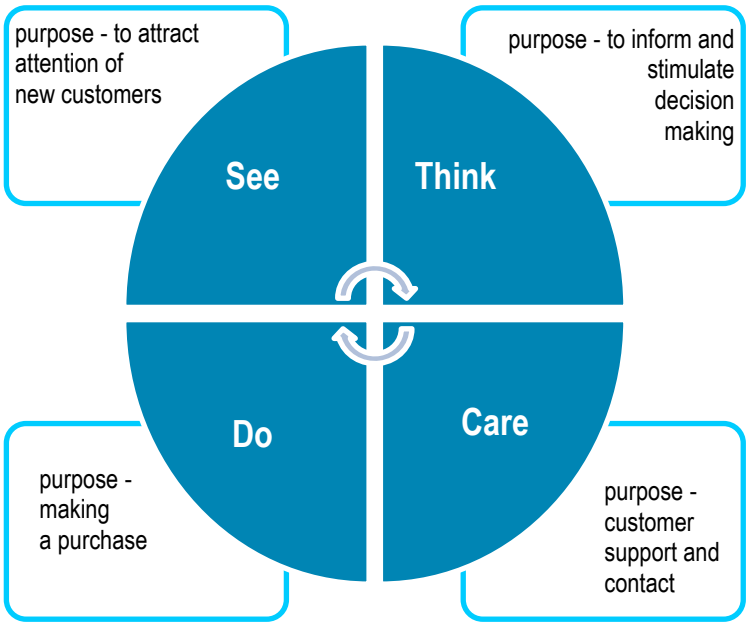
Name of company, country of registration	Annual income, USD							Average annual expenses on digital content marketing, USD						
	2017	2018	2019	2020	2021	2022	2023	2017	2018	2019	2020	2021	2022	2023
ProCogia, Canada	224400	235171	245284	224400	235171	245284	224400	2395	2510	2618	2395	2510	2618	2395
DocuShield, USA	217111	230572	245559	217111	230572	245559	217111	1600	1699	1809	1600	1699	1809	1600
Rotageek, Great Britain	180000	187020	199737	180000	187020	199737	180000	1875	1948	2080	1875	1948	2080	1875
Fabrikatör Virtual Head of Operations, Germany	162000	165888	172192	162000	165888	172192	162000	1946	1993	2068	1946	1993	2068	1946
Cynch Security, Australia	200000	207400	214037	200000	207400	214037	200000	2131	2210	2281	2131	2210	2281	2131
Encircled, Canada	680000	712640	743284	680000	712640	743284	680000	7611	7977	8320	7611	7977	8320	7611
Agri Produce, USA	657912	698703	744118	657912	698703	744118	657912	7200	7646	8143	7200	7646	8143	7200
Exactair, Great Britain	600000	623400	665791	600000	623400	665791	600000	7500	7792	8322	7500	7792	8322	7500
CECONOMY AG, Germany	585000	599040	621804	585000	599040	621804	585000	6622	6781	7038	6622	6781	7038	6622
Bravo Charlie, Australia	720000	746640	770532	720000	746640	770532	720000	6774	7025	7249	6774	7025	7249	6774
Name of company, country of registration	Annual income, USD							Number of tourists, who visited specific region, mln.ppl						
	2017	2018	2019	2020	2021	2022	2023	2017	2018	2019	2020	2021	2022	2023
Expedia Source, Canada	234685	245950	256526	234685	245950	256526	234685	5.9	6.1	6.4	5.9	6.1	6.4	5.9
Kind Traveler, PBC, USA	345600	367027	390884	345600	367027	390884	345600	8.3	8.8	9.4	8.3	8.8	9.4	8.3
Streetours, Great Britain	225000	233775	249672	225000	233775	249672	225000	6.1	6.3	6.8	6.1	6.3	6.8	6.1
Tourlane, Germany	233564	239170	248258	233564	239170	248258	233564	3.9	4.0	4.1	3.9	4.0	4.1	3.9
Local Tourism Network, Australia	208870	216598	223529	208870	216598	223529	208870	2.8	2.9	3.0	2.8	2.9	3.0	2.8

Source: based on Statista (2024)

2.3. Methods

In the first stage, objective of digital content-marketing is the analysis on the basis the of See Think Do Care strategy, developed by Avinash Kaushik (Pushon, 2023), presented in Figure 2.

Figure 2. Graphic Presentation of See-Think-Do-Care Strategy



Source: Pushon (2023)

This strategy enables effective management of interaction with customers at different stages of their way from being unfamiliar to loyalty. Beginning from the stage "See", where the purpose is to attract the attention of new customers and to the stage "Care", where support and developing relations with present customers are important. At the stage "Think" customers are already familiar with the product and consider the possibility of buying it, therefore, it is important to provide them with sufficient information and stimulate decision-making. The "Do" stage reflects the fact of making a purchase, which is the result of successful work at the previous stages. Special attention should be given to the "Care" stage, where support and strengthening relations with customers after purchase are important.

The further stage of the study is the determination of the presence of correlation between the dependent variable Y and independent variable X on the basis of building three dependency models. The first model - the dependency between the average expense sum on digital content marketing and the average annual income of one small business enterprise. The second model is similar, as average expense sum and average annual income are considered, but those of a trading company. The third model for territorial marketing is developed on the basis of the determination of the presence of a correlation between average expenses on digital content marketing and the number of tourists in the region. Generally, correlation is calculated according to the formula (Shrestha 2020):

$$r = \frac{n(\sum XY) - (\sum X)(\sum Y)}{\sqrt{(n\sum X^2 - (\sum X)^2)\,(n\sum Y^2 - (\sum Y)^2)}}, \quad (1)$$

where X - an average expense cum on digital content marketing, USD

Y (for models 1 and 2) - average annual income, USD

Y (for model 3) - number of tourists in the region, thousand people

The third stage of the study is building models of linear regression to determine the level of influence of expenses on digital content marketing on the increase in trust in the brand (Tanni *et al.* 2020):

$$Y = \beta 0 + \beta 1X \quad (2)$$

when the value of X is equal to zero, the value of Y is β0 (the line intersection), and β1 is the slope, which gives us information about the magnitude and direction of the relationship between X and Y, similar to a correlation coefficient. When β1 = 0, there is no relation between X and Y. When β1 > 0 or β1 < 0, the relationship between X and Y is positive or negative, respectively. Important assumptions of linear regression are normality and linearity of the outcome variable, independence between the two variables, and equal variance of the outcome variable along the regression line.

3. Results

At the first stage, it is offered to consider the main channels of digital content marketing on the basis of the See-Think-Do-Care strategy in brand management. According to the offered strategy, the matrix was built according to digital content marketing type and object of realisation of digital content marketing (Table 2)

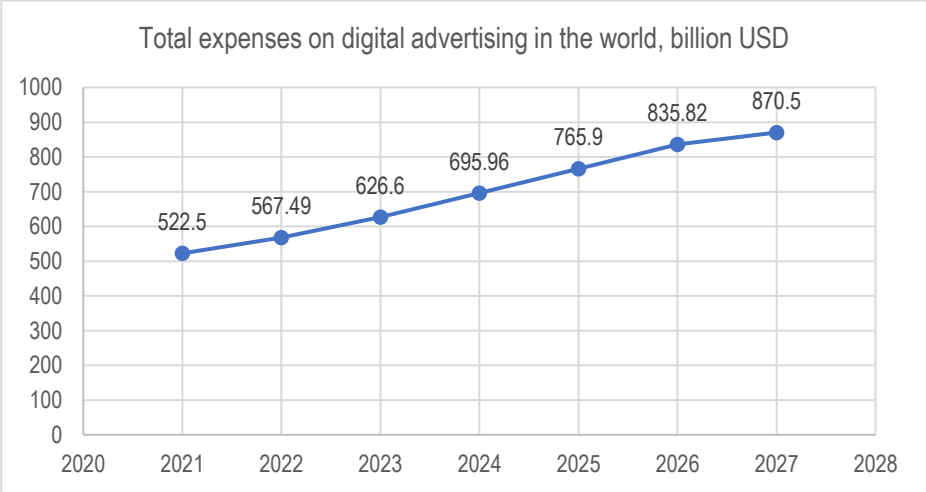
Table 2. Matrix of Correlation of Digital Content and Object of Realisation of Digital Content Marketing in Brand Management.

	Small business	Trading company	Territorial marketing
See	Digital video content, posting, and visual support in social networks (TikTok, Instagram, Facebook)	Digital video content, posting, visual support in social networks (TikTok, Instagram, Facebook); full-fledged reviews on Youtube; implementation of SEO strategies; PPC	Digital video content, posting, visual support in social networks (TikTok, Instagram, Facebook); full-fledged reviews on Youtube; implementation of SEO strategies; organic search
Think	Digital content presented in social networks by bloggers (up to 100K subscribers) and brand followers, high-quality reviews design	Targeted content, PPC, collaboration with bloggers and influencers, organic content, and email marketing	Informational content, reviews of establishments and famous places, YouTube, PPC, online tours and 3D reviews
Do	Visual photo content and text description of the product for marketplaces (Amazon)	Digital content based on affiliate marketing, PPC, visual photo content and text description of the product for marketplaces (Amazon); own online store with SEO support	Landing page with a clear interface and contacts, YouTube, own information site with SOE support, online directory
Care	Digital content is transformed into a permanent Customer Service; development of special offers for regular customers (discounts, promotions, bonuses, cashback)	Digital content is transformed into a permanent Customer Service; development of special offers for regular customers (discounts, promotions, bonuses, cashback), PPC, the company's own website, email newsletters	PPC, the company's own website, email newsletters, online directory

Source: developed by authors based on Shrestha (2020)

According to Table 1, different needs in different content arise depending on the size and type of the activity of the company, enterprise or structure. For example, in the case of small businesses, digital content marketing has a much narrower range of required and possible content in brand management due to the lack of significant financial and other resources. Within this context, a trading company has wider possibilities and requires much more diverse digital content.

Figure 3. Total Expenses on Digital Advertising in the World



Source: based on Statista (2024)

At the other stages, the influence of digital content marketing on brand management and development is offered to be calculated. For this, dynamics and forecast of expenses on digital advertising in the world in 2021-2027 will be analysed (Statista 2024) (Figure 3).

Considering the presented data, it is possible to conclude that the volume of funds invested in advertising is growing by an average of 8-9% annually. Considering numbers this is approximately 50 bln USD. This analysis confirms the necessity to study the influence of digital content marketing on brand marketing, as expenses on this digital content rise every year. According to the procedure, the correlation coefficient was calculated in Table 3.

Table 3. Results of Calculation of Correlation Coefficients for 2017-2023.

Name	Small business	Name	Trading company	Name	Territorial marketing
ProCogia, Canada	0.987844	Encircled, Canada	0.999914	Expedia Source, Canada	0.9996
DocuShield, USA	0.986704	Agri Produce, USA	0.998781	Kind Traveler, PBC, USA	0.999344
Rotageek, Great Britain	0.987066	Exactair, Great Britain	0.999142	Streetours, Great Britain	0.999994
Fabrikatör Virtual Head Of Operations, Germany	0.987933	CECONOMY AG, Germany	0.99899	Tourlane, Germany	0.999344
Cynch Security, Australia	0.998601	Bravo Charlie, Australia	0.998601	Local Tourism Network, Australia	0.979994

Source: based on Statista (2024)

Table 4. Input Data for Building Model 1 of the Linear Regression

Years	Small business - Model 1									
	ProCogia, Canada		DocuShield, USA		Rotageek, Great Britain		Fabrikatör Virtual Head Of Operations, Germany		Cynch Security, Australia	
	X, USD	Y, USD	X, USD	Y, USD	X, USD	Y, USD	X, USD	Y, USD	X, USD	Y, USD
2017	20621	193184	12837	174185	15567	149444	17579	146310	19087	179072
2018	21736	203626	13885	188409	16595	159313	18191	151406	19836	186090
2019	22850	214068	14933	202633	17623	169182	18803	156502	20584	193109
2020	23953	224400	16000	217111	18750	180000	19464	162000	21318	200000
2021	25103	235171	16992	230572	19481	187020	19931	165888	22107	207400
2022	26182	245284	18096	245559	20806	199737	20688	172192	22814	214037
2023	26182	245284	19126	259529	21735	208656	21252	176885	23576	221182

Source: based on Statista (2024)

All calculated correlation coefficients have values higher than 0.7. Such results indicate a tight correlation between expenses on digital content marketing and the average annual income of a small business enterprise and trading company. A tight correlation is also observed between expenses on digital content marketing territorial marketing and the number of tourists in a region. Thus, it is possible to conclude that at present time there is a tight direct correlation between digital content marketing and brand management. So, it is possible to state that digital content marketing plays a key role.

The other stage of the study is building three types of models for five countries for 2017-2023 (Table 4).

Model 1 is built based on the assumption that expenses on digital content marketing have a significant influence on the income of a small business enterprise, therefore:

- data on the annual sum of expenses on digital content marketing were defined as independent variable X;
- data on the annual income of a small business enterprise were defined as a dependent variable Y (Table 5).

Table 5. Results of Calculation of Linear Regression for Small Business Enterprises (Model 1).

Country	Small business		
	Regression equation	t-statistics	Correlation coefficient
ProCogia, Canada	y = 9.3689 x -13.6912	21913.471	0.987844269
DocuShield, USA	y = 1.7E-5*x -19.398	27010.49	0.986704277
Rotageek, Great Britain	y = 9.6*x + 3.867	52034.16	0.987065545
Fabrikatör Virtual Head Of Operations, Germany	y = 8.324*x -18.124	16049.46	0.987933246
Cynch Security, Australia	y = 9.382*x -6.496	10328.57	0.998601065

Analysing linear regression results for ProCogia, it is possible to make a conclusion about income rise for 9,40USD in case of an increase of the studies expenses for 1USD. In the case of DocuShield, an increase in expenses on digital content marketing by 1 USD, determines an income increase by 13,52 USD. Rotageek has an analogous situation with a direct dependency between expenses on digital marketing and average annual income (income increase by 9,6 USD). Thus, we have a situation where the income of an enterprise will increase by 9600 USD in case of an increase in expenses for digital content marketing by 1000 USD. Increase of expenses on digital content marketing Fabrikatör Virtual Head of Operations by at least 1 USD, stipulates an increase in average annual income by 8,2 USD, while indicators for Cynch Security are somewhat higher, since an increase in digital marketing expenses by at least $1 leads to an increase in income by $9.82. In general, the results of evaluation according to Model 1 indicate a significant influence of expenses on digital content marketing in brand management of small business enterprises. The significance of the model parameters is determined by the Student's criterion (t-statistics). This calculated parameter is higher (21913,471; 27010,49; 52034,16; 16049,46; 10328,57) than the critical table value, which is equal to 3,163 (Table 6).

Table 6. Input Data for Building Model 2 of the Linear Regression

Years	Trading Company - Model 2									
	Encircled, Canada		Agri Produce, USA		Exactair, Great Britain		CECONOMY AG, Germany		Bravo Charlie, Australia	
	X, USD	Y, USD	X, USD	Y, USD	X, USD	Y, USD	X, USD	Y, USD	X, USD	Y, USD
2017	65529	585407	174185	527832	149444	498148	146310	528341	179072	644659
2018	69070	617049	188409	570935	159313	531044	151406	546743	186090	669925
2019	72612	648691	202633	614038	169182	563939	156502	565144	193109	695192
2020	76117	680000	217111	657912	180000	600000	162000	585000	200000	720000
2021	79771	712640	230572	698703	187020	623400	165888	599040	207400	746640
2022	83201	743284	245559	744118	199737	665791	172192	621804	214037	770532
2023	86780	775258	259529	786450	208656	695522	176885	638751	221182	796257

Source: based on Statista (2024)

Model 2 is also built based on the assumption that expenses on digital content marketing have a significant influence on the income of a trading company, therefore, in the calculation, the annual sum of expenses on digital content marketing is independent variable X, and the annual income of a trading company - dependent variable Y. This is the fundamental difference between Model 1 and Model 2 - the type and size of the enterprise (Table 7).

Evaluation results based on Model 2 for Encircled indicate that in case of increasing expenses on digital marketing by 1000 USD, income increases by 8934 USD. Such a result is not so significant as in the case of small businesses, but we can also observe positive dynamics of the influence of digital content marketing in brand management.

Table 7. Results of Calculation of Linear Regression for Trading Companies (Model 2).

Country	Regression equation	Trading company t-statistics	Correlation coefficient
Encircled, Canada	y = 8.934*x + 7.623	50579.36	0.999913587
Agri Produce, USA	y = 3.03*x -2.578	30303.11	0.998781079
Exactair, Great Britain	y = 3.333*x -1.862	33333.47	0.999142062
CECONOMY AG, Germany	y = 3.611*x -4.939	36111.38	0.998990025
Bravo Charlie, Australia	y = 3.6*x -1.916	36000.1	0.998601065

Source: based on Statista (2024)

Encircled, Exactair, CECONOMY AG and Bravo Charlie also demonstrate positive dynamics in income increase in case of the change of expenses on digital marketing by 1000USD. However, this dynamic is significantly lower than in case of Canada - 3030 USD, 3333 USD, 3611 USD, 3600 USD accordingly (Table 8).

Table 8. Input Data for Building Model 3 of the Linear Regression

Years	Territorial marketing – Model 3									
	Expedia Source, Canada		Kind Traveler, PBC, USA		Streetours, Great Britain		Tourlane, Germany		Local Tourism Network, Australia	
	X, USD	Y, mln ppl	X, USD	Y, mln ppl	X, USD	Y, mln ppl	X, USD	Y, mln ppl	X, USD	Y, mln ppl
2017	202039	5.04	277269	6.66	186806	5.06	210943	3.52	187014	2.51
2018	212959	5.31	299911	7.20	199141	5.40	218290	3.64	194343	2.61
2019	223879	5.58	322553	7.75	211477	5.73	225637	3.77	201673	2.70
2020	234685	5.85	345600	8.30	225000	6.10	233564	3.90	208870	2.80
2021	245950	6.13	367027	8.81	233775	6.34	239170	3.99	216598	2.90
2022	256526	6.39	390884	9.39	249672	6.77	248258	4.15	223529	3.00
2023	267561	6.67	413121	9.92	260821	7.07	255025	4.26	230991	3.10

Source: based on Statista (2024)

Model 3 is built based on the assumption that expenses on digital content marketing have a significant influence on the number of tourists, who visit a specific region of the country. In calculations, independent variable X reflects annual expenses on digital content marketing, while dependent variable Y reflects the number of tourists per year (Table 9).

Table 9. Results of Calculation of Linear Regression for Territorial Marketing (Model 3).

Country	Territorial marketing		
	Regression equation	t-statistics	Correlation coefficient
Expedia Source, Canada	y = 2.5E-5*x + 0.0168	12.563	0.999600156
Kind Traveler, PBC, USA	y = 2.4E-5*x + 0.00271	11.026	0.999343653
Streetours, Great Britain	y = 2.7E-5*x -0.0106	13.27	0.999993799
Tourlane, Germany	y = 1.7E-5*x -0.0297	16.17	0.999343653
Local Tourism Network, Australia	y = 1.3E-5*x + 0.00248	13.12	0.979993799

Source: based on Statista (2024)

Model 3 also illustrates positive results of the relation of expenses on digital content marketing. However, these parameters should be evaluated within the activity of the whole region. Thus, the expenses for territorial marketing in Ontario (Canada) will be increased by 10,000 USD, which will lead to an increase in the number of tourists by 25 thousand people. In case of an increase in expenses in digital content marketing for any state of the USA, the increase in the number of tourists will amount to 24 thousand people. In case of an increase in expenses in digital content marketing in Great Britain, the increase in the number of tourists will amount to 27 thousand people. Somewhat lower results are observed in Germany and Australia. An increase in expenses in digital content marketing by 10,000 USD will provide an increase in the number of tourists to 17 thousand people and 13 thousand people.

Generalising the above-mentioned modelling results, digital content marketing was proven to influence brand management. However, it is worth noting that digital content marketing plays the most significant role for small business enterprises. This can be stipulated by the use of the instruments of digital economics as the key change of brand promotion and development.

In the modern business environment, there is a clear trend towards the implementation of digital marketing tools, which are becoming an integral part of the strategies of successful companies. Conducted research confirms that the use of these tools not only opens up new digital markets, but also affects the increase in sales volume. In turn, this leads to an increase in the total income of the organization. An important aspect is also the fact that modern marketing tools contribute to strengthening the brand and forming a positive image of the company in the market. Such a phenomenon is crucial for creating long-term relationships with consumers and increasing competitiveness.

4. Discussion

The study offers the matrix of correlation of digital content and the object of realisation of digital content marketing in brand management on the basis of the See-Think-Do-Care model. In such a way, we note that types of digital content marketing differ depending on the type of activity and size of the enterprise. The result of such distribution

is building three models of linear regression to evaluate the role of digital content marketing in brand management.

Nowadays, there are many publications (Inkinen *et al.* 2024; Bose *et al.* 2021) on brand development and management for tourist companies. However, they contain generalized findings and the influence of cultural biases in interpretations (Gounder and Cox 2022) due to the experience and context of the researchers. Our study eliminates the influence of cultural prejudice and addresses brand management through the prism of different types of enterprises and territorial marketing. In our study, territorial marketing is considered from the position of tourist brand management. The results of our study offer a review of the current state of expenses for digital content marketing. Despite possible expectations, there are almost no digital branding practices in the field of digital branding in large capitals within the framework of territorial marketing (Confetto *et al.* 2023).

Studies conducted by (Gartner 2020) showed that only 17% of the time of the average business customer is spent on meetings with potential suppliers. Hence, they spend 27% of their time on independent information searches on the Internet. This indicates that buyers have become more independent in the process of decision-making on the purchase and use digital resources to receive necessary information. Therefore, in order to engage modern business-to-business (B2B) buying processes, sellers must provide content that helps target customers complete their tasks at different stages of the buyer's journey. As a result, digital content marketing became a key paradigm in marketing communication in business markets (Terho *et al.* 2022).

Brands strive to maximise the return on investment in marketing campaigns with influencer engagement, including the development of an effective media relations strategy (Audrezet and De Kerviler 2019), which is also covered in our See-Think-Do-Care matrix. However, we considered this issue wider, due to the focus on content types depending on the object, which aims to use digital content marketing.

This study (Syed *et al.* 2023) presents a research approach to understanding how to participate in the marketing of influence. It combines views of representatives of brands and mass media to study methods of management of effective cooperation between brands and mass media. Data variety contributes to understanding the literature on the difficulties of participation in marketing campaigns with influencer engagement. This study reveals the importance of engaging the content of opinion leaders to increase trust in the brand and proves the appropriateness of our analysis.

The other interesting work is the study by Keke (2022), who notes that digital marketing and social networks should be perceived as an inseparable duo. Digital marketing enables companies to promote their products and services using different online platforms. Social media plays a vital role in this process as they allow users to interact with the audience, create interesting content and monitor user reactions. Digital marketing campaigns help to increase brand awareness, attract new customers and boost sales. Our studies confirm such conclusions.

The main difference between our study and those available is our attempt to calculate the role of digital content marketing in brand management. Herewith, an analysis of companies different in activity types and size was considered in our study.

The research work (Niyas and Kavida 2023) calculates the value of the brand within the context of India. The current relationship between brand value and profitability was tested using a panel data regression model with control variables in the model. We believe that such evaluation characterises the influence of digital c] on brand value insufficiently. In such a case, combining our study and the research (Niyas and Kavida 2023) illustrates the importance of brand management most completely.

The results of our study will be useful for developing digital content plans for small business enterprises, trading companies and territorial marketing based on the See-Think-Do-Care model. The results of regression analysis can be an informative basis for research in the field of digital economics.

Conclusion

Summarising the study results, it is worth noting that the issue of integration of digital Internet marketing in the system of brand management plays a significant role. Such conclusions are confirmed by the results of the evaluation of the correlation coefficient (all coefficients are greater than or equal to 0.98, which indicates a direct tight correlation). The relevance of the study is underlined by the rapid growth in digital advertising expenses, which is projected to reach $870.5 billion globally in 2027. Due to this, digital content marketing was defined as having different influences on different enterprises, organisations, and institutions and depending on different factors. The type of digital content was found to differ for different forms of companies with the use of the See-Think-Do-Care strategy in brand management. Based on the building of three linear regression models, expenses on digital content marketing were found to have the highest influence on brand management. Such influence is

lower in situations with trading companies. The correlation of expenses on digital content marketing and the number of tourists who can visit the region, was considered in relation to territorial marketing. The limitation of this study is conditional consideration of a trading company as average or large in size. Still, territorial marketing is a study object, which is larger in size than small business and trading companies.

Therefore, further studies can be directed at classifying and dividing companies by size and type of conducted activity. Such an analysis will enable quantitative evaluation of the influence of digital content marketing in brand management, and further forecast the economic effect of the realisation of a certain measure within digital content marketing.

The perspective of further studies lies in a detailed study of the influence of digital content marketing for small businesses, as small business enterprises have the tightest direct dependence between digital content marketing and brand management and needs to be deepened. Profound analysis can be conducted on the basis of dividing small business enterprises by activity types and evaluating the role of digital content marketing in this area in particular.

Credit Authorship Contribution Statement

The authors equally contributed to the present research, at all stages from the formulation of the problem to the final findings and solution.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Declaration of Use of Generative AI and AI-Assisted Technologies

The authors declare that they have not used generative AI and AI-assisted technologies during the preparation of this work.

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The Effects of the Regional Comprehensive Economic Partnership on China's Trade, Tariff Revenue and Welfare

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Abstract: Increasing attention is being paid to the role of regional economic integration in facilitating a country's trade. This is especially true for the state like China, which has the second largest GDP in the world. This study explores the effects of the Regional Comprehensive Economic Partnership (RCEP) on China, looking at changes in welfare, trade creation, trade diversion, and tariff revenue under four tariff reduction scenarios with RCEP members. The study evaluates how RCEP affects China's trade relations with Japan, Korea, ASEAN, Australia, and New Zealand by using the World Bank's World Integrated Trade Solution Software for Market Analysis and Restrictions on Trade (WITS-SMART) tool. The findings demonstrate increased market accessibility and competitiveness of commodities in the Chinese market, with notable increases in trade creation and diversion, especially with Korea and Japan. RCEP considerably increases welfare even though it results in lower tariff revenues, indicating that the advantages of lower trade costs and more effective supply chains exceed the fiscal drawbacks. The paper concludes with policy recommendations that emphasize the need for strategic adaptations in China's trade policies to fully capitalize on the economic opportunities presented by RCEP, ensuring sustainable growth and the equitable distribution of trade benefits among all member states.

Keywords: RCEP; tariff reduction; trade creation; trade diversion; welfare; WITS-SMART tool.

JEL Classification: F14; F15; F17.

Introduction

As global economic integration accelerates, regional trade agreements (RTAs) have emerged as formidable forces within international economic exchanges. The Regional Comprehensive Economic Partnership (RCEP), as one of the largest free trade agreements (FTAs) in the Asia-Pacific region, encompasses nearly one-third of global GDP and exerts significant influence on the trade policies and economic development of its member states. As Table 1 indicates, China and Japan held the highest GDPs among RCEP members, ranking as the second and third largest economies globally, following the United States. Meanwhile, Australia and South Korea were positioned as the 12th and 13th largest economies worldwide in 2022.

Trade liberalization is a pivotal strategy for enhancing national competitiveness, and as the largest economy within RCEP, China plays a crucial role in regional trade. Since the late 20th century, China has

progressively expanded its openness, actively engaging in and promoting RTAs to secure a favorable position in the global economic restructuring. As Table 2 shows, the share of foreign trade in China's GDP has remained at approximately one-third over the past five years, serving as a vital source of GDP growth. Notably, ASEAN countries have been China's largest trading partners for four consecutive years, followed by Japan, South Korea, and Australia, ranking fourth, fifth, and eighth, respectively. The implementation of RCEP is regarded as a critical step for China to further integrate into the Asia-Pacific economy, promote trade liberalization, and facilitate regional economic integration.

Table 1. Economic performance of RCEP nations in 2022, (US$ billion)

	GDP	GDP per capita	Export of goods	Import of goods	Trade in goods balance
China	17960	12720	3590	2720	870
Japan	4232	33823	747	897	-150
Korea	1674	32422	684	731	-48
Australia	1693	65099	424	309	115
New Zealand	248	48418	45	54	-9
Brunei Darussalam	17	37446	14	9	5
Cambodia	30	1758	21	30	-9
Indonesia	1317	4778	292	237	55
Lao PDR	15	2022	10	8	2
Malaysia	407	12468	357	299	59
Myanmar	63	1130	17	17	0
Philippines	404	3624	79	145	-66
Singapore	467	82795	515	475	40
Thailand	495	7494	287	305	-18
Viet Nam	409	4110	371	359	12

Source: General Administration of Customs of China

It is particularly important to comprehensively assess the impact of the RCEP on China's economy, as the member countries covered by the agreement occupy an important position in China's foreign trade. This not only helps to gain a deeper understanding of the specific impact of RCEP on China's economy, but also provides an important reference for China's pursuit of a more sustained and deepened economic development and reform strategy.

Table 2. Import and export data of China's top ten trading partners in 2022

	Total Trade Value	Growth Rate	% in China's Foreign Trade	Growth Rate	Imports	Growth Rate
ASEAN	6.5	15	15.5	21.7	2.7	6.8
EU	5.7	5.6	13.4	11.9	1.9	-4.9
United States	5.1	3.7	12	4.2	1.2	1.9
Korea	2.4	3.2	5.7	13	1.3	-3.7
Japan	2.4	-0.7	5.7	7.7	1.2	-7.5
Chinese Taiwan	2.1	0	5	8	1.6	-2
Chinese Hongkong	2	-12.6	4.8	-13	0	-17
Australia	1.5	-0.7	3.5	24	1	-10
Russia	1.3	34.7	3	18.6	0.8	51
Brazil	1.1	8.6	2.7	20.6	0.7	2.8

Source: General Administration of Customs of China

The novelty of this study is the comprehensive application of World Integrated Trade Solution Software for Market Analysis and Restrictions on Trade (WITS-SMART) model to assess the multifaceted economic impacts of the RCEP agreement on China's trade relations with its major regional partners, including Japan, Korea, ASEAN,

Australia and New Zealand. In contrast to earlier research that primarily examined specific trading partners or trade agreement sectors, this paper examines trade creation, trade diversion, changes in tariff revenue, and welfare implications in a comprehensive way. Significant variations in trade dynamics are revealed by this integrated methodology, which are impacted by the distinct market structure and economic environment of each partner nation. The importance of this study lies in its potential to inform policymakers about the differential impacts of regional economic integration, thereby helping to develop targeted strategies to enhance trade efficiency. In addition, this study contributes to academic literature by filling an important gap in the understanding of the full economic impact of RCEP and provides a solid foundation for future empirical and policy-oriented research.

1. Literature Review

1.1 Trade Creation and Diversion

The impact of FTAs on international trade patterns has garnered widespread attention, particularly, the phenomena of trade creation and trade diversion.

Trade creation is the expansion of trade flows among member nations due to FTAs. Tariffs are reduced or eliminated, rendering products and services from FTA members more economically viable in comparison to those from non-member nations (Balassa 1961). It is estimated that international trade can be increased by an average of 54% within ten years of an FTA's implementation; more recent FTAs have a more pronounced effect than their predecessors (Franco-Bedoya and Frohm 2021). To illustrate, Japan's FTAs have had a beneficial impact on the establishment of trade with the majority of its partner nations. However, the effects on third countries have been comparatively less consistent (Mitsuyo *et al.* 2019).

Empirical findings in terms of how a nation's trade can be affected by FTAs have been conducted by many scholars. Wine and sugar exports, for example, have expanded dramatically as a result of Australia's FTAs (Timsina and Culas 2020). The Middle East and North Africa (MENA) region's agricultural exports have shown to benefit greatly from North-South FTAs (Parra *et al.* 2016). Moreover, Korean businesses have used FTAs to boost the sales of their domestic subsidiaries in both Korea and other nations within the manufacturing sector (Chun *et al.* 2016). Similarly, by reducing trade policy uncertainty, the EU-Korea FTA has made it possible to have a larger and more diverse export portfolio (Lakatos and Nilsson 2017). More evidences can be found from Hong Kong-ASEAN FTA (Pham *et al.* 2024;)

FTAs do not, however, have the same impact. An analysis of three major FTAs in Asia shows that the effects of FTAs can vary depending on the specific agreement and the countries that are involved. FTAs have the potential to increase trade, but they can also divert trade (Lakatos and Nilsson 2017). Japan ratified new free trade agreements in the midst of a trade spat. While these agreements have presented prospects for market growth and improvements in welfare, they may also negatively impact the GDP and the welfare of non-member nations (Gaurav and Bharti 2019). Wheat export analysis in Australia reveals that the trade creation effects of FTAs surpass intra-bloc export diversion, suggesting the possibility of additional market investigation (Biyik 2020). Agricultural imports were initially the primary sector in which South Korea benefited substantially from FTAs; however, as time passed, the repercussions of trade diversion became more conspicuous (Timsina and Culas 2021).

Trade diversion occurs when member countries substitute less efficient products from non-member countries for more cost-effective ones (Lipsey 1960), due to tariff reductions among FTA participants. Based on empirical evidence, FTAs do not substantially redirect investments from non-member nations, despite facilitating bilateral cross-border acquisitions and mergers among member nations (Li *et al.* 2018). This shows that FTAs promote economic integration rather than just divergence. Additionally, trade diversion is lessened by a decrease in trade shifts from non-member to member nations, which is accomplished by enacting stringent preferential norms of origin in FTAs (Lee 2016).

The effectiveness and structure of FTAs are improving in relation to changes in global economic policy (Franco-Bedoya and Frohm 2021). The fact that recent FTAs have significantly improved global trade by reducing border effects suggests that this trend is still going strong. FTAs have the potential to encourage non-member nations to lower their tariffs on FTA members by reducing their capacity to influence trade policies (Saggi *et al.* 2018). This shows that the effects of FTAs extend beyond their member countries.

Concerns about trade diversion are evident throughout Asia, particularly with respect to significant FTAs established between South Korea and ASEAN, the EU, and the US. These trends, however, also suggest that trade creation and structure may present challenges (Ji and Yoo 2018). To fully understand the consequences of free trade agreements on trade diversion, more investigation is required (Suslov 2020). However, compared to

FTAs with Korea and Japan, ASEAN-plus-one agreements, especially the one with China, have shown more significant effects on trade diversion (Taguchi 2015).

1.2 Tariff Revenue

FTAs typically promote international trade between participating countries by decreasing both tariff and non-tariff obstacles. Although there can be a temporary decline in tariff revenues, the long-term benefits of improved economic integration and higher trade activity usually outweigh these losses.

The development of FTAs is closely connected to the reduction of tariff rates and non-tariff obstacles. This leads to a significant increase in trade between member states, but it also has the potential to decrease tariff revenue (Hayakawa and Kimura 2015). In addition, the establishment of FTAs may lead to a decrease in tariff revenues from non-member nations (Saggi *et al.* 2018; Karacaovali 2013; Kawabata 2014).

Studies suggest that while FTAs may lead to a decline in tariff revenues, this drawback is typically balanced out by the enhanced economic well-being that fosters stronger ties among member nations (Yi 2020). In addition, the expenses related to adhering to rules of origin (ROO) may lead to increased import prices due to the adoption of FTAs. However, this effect does not fully offset the decline in tariff revenue (Mukunoki and Okoshi 2020).

The magnitude of domestic industries competing for imports and the government's assessment of the trade-off between political support and social welfare also impact the viability of FTAs. The aforementioned elements collaborate in determining the tariff rates levied by foreign countries and the wider economic ramifications of the FTA (Karacaovali 2010; Karacaovali 2013).

1.3 Welfare

Eliminating tariffs in FTAs boosts GDP, exports, imports, and consumer welfare by lowering import prices and improving quality. Welfare effects vary depending on the depth of the agreement, the presence of FDIs and ROOs, and the countries' economic structures. Non-member countries may adjust tariffs in response to FTAs, affecting global trade.

If they increase imports from the rest of the world, FTAs can boost welfare, according to theoretical models. FTAs alone do not guarantee welfare gains for SOEs (Mandal 2019). FTAs can increase GDP, welfare, and productivity in markets and targeted countries, but they may hurt GDP and welfare in non-FTA countries (Biyik 2020).

European FTAs improve import quality and lower quality-adjusted prices, improving consumer welfare through product variety, quality, and price (Breinlich *et al.* 2016). FTA welfare effects can be complicated by factors like FDI and ROO, which may deter outside firms' FDIs or lead to less efficient firms replacing more efficient ones, decreasing consumer surplus (Mukunoki 2017).

FTAs like those between Korea, Japan, and the EU have shown that removing tariffs and non-tariff measures (NTMs) boosts GDP, exports, imports, and welfare (Yi 2020). A bilateral FTA, such as one between Japan and the US, may also benefit the involved nations, depending on the agreement's depth and integration (Walter 2018). Tariff liberalization can benefit India, but trade diversion and sector-specific effects may occur (Khorana and Narayanan 2017). Trading volume, economic growth, and welfare in ASEAN-China Free Trade Area (ACFTA) countries have improved after tariff and non-tariff trade barriers were eliminated (Safuan 2017).

The removal of tariffs can have a positive impact on production and the amount of exports and imports. This can in turn affect the well-being of households and the labor market, with the extent of the impact varying depending on the specific sector and area (Heng *et al.* 2015). FTAs can potentially reduce the tariffs imposed by non-member countries on FTA members as a result of external trade diversion (Saggi *et al.* 2018).

2. Research Method

2.1 WITS-SMART Model

This study assesses the economic consequences of reducing tariffs by employing the WITS-SMART model developed by the World Bank. The structure of tariff reductions allows for an analysis of the impact on China's trade creation, trade diversion, tariff revenue, and welfare affected from other RCEP member nations.

The WITS-SMART model, categorized as a partial equilibrium (PE) model, can evaluate a wide range of scenarios, such as complete tariff elimination, different levels of tariff reductions, and various market responses and elasticities (Fathelrahman *et al.* 2021). The WITS-SMART model has the ability to accurately replicate a diverse set of situations, such as complete elimination of tariffs, different levels of tariff reductions, and varied degrees of market response elasticity (Guei *et al.* 2017). Econometric models communicate complicated

economic phenomena to policymakers with limited technical understanding by presenting conclusions in terms of statistical significance rather than real monetary values, such as dollars (Arapova and Maslova 2020).

2.2 Data Used

The trade data used in this study is sourced from the WITS-SMART system and pertain to the year 2020. The results will be presented using trade data that have been standardized based on the HS 2-digit criteria. The application of this data processing technology enables a more accurate analysis of the impacts of tariff reductions under the RCEP on China and its various industries.

This study designates China as the recipient country, while the remaining fourteen countries are categorized as Australia, New Zealand, Japan, Korea, and ASEAN. To facilitate the organization and analysis of data, the World Bank has categorized its comprehensive list of over 90 industries into 16 distinct sectors, considering the specific characteristics and types of products associated with each industry.

2.3 Setting of Scenarios

According to the Chinese Ministry of Commerce's RCEP tariff reduction schedule, China would apply a zero-tariff policy to about 90 percent of goods from other member countries. This study uses four scenarios to examine the impact of tariff reductions at different stages (Phan and Jeong 2016).

Scenario 1: Imposing zero tariffs on 25% imported goods from Japan, 38.6% from South Korea, 67.9% from ASEAN, 65.8% from Australia, and 66.1% from New Zealand;

Scenario 2: Imposing zero tariffs on 71.5% imported goods from Japan, 79.6% from South Korea, 80.6% from ASEAN, 80% from Australia, and 80% from New Zealand;

Scenario 3: Imposing zero tariffs on 83% imported goods from Japan, 82.7% from South Korea, 83.6% from ASEAN, 80% from Australia, and 80% from New Zealand;

Scenario 4: Imposing zero tariffs on 86% imported goods from Japan, 85.9% from South Korea, 90.5% from ASEAN, 90% from Australia, and 90% from New Zealand;

2.4 Technical Notation and Equations

This study examines the trade, tariff, and welfare impacts of RCEP member countries with China as the importing country, and the analysis involves all industries, so all elasticities are calculated using the system defaults of the WITS-SMART analysis.

In this paper, 1.5 is used as the system's default elasticity of substitution, indicating that the items considered exhibit a degree of similarity while maintaining different characteristics. The default value of the export supply elasticity is set at 99, indicating an infinite elasticity. This value is held constant across all trading partners. It is possible for the elasticity value to change, but it remains unique for a given product. It is worth noting that the export supply elasticity is not affected by the partner in question (World Bank). The practical calculations described below are included in equation (1):

$$TC_{ijk} = M_{ijk} \times \eta \times \frac{\Delta_{ijk}}{(1+t_{ijk}) \times (1+ \eta/\beta)} \quad (1)$$

where;

TC_{ijk} : Trade creation;

M_{ijk} : Imports;

t_{ijk} : Tariff;

η : Import elasticity of demand (system defined);

β : Export supply elasticity (99 by default);

i : Commodity;

j : Exporting country;

k : Importing country;

Trade diversion, which is mostly dependent on substitution elasticity, is represented by equation (2):

$$TD_{ijk} = \frac{M_{RCEP} \times M_{RoW}\left[\left(\frac{1+t_t}{1+t_0}-1\right)\times\lambda\right]}{M_{RCEP} + M_{RoW}\left[\left(\frac{1+t_t}{1+t_0}\right)-1\right]\times\lambda} \quad (2)$$

Where;

TD_{ijk} : Trade diversion;

M_{RCEP} : Imported commodities from RCEP countries;

M_{RoW} : Imported commodities from the rest of the world;

t_t : Tariff (where t_0 and t_t represent pre and post integration levels of tariffs) ;

λ : Elasticity of substitution (1.5 by default);

Equation (3) indicates the net trade impact (TE), which can be defined as the combined result of trade creation and trade diversion:

$$TE = TC + TD \quad (3)$$

The net revenue effect (RE) in equation (4) represents the revenue fluctuations caused by tariff changes. It is mostly determined by the price and quantity of imports.

$$\Delta R_{ijk}/R_{ijk} = \left[\Delta t_{ijk}/(1+\Delta t_{ijk})\right]\times\eta\times\left[(1+\beta)/(\beta-\eta)\right] \quad (4)$$

Where;

ΔR_{ijk} : The effects on revenue due to tariff changes

η : The elasticity of demand for the importing economy

t_{ijk} : Tariff

β : Elasticity of supply for the exporting economy.

Equation (5) estimates the welfare effects are basically the summation of the producer and consumers' surplus.

$$W_{ijk} = \frac{1}{2}\times\left(t_{ijk}\times M_{ijk}\right) \quad (5)$$

Where:

W_{ijk}: Welfare;

t_{ijk}: Tariff;

M_{ijk}: Imports.

3.5 Limitation of WITS-SMART

The WITS-SMART uses a partial equilibrium paradigm to analyse tariffs and trade policy, focusing on sector-specific consequences rather than macroeconomic changes. This assumption restricts the model's dynamic trade policy adaptation. Additionally, the model's use of past trade and tariff data may not account for future trade policy or global economic changes, which could undermine its long-term impact assessment of RCEP. Due to its limitations in measuring non-tariff measures' impact on trade dynamics, the model may underestimate the RCEP's economic impact. These constraints advise care when interpreting model conclusions, especially when creating policy based on these assessments (World Bank).

4. Research Results

4.1 Results Analysis

In this section, China's trade, tariff revenue and welfare simulation results with each RCEP member will be presented.

China-Japan

Under the RCEP framework, the trade dynamics between China and Japan demonstrate significant economic impacts in several scenarios. Analysis of the data shows a significant trade creation effect, which increases from US$728.9 million in Scenario 1 to US$623.1 million in Scenario 4. This increase reflects the role of RCEP in reducing trade barriers, which significantly improves the access and competitiveness of Japanese goods in the Chinese market.

Trade diversion, a measure of shifts from efficient global suppliers to regional partners due to preferential tariffs, also shows an increasing trend, from US$596.8 million in Scenario 1 to US$4589.6 million in Scenario 4. This suggests that China is relying more on Japan for its imports at the expense of other countries, which may reflect China's strategic reorientation to seek more favorable economic partnerships within Asia.

Table 3. Impacts on China as importer from Japan under four scenarios, US$ million.

	S1	S2	S3	S4
Trade Creation	728.9	3608.9	5464.9	6223.1
Trade Diversion	596.8	2893.5	4289.7	4589.6
Total Trade Effect	1325.7	6502.3	9754.6	10812.7
Tariff Revenue	-686.6	-3232	-4783.2	-5117.7
Welfare Change	802.1	3831.7	5747.9	6506.2

Source: Authors' calculation from SMART-WITS

In Scenario 4, tariff revenues loss exhibits a distinct upward trajectory, increasing from US$686.6 million in Scenario 1 to US$5117 million. The decrease in question is a direct consequence of the tariff reductions implemented under the RCEP. Although these tariff reductions diminish fiscal revenues from imports, they further the objectives of economic integration and trade facilitation.

In terms of welfare, the figure for each scenario is positive, with an increase of US$6506.62 million from US$802.1 million. The rise in welfare indicates that the advantages stemming from increased supply chain efficiency and reduced trade expenses are substantial enough to compensate for the drawbacks linked to decreased tariff revenues.

China-Korea

The trade relationship between China and South Korea demonstrates distinct economic patterns in various scenarios within the framework of the RCEP. Scenario 1 exhibits an initial trade volume of US$155.6 million, whereas Scenario 4 witnesses a substantial surge in trade volume to US$1954.1 million. Due to the reduction of trade barriers mandated by the RCEP agreement, access for Korean goods to the Chinese market has increased substantially, as indicated by this substantial increase.

Simultaneously, the rise in trade diversion from US$1536.4 million in Scenario 4 from US$166.3 million in Scenario 1 indicates a substantial shift in the origin of China's imports, with South Korean goods being increasingly favored over those originating from non-RCEP members. This modification exemplifies China's astute implementation of regional synergies, which are critical components of the anticipated economic framework of the RCEP.

Table 4. Impacts on China as importer from Korea under four scenarios, US$ million

	S1	S2	S3	S4
Trade Creation	155.6	1751.3	1827.4	1954.1
Trade Diversion	166.3	1339	1420.4	1536.4
Total Trade Effect	321.9	3090.2	3247.8	3490.5
Tariff Revenue	-198.4	-1350.5	-1423	-1536.1
Welfare Change	158.9	1759.6	1835.7	1962.5

Source: Authors' calculation from SMART-WITS

There is an ongoing increase in tariff revenue loss, which grows from US$198.4 million in Scenario 1 to US$1536.1 million in Scenario 4. This declining trend underscores the comprehensive tariff reductions implemented under the Partnership. Although these reductions are designed to foster a more liberalized trade climate, they concurrently lead to diminished import fiscal revenues.As for welfare impact, the figure continues to trend positively, increasing from US$158.9 million in Scenario 1 to US$1962.5 million in Scenario 4. This suggests that as consumer surplus increases and market efficiency improves, the broader economic benefits far outweigh the direct fiscal costs stemming from reduced tariff revenues. The data provided not only illustrates the influence of RCEP on the trade dynamics between China and Korea, but also expose the potential benefits of economic integration in fostering collaboration within the region.

China-ASEAN

Under the RCEP framework, China's trade creation from ASEAN countries is lower than that of Japan and Korea. The results of the analysis show a steady increase in trade creation from US$13.9 million in Scenario 1 to US$40.1 million in Scenario 4. The incremental growth observed signifies the strengthening of trade ties between China and ASEAN, as ASEAN nations assume greater importance in China's import strategy.

In scenario 4, trade diversion continues to rise from USUS$8.3 million in scenario 1 to US$39.8 million. This finding suggests that China's import dependence on ASEAN countries is increasing, which may have a negative impact on other trading partners. This change suggests that China has made strategic adjustments in response to the favorable conditions brought about by RCEP, which has facilitated regional economic cooperation.

Tariff revenue loss grows significantly from US$12.2 million in Scenario 1 to US$53.3 million in Scenario 4. The observed decline suggests that the substantial tariff reductions implemented within the framework of RCEP not only increase the volume of trade but also reduce fiscal revenues from imports.

Table 5. Impacts on China as importer from ASEAN under four scenarios, US$ million

	S1	S2	S3	S4
Trade Creation	13.9	23.8	31.7	40.1
Trade Diversion	8.3	22.2	33.2	39.8
Total Trade Effect	22.2	46	65	79.8
Tariff Revenue	-12.2	-35.1	-44.5	-53.3
Welfare Change	13.8	49.8	57.8	66.2

Source: Authors calculation from SMART-WITS

Welfare changes tend to increase in all scenarios, with Scenario 4 increasing by US$52.4 million to US$66.2 million. These analyses suggest that the economic benefits of increased market access and reduced trade costs far outweigh the adverse effects of reduced tariff revenues. The results of these analyses demonstrate the wide-ranging impact of RCEP on regional trade dynamics. They also provide important insights for future policy formulation.

China-Australia

Results on China-Australia trade collected under the RCEP framework show significant changes in the bilateral trade relationship. Trade creation in Scenario 4 sees a great increase from US$1.6 million in Scenario 1 to US$234.4 million as trade barriers are removed or eliminated. This significant increase suggests that Australian goods have much greater access to the Chinese market.

Table 6. Impacts on China as importer from Australia under four scenarios, US$ million

	S1	S2	S3	S4
Trade Creation	1.6	162.3	162.3	234.4
Trade Diversion	1.9	27.8	27.8	53.4
Total Trade Effect	3.4	190.2	190.2	287.9
Tariff Revenue	-1.5	-32.5	-32.5	-55.9
Welfare Change	1.5	162.4	162.4	234.5

Source: Authors calculation from SMART-WITS

Meanwhile, the trend of trade diversion continues to expand from USUS$1.9 million in Scenario 1 to USUS$53.4 million in Scenario 4. According to this pattern, China is gradually shifting from imports to Australian products. This shift could result in non-members importing more products from Australia if RCEP provides preferential treatment.

This trend is evident in the steady growth in tariff revenue from a loss of US$1.5 million in Scenario 1 to a significant loss of US$55.9 million in Scenario 4. This loss is directly attributable to the tariff reductions implemented by RCEP, while facilitating cross-border trade, have also reduced government import tariff revenues.

On the welfare side, the changes are equally positive, with all scenarios showing a significant increase, from US$1.5 million in Scenario 1 to US$234.5 million in Scenario 4. This suggests that the economic benefits of increased consumer surplus and market efficiency due to increased market access and reduced trade costs far outweigh the fiscal impact due to reduced tariff revenues. These data not only demonstrate the far-reaching impact of RCEP on China-Australia trade dynamics, but also provide an important basis for assessing the overall economic benefits of the trade agreement.

China-New Zealand

Data on the trade relationship between China and New Zealand under the RCEP framework illustrate the economic interactions under different scenarios, although the scale of the impacts is significantly smaller compared to China's dealings with other RCEP members. The trade creation effect is extremely limited, growing from zero in Scenario 1 to a slight increase to 100,000 USD in Scenario 4. This slight increase reveals that while there are some benefits from reducing trade barriers, the overall impact of RCEP on trade flows between two nations is very limited.

Table 7. Impacts on China as importer from New Zealand under four scenarios, US$ million

	S1	S2	S3	S4
Trade Creation	0	0	0	0
Trade Diversion	0	0	0	0.1
Total Trade Effect	0	0	0	0.1
Tariff Revenue	0	0	0	0
Welfare Change	-0.1	-0.1	-0.1	-0.1

Source: Authors calculation from SMART-WITS

In all scenarios, trade diversion is almost zero, showing no significant change in China's imports from New Zealand and no impact on other countries. This stability may stem from the already fairly low trade barriers between the two countries prior to the implementation of RCEP, or because the traded goods involved are insensitive to changes in tariff structures.

The effect of tariff revenues is also minimal, showing no significant variations across different scenarios. This is in line with the relatively limited extent of trade generation and transfers. The minimal decrease in tariff revenue provides additional evidence that the impact of RCEP on the trade volume between China and New Zealand is extremely limited.

The welfare changes are insignificantly small, with an average of approximately US$100,000 across all conditions. This indicates that the effect of RCEP on market efficiency and consumer surplus between China and New Zealand is minimal. This could be attributed to the restricted extent of tariff reductions implemented on goods exchanged between the two nations. These evaluations indicate that considering the distinctiveness of each nation's trade agreements and goods is crucial when evaluating the economic consequences of RCEP.

5. Discussions

The findings of this analysis suggest an enormous increase in trade among the states within the RCEP. These findings are consistent with the predictions made by studies in the field of international economics. The significant increase in trade creation impacts seen in Japan and South Korea supports the conclusions of Cui *et al.* (2019) and Wang (2023).

Out of all the members of RCEP, China's economic changes with New Zealand have undergone the smallest changes. Magee (2008) observed that trade diversion with New Zealand is negligible, possibly due to distinctive market dynamics resulting from low trade barriers. These differences emphasize the complex relationship between the economic structures and preferences of different regions, which could potentially change

the expected outcomes of trade agreements. The analysis is corroborated by recent studies that quantify the impact of the RCEP and predict substantial growth in regional commerce. The observed increase in trade flows is supported by empirical evidence from this research (Rahman and Sharma 2023). Moreover, the strong agreement between the expected academic results and the collected data strengthens the dependability of the study's findings (Lee *et al.* 2022).

The results indicate a constant and positive improvement in well-being under different conditions and in different countries, which closely corresponds to the economic literature that emphasizes the advantages of trade liberalization. FTAs have the potential to enhance overall well-being by increasing household incomes and expenditures, improving the quality of imported commodities, and encouraging specialization in services and manufacturing (Vo and Nguyen 2020; Berlingieri *et al.* 2016; Deswal 2020).

However, the slight differences in well-being between China and ASEAN, as well as New Zealand, suggest that even small or less extensive decreases in tariffs can have a more subtle effect on overall wellbeing, as emphasized by Venables (2003). Hence, the level of trade integration and the unique economic attributes of member nations would significantly impact the total welfare advantages obtained by RCEP.

The strength and reliability of these findings are further supported by a recent empirical investigation undertaken by Cheong *et al.* (2020), which highlights significant improvements in welfare in East Asia due to trade facilitation measures used in similar economic accords. These references confirm the trends discovered in this study and emphasize the broad applicability and trustworthiness of the study's findings.

Conclusions

The paper thoroughly examines the economic consequences of the RCEP agreement on China's trading ties with Japan, Korea, ASEAN, Australia, and New Zealand. This is achieved by utilizing the WITS-SMART model to provide an in-depth analysis of trade creation, trade diversion, tariff revenue, and welfare changes. The analysis reveals significant disparities in trade dynamics among various partner countries and circumstances. These distinctions have emerged as a result of an intricate interaction between the removal of trade obstacles, regional economic integration, and market peculiarities.

The effectiveness of RCEP in fostering stronger economic connections and improved market entry in the area is seen by the substantial growth in trade creation and diversion with Japan and South Korea. The findings of the current study support both theoretical predictions and empirical evidence, confirming that trade liberalization under the RCEP framework can lead to significant economic advantages by promoting higher levels of trade and strengthening regional cooperation.

Welfare studies indicate that the removal of trade barriers through the RCEP significantly enhances economic welfare. This is primarily achieved by boosting consumer surplus and improving market efficiency. However, the extent of these economic benefits varies between countries, suggesting that increased integration and consistent policy implementation may be required to optimize rewards for all member states.

To sum up, this analysis presents persuasive data that underscores the profound influence of RCEP on the transformation of China's trade landscape, thereby substantiating the substantial economic benefits associated with trade liberalization. To ensure optimal utilization of the benefits offered by RCEP, it is imperative to enact policy initiatives that are both comprehensive and strategic. The aforementioned findings emphasize the criticality of enhancing policy alternatives in order to maintain stability and economic expansion in the area. Ensuring the complete enjoyment of the benefits by all nations involved in this significant trade agreement is of the utmost importance.

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Credit Authorship Contribution Statement

Wenjie Zhang: Conceptualization, Investigation, Methodology, Software, Writing – original draft;
Muhammad Daaniyall Abd Rahman: Formal analysis, Project administration, Supervision;
Mohamad Khair Afham Muhamad Senan: Writing – review and editing, Visualization;

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Declaration of Use of Generative AI and AI-Assisted Technologies

The authors declare that they have not used generative AI and AI-assisted technologies during the preparation of this work.

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The Impact of Project Activities on the International Business Development

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Abstract: The impact of project activities on the international business development is an urgent issue in view of the increasing global expansion and intensifying competition between companies. The aim of the study is to assess the impact of project activities on the international business development. The research methodology is based on the analysis of modern trends in the development of international business using econometric modelling, statistical analysis, and extrapolation. The impact of project activities on business expansion was determined and the use of Agile and PMBOK methodologies was assessed. The obtained results show the experience of international companies in the use of project methodologies, which increased by 20% in 2023 compared to 2022. The study found that project activities have a significant impact on the international business development thanks to the support of bank lending. The results show that the effective use of project methodology optimize production processes and reduce costs in international business. The available results emphasize the importance of strategic project management for the successful development of enterprises on the international market using the example of Azerbaijan. The research findings indicate the effective practice of applying innovative technologies in project activities with the help of Agile for international business development. A comparative analysis of management approaches objectively determines the advantages, which include the promptness of decision-making, ensuring organizational efficiency. Further research into project management methods in international business will contribute to the improvement of management practices and the development of strategies that meet the modern globalization challenges.

Keywords: project activities; international business; loan portfolio; corporate loans; digital technologies; Agile.

JEL Classification: E52; F23; G40; R11; O22.

Introduction

Project activities are an important component of management and control, which includes planning, organization, implementation, and control of projects in order to achieve the goals within the specified period. According to Issa (2023), project management uses special methodologies and tools to ensure the successful implementation of projects, which may include different areas of activity. The significance of project activity is its ability to ensure effective achievement of goals, optimization of resources, reduction of risks and increase in competitiveness of organizations. Project management enable companies to quickly respond to new challenges and opportunities in view of rapid changes and high uncertainty in the markets.

The study of the influence of project activities on the development of international business is a relevant and important topic in the conditions of globalization and constant changes in the world economy. It offers an analysis of aspects of project management that directly affect the success of companies in international markets. The expediency of conducting the research is due to the emergence of new tools and approaches for managers who seek to improve the competitiveness of their enterprises in the global space.

The international business development has been greatly accelerated by globalization, which promotes the interpenetration of economies, cultures, and technologies. Globalization has opened up new markets for goods and services, increased opportunities for investment, and enabled companies to expand beyond national borders. The author (Buber and Unal Coban, 2023) believes that project activities play a crucial role, as it provides a structured approach to the implementation of multi-phase projects on an international scale. International business requires effective management of resources, coordination of activities between different departments. Management enables companies to ensure synergy between different elements of their operations, thereby reducing costs, increasing efficiency and profitability.

Project activity is a key success factor in international business development, providing a structured approach to managing complex initiatives. Implementation of modern Agile and PMBOK project management methodologies enables companies to optimize the use of resources, reduce risks and increase productivity. For example, the American companies Google and Microsoft actively use the Agile methodology to quickly adapt to changes under the market conditions. In Germany, the implementation of PMBOK standards reduces risks and ensures high quality of project management. This enables businesses to effectively implement projects and adapt to regional and cultural characteristics of various markets, which is critical for successful international expansion.

The emergence and rapid development of digital technologies have radically changed approaches to project activity, opening up new opportunities for international business. Digital tools provide a high level of transparency, automation and accuracy in project management. According to Vaseghi and Vanhoucke (2023), the introduction of machine learning enables predicting risks, optimizing resources and increasing the efficiency of operations. Innovative technologies increase the speed and quality of project execution and contribute to the improvement of communication and coordination between international teams. The research problem is the intensification of competition on the international market due to globalization, which is intensified thanks to digital technologies and effective organization of project activities.

The aim of the study is to assess the impact of project activities on the international business development. The aim involves the fulfilment of the following research objectives:

1. Determine the relationship between the project management quality and the success of international business projects based on the experience of different countries;
2. Identify the influence of different approaches to project management on the development of international business and outline trends in international trade;
3. Develop recommendations for improving management procedures in project activities in the field of international business;
4. Study the role of digital technologies in project activities and outline the prospects for their further application.

1. Literature Review

The study of the impact of project activities on the international business development is relevant among the researchers. Current literature offers different approaches and interpretations of this phenomenon. The research by Pepin *et al.* (2024) introduces the Responsible Business Model Canvas, which is a sustainable business modeling tool designed for students and start-up entrepreneurs, emphasizing the importance of integrating ethical and environmental considerations in business planning. Muller (2023) emphasizes the importance of project management as a key factor in successful international expansion. The study by Ukah *et al.* (2023) claims that the use of Agile methodology enables companies to adapt more quickly to new market conditions and cultural

characteristics. Cheng *et al.* (2023) draw attention to the role of technology in international projects, arguing that digital tools and platforms for project management facilitate coordination. Marzouk and Hamdala (2024) focus on real estate projects, proposing a phased approach that balances profitability with customer satisfaction, highlighting the need for a holistic view in managing large-scale projects. The work by Kanski *et al.* (2023) emphasizes the importance of intercultural competence in managers of international projects. Humeniuk (2023) claims that successful project management at the global level requires technical skills and an understanding of cultural differences. Vazquez *et al.* (2023) examine the impact of global economic trends on project activities. In a quantitative analysis, Berntsson Svensson and Torkar (2024) explore the variability in the importance of requirements prioritization criteria, suggesting that the context and phase of a project can significantly influence the selection of these criteria. According to Armadani (2023), economic instability can both stimulate and hinder the implementation of international projects. Jeremiah *et al.* (2023) recommend using scenario analysis to predict possible risks and develop appropriate strategies. As Pérez-Guerra *et al.* (2023) state, the successful completion of international projects depends significantly on the companies' ability to effectively manage human resources. The research by Liora (2023) confirms that the use of a systematic approach to project management enabled a number of international companies to successfully implement large-scale projects. For instance, the work by Nikonenko *et al.* (2022) assesses the policy of attracting investments in the main sectors of the economy, emphasizing the role of Industry 4.0 technologies in enhancing international project management effectiveness. Additionally, Alazzam *et al.* (2023) explore the development of information models for e-commerce platforms, highlighting the importance of digitalization and legal compliance in modern socioeconomic systems. The work by Chiou and Tseng (2023) emphasizes the importance of corporate social responsibility in the process of international business development. According to Başaran and Bay (2023), the involvement of local employees facilitates the companies' adaptation to local conditions and increases the level of trust and support from local communities. The article by Lindner *et al.* (2023) considers project activity as part of a broad process of modernization of international business. Willems *et al.* (2023) add that an important aspect is the constant training and development of skills of employees participating in international projects. The articles emphasize the importance of adaptive management, which enables companies to quickly respond to changes in market conditions and cultural peculiarities (Risqi *et al.* 2023; Bielialov *et al.* 2019). In general, modern literature confirms that project activities play an important role in the development of international business, contributing to the effective integration of various markets and increasing the competitiveness of companies at the global level.

2. Materials and Methods

This section should be detailed enough that readers can replicate your research and assess whether the methods justify the conclusions. It's advisable to use the past tense – it's about what you did – and avoid using the first person. Ultimately, you should explain how you studied the problem, identify the procedures you followed, and structure this information as logically as possible.

If your methods are new, you'll need to explain them in detail. If they've been published before, cite the original work, including your amendments if you've made modifications. Identify the equipment and the materials you used, specifying their source. State the frequency of observations and what types of data were recorded.

Give precise measurements, stating their strengths and weaknesses when necessary. Name any statistical tests, so your quantitative results can be judged.

If your research involved human participants, you'll need to include certain information in the ethics statement, such as committee approvals and permission to publish. You should also explain your criteria for selecting participants.

2.1 Research Design

The research design consisted of several stages. The first stage involved a statistical analysis of the current state of international business development in the G20 countries. The second stage provided for studying the peculiarities of the impact of project activities on the support of international business using the experience of Azerbaijan. The analysis included the study of data on the credit portfolio, economic indicators and the results of project implementation. The third stage of the study involved an assessment of the application of the project activities in accordance with the cultural and ethical standards of leaders in international business. The final stage of the research was drawing conclusions and providing recommendations regarding the prospects for the further development of project activities in international business.

2.2 Sampling

The sample for the study includes the G20 countries chosen because of their significant influence on the world economy and the high level of development of financial institutions. The G20 countries represent a variety of economic systems and approaches to bank lending, which enables comparative analysis and identifies best practices. The choice of countries is based on their active participation in international trade and their significant role in shaping global economic trends. Data analysis identified general trends and specific features affecting the success of project activities and business development. It contributes to the increase in trade volumes and the improvement of economic indicators, which is shown in Table 1.

Table 1. G20 quarterly international merchandise trade, Current prices, billion US dollars, seasonally adjusted

	2022	2023	2022			2023			
Exports			Q2	Q3	Q4	Q1	Q2	Q3	Q4
G20	18800.2	18173.7	4803.6	4741.1	4582.8	4639.5	4528.7	4500.9	4504.5
Argentina	88.4	66.8	23.6	21.3	21.5	17.9	16.5	16.6	15.8
Australia	411.4	371.1	109.6	103.0	101.6	101.7	91.3	87.6	90.6
Brazil	334.3	339.8	85.6	84.0	83.4	83.6	83.6	83.7	89.0
Canada	598.9	568.5	159.2	153.3	143.8	144.8	139.3	141.4	143.0
China	3557.7	3395.0	901.4	914.0	841.4	877.6	856.8	827.7	832.9
EU 27	7147.1	7203.1	1800.1	1775.6	1789.3	1833.1	1810.6	1784.6	1774.6
France	619.0	650.0	152.4	152.7	156.7	162.6	166.0	161.5	159.9
Germany	1655.1	1675.4	417.6	406.4	412.7	424.6	423.7	416.8	410.3
India	453.7	432.6	122.0	111.6	107.8	110.0	104.9	108.6	109.1
Indonesia	291.8	259.1	76.6	76.6	70.7	68.9	62.9	62.5	64.7
Imports									
G20	19577.5	18494.0	4975.8	4946.9	4789.5	4733.0	4640.5	4561.9	4558.5
Argentina	81.5	73.7	22.4	21.4	17.8	18.9	19.8	18.5	16.4
Australia	290.1	276.3	74.7	73.1	69.5	70.9	68.8	69.3	67.3
Brazil	272.9	241.6	71.1	72.2	66.8	61.7	62.0	58.8	59.2
Canada	571.7	558.9	148.8	146.8	140.1	139.8	141.1	139.9	138.2
China	2724.3	2574.4	689.0	681.6	651.6	648.0	640.6	630.6	655.1
EU 27	7473.5	7058.8	1902.0	1888.1	1838.5	1817.9	1792.7	1739.9	1708.2
France	822.1	788.4	203.4	210.6	205.9	201.0	201.0	197.0	189.3
Germany	1570.6	1458.2	404.8	394.1	381.2	377.0	372.6	360.3	348.3
India	720.7	671.6	184.2	187.6	174.2	168.4	160.3	168.6	174.3
Indonesia	237.5	221.9	58.9	62.9	56.9	56.5	53.3	55.8	56.3

Source: based on OECD report (2024)

2.3 Research Methods

The research employed quantitative and qualitative analysis, statistical methods, and data extrapolation. Quantitative analysis included statistical analysis of data on lending volumes. The volume of international trade was revealed using a statistical method. Qualitative analysis involved studying cases of successful international projects, analysis of policies and strategies for implementing project activities in the G20 countries. Methods of statistical analysis are applied to provide an assessment of trends in the modern development of international trade.

2.4 Instruments

SPSS and Excel tools were used for data collection and analysis. The tool for systematization and identification of key topics and trends of international trade was introduced. Available tools provide a comprehensive approach to research.

3. Research Results

Project activities have a significant impact on international trade, contributing to the improvement of logistics processes, cost reduction, and increased efficiency of operations. The implementation of digital technologies in project activities optimizes the management of supply chains and ensures the transparency of transactions. China, where the use of these technologies is widespread, shows a steady increase in exports of 12.5% in 2023 compared to 2022. Digital tools improve coordination between international partners and provide more efficient management of trade operations. Let's calculate the predicted values in Table 2.

Table 2. Calculation of forecast values of export and import for 2024-2026, billion US dollars

Country	Exports			Imports		
Country	2024	2025	2026	2024	2025	2026
G20	17568.1	16982.6	16416.7	17470.5	16503.6	15590.2
Argentina	50.5	38.1	28.8	66.6	60.3	54.5
Australia	334.7	302.0	272.4	263.2	250.6	238.7
Brazil	345.4	351.1	356.8	213.9	189.4	167.6
Canada	539.6	512.3	486.2	546.4	534.2	522.2
China	3240.3	3093.4	2954.7	2433.2	2299.9	2174.0
EU 27	7261.0	7319.9	7379.8	6668.7	6298.8	5947.2
France	682.6	716.8	752.5	756.0	724.9	695.1
Germany	1695.9	1716.6	1737.5	1354.7	1259.9	1173.4
India	412.8	393.9	375.8	625.8	582.8	542.4
Indonesia	229.9	204.0	180.9	207.3	193.6	180.7

Source: calculated by the author

Deviations in percentage value demonstrate expected changes in export and import volumes for G20 countries during 2024-2026 compared to previous years. Declining exports and imports for many countries indicate possible economic stagnation or slowing growth caused by global economic challenges such as changes in trade policy, economic instability or other macroeconomic factors. China demonstrates stable performance because of effective implementation of digital technologies in project activities and management of trade processes. Current trends indicate the need to adapt business strategies and implement innovative solutions to ensure sustainable economic growth. The percentage deviations for the predicted data are calculated in Table 3.

Table 3. Percentage deviations for forecasted export and import data for 2024-2026

Country	2025 Exports Deviation (%)	2026 Exports Deviation (%)	2025 Imports Deviation (%)	2026 Imports Deviation (%)
G20	-3.33	-3.21	-5.53	-5.53
Argentina	-24.55	-24.41	-9.46	-9.62
Australia	-9.77	-9.80	-4.79	-4.75
Brazil	1.65	1.62	-11.45	-11.51
Canada	-5.06	-5.09	-2.23	-2.25
China	-4.52	-4.49	-5.48	-5.47
EU 27	0.81	0.82	-5.54	-5.59
France	5.00	5.01	-4.13	-4.11
Germany	1.22	1.22	-7.52	-7.74
India	-4.58	-4.59	-6.87	-6.93
Indonesia	-11.27	-11.32	-6.64	-6.68

Source: calculated by the author

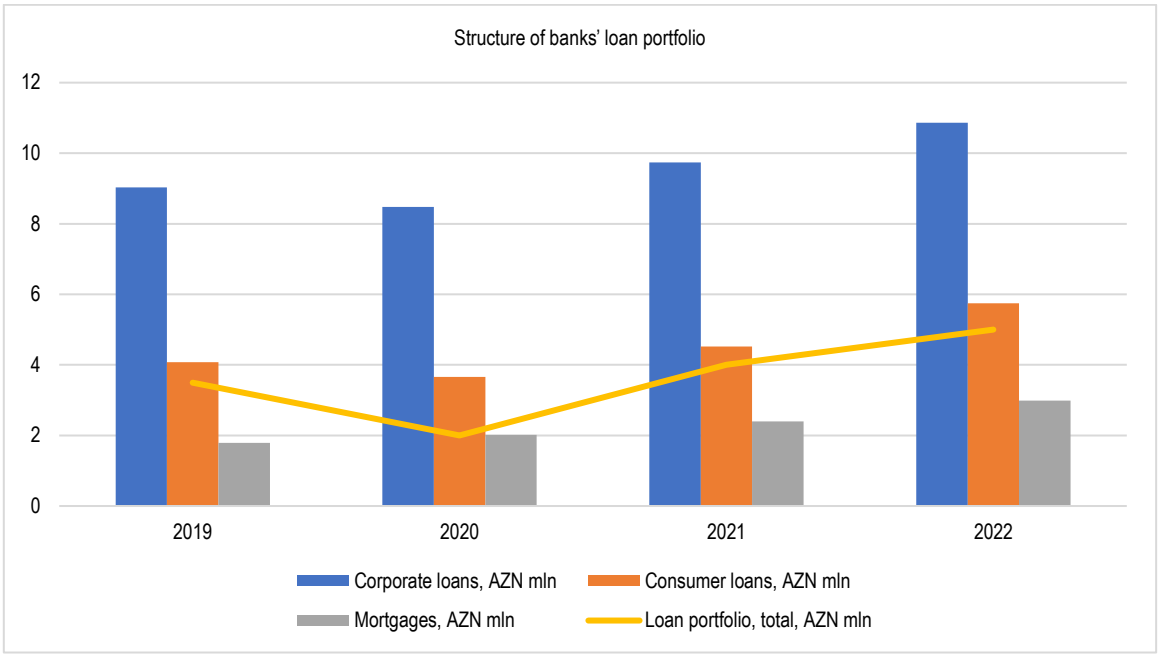
Project activities can have a significant impact on economic deviations in exports and imports, depending on the scale and direction of investments. Large infrastructure projects can increase exports by 5-10% because of increased efficiency of production and logistics. At the same time, imports may increase by 3-7% due to the need for specialized equipment, materials and technologies to implement these projects.

The structure of a bank's loan portfolio plays an important role in business activity, as different types of loans have different effects on the economic stability and development of companies. Corporate loans are the main source of financing for business, allowing companies to attract the necessary funds for investments, expansion of production and implementation of strategic projects. A balanced portfolio includes corporate loans,

consumer loans and mortgages, allowing banks to reduce risks and ensure stable income. However, the predominance of corporate loans in the portfolio may indicate a greater focus of banks on the business sector.

Azerbaijan's experience in making the loan portfolio structure is useful for other countries due to its balanced approach to various types of lending. The business support policy implemented by Azerbaijani banks contributed to the stable growth of corporate loans. The strategy enabled local companies to access the necessary financing for expansion and innovation. Figure 1 shows the general structure of bank lending.

Figure 1. Structure of banks' loan portfolio in Azerbaijan



Source: based on Deloitte (2022)

The growth of corporate loans from 9.03 billion manats in 2019 to 10.86 billion manats in 2022 shows the effective support of business, which contributed to the increase of investments in the economy. The increase in the volume of consumer loans and mortgages demonstrates a comprehensive approach to lending that includes supporting business and stimulating consumer demand. The growth of consumer loans from 4.08 billion manats in 2019 to 5.75 billion manats in 2022 shows that the banking system of Azerbaijan actively supported citizens.

Mortgage lending support increased from 1.79 billion manats in 2019 to 2.99 billion manats in 2022. This indicates the stimulation of the construction sector and the provision of housing to the population. A balanced approach ensures economic stability and promotes the development of various sectors of the economy.

In view of globalization and the expansion of international cooperation, an important aspect of the development of project activities is to increase the level of intercultural competence of managers and employees. A key factor in the success of international projects is taking into account cultural peculiarities and differences in approaches to operation. Education and training aimed at developing intercultural skills ensure more effective communication and cooperation between international teams. The impact of project activities has its own peculiarities in each country in terms of the cross-cultural component, which is shown in Table 4.

Further development of project activities will require a strategic approach to resource management, which includes financial, human, and material resources. The implementation of digital tools for planning and control of resources will optimize their use and reduce costs. The analytical platforms for forecasting and modelling of different scenarios, as in the US, are used to accurately assess needs and risks. Effective management of large and complex projects is especially important for companies that operate internationally.

Digital technologies play a significant role in the development of project activities. The introduction of blockchain automates routine processes, increases the accuracy of forecasting, and ensures transparency of project management by minimizing errors. Blockchain technologies can be used to ensure data security and immutability, which is important for managing complex international projects. Implementation of appropriate technologies will significantly reduce risks and improve coordination between various project participants.

Table 4. The impact of project activities on the international business development

Country	Method	Description
USA	Increasing efficiency	The use of Agile and Scrum methodologies enables companies to quickly adapt to market changes and increase productivity.
Germany	Risk reduction	Implementation of PMBOK standards reduces risks and ensures high quality of project management.
Japan	Adaptation to local conditions	Involvement of local experts and partners helps Japanese companies to better understand local markets and cultural features.
China	Innovations and technologies	The use of artificial intelligence (AI) and blockchain for project management increases the speed and transparency of business processes.
Great Britain	Intercultural competence	Training and professional development of employees in the field of intercultural competence improves international cooperation.
India	Corporate social responsibility	Implementation of projects aimed at supporting local communities increases trust and support from local communities.
Brazil	Management flexibility	The use of adaptive management allows Brazilian companies to quickly respond to changes in market conditions.
Australia	Resource optimization	Effective resource management using project methodologies enables Australian companies to reduce costs and increase profitability.
South Corea	Implementation of digital technologies	The use of modern digital tools for project management improves efficiency and coordination between teams.

Source: tabled by the author

Therefore, the introduction of flexible methodologies and the integration of digital technologies are key areas that will contribute to the successful implementation of international projects. Innovative approaches will allow companies to adapt to the rapidly changing conditions of the global market, reduce risks and ensure transparency and efficiency of project management. In the long run, it will contribute to sustainable economic growth and development of international trade.

4. Discussions

The discussion about the impact of project activity on the development of international business shows the need for a deeper analysis of different approaches to project management. Unlike Golab *et al.* (2023), which emphasize the importance of Agile methodology, our study emphasizes the importance of cultural sensitivity and intercultural competence. The obtained results confirm the opinion of Yang *et al.* (2023) that the integration of functional divisions is a key factor in the success of international projects. According to Usman *et al.* (2023), the results of the study confirmed that the PMBOK standards do not always sufficiently take cultural and regional characteristics into account. The findings of Aulia and Cipta (2023) regarding the importance of involving local experts are supported by an analysis indicating that local partners can significantly reduce risks. A study by Malik and Zhu (2023) emphasizes the role of technology, which is consistent with our results, which show significant benefits from using digital tools for project management. Pratiwi *et al.* (2023) emphasize that international projects require greater flexibility and integration of different functional divisions of the company. The results on corporate social responsibility are confirmed by our data, which show that social initiatives contribute to the successful implementation of business projects. The article by Bui *et al.* (2023) on the importance of involving local employees is supported by our research, which showed that it increases trust and support from local communities. Sudarsan *et al.* (2023) emphasize cultural challenges, as the research showed that the effectiveness of international projects largely depends on adaptive management. The opinion of Zhylin *et al.* (2023) about the integration of project activities with emotional intelligence is confirmed by results that show the importance of matching projects with personnel development strategies. Therefore, this discussion opens up a wider space for understanding how project activity affects the international business development.

The researchers indicate the need for further research and development of specific strategies for effective management of international projects. The effective organization of the companies' operations and the use of the latest technologies remain important issues. They ensure well-established activities in an intercultural environment with high efficiency.

Conclusions and Further Research

The use of Agile, PMBOK and Scrum proved to be effective in project activities to support the functioning of international business. The study showed that project activity plays a key role in the development of international

business, contributing to the effective integration of various markets. Project activities increase the companies' competitiveness and adaptation to cultural peculiarities. The analysis of the literature and our own results give grounds to conclude that the use of Agile methodology, PMBOK standards, and innovative technologies significantly improve the management of international projects. Cultural sensitivity, involvement of local experts and partners, integration of corporate social responsibility are critical success factors. At the same time, adaptive management that takes into account local conditions and needs is required to reduce risks and ensure effective implementation of projects.

Implementation of project management in international business faces a number of problems and global challenges. Cultural and regional differences can create significant barriers to effective communication and collaboration between teams from different countries. Economic instability and regulatory challenges in various regions complicate project implementation and require additional resources to adapt to new conditions. The insufficient level of digital literacy and the lack of proper infrastructure in some countries slow down the process of introducing innovative technologies. They are critically necessary for the successful management of international projects. Existing problems with legal and regulatory aspects create additional difficulties for companies seeking to expand their activities in the global market.

The study of the impact of project activities on the international business development gives grounds to recommend the following measures.

1. Develop and implement standardized project management methodologies adapted to international conditions.
2. Conduct systematic training and advanced training of managers and employees participating in international projects.
3. Invest in the development of digital infrastructure and the introduction of modern technologies to improve the management and monitoring of international projects.
4. Develop flexible legal frameworks to support and regulate international projects.
5. Create mechanisms for monitoring and evaluating the effectiveness of international project management.

Credit Authorship Contribution Statement

Anna Kukharuk: Conceptualization, Methodology, Writing – review and editing;
Ruhiyya Nagiyeva Sadraddin: Investigation, Project administration, Validation;
Olha Anisimovych-Shevchuk: Software, Visualization.
Oksana Marukhlenko: Formal analysis, Data curation.
Mykhaylo Kapyrulya: Writing – original draft, Supervision.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Declaration of use of Generative AI and AI-Assisted Technologies

The authors declare that they have not used generative AI (a type of artificial intelligence technology that can produce various types of content including text, imagery, audio and synthetic data.

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Moderating Effect of Board Characteristics on the Association between Asset Liability Management and Financial Performance of Commercial Banks in Nigeria

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Abstract: Asset liability management and consistent improvement in financial performance are the responsibility of the Board of Directors of commercial banks, yet studies on the impact of asset liability management on the financial performance of commercial banks in Sub-Saharan Africa have excluded board characteristics variable from their statistical model. This study examines the moderating effect of board characteristics and asset liability management on the financial performance of commercial banks in Nigeria. Commercial banks. It was based on secondary data, obtained from annual reports of commercial banks in Nigeria, the study covered the period starting from 2012 to 2021 and it purposively selected eleven (11) commercial banks out of fourteen (14) commercial banks in Nigeria. The statistical analysis was done using LASSO (Least Absolute Shrinkage Selection Operator). The findings of the study revealed that the moderating effect of board characteristics and asset liability management had a statistically significant impact on the financial performance of commercial banks in Nigeria because the p-values (0.04;0.03,0.02,0.01, and 0.005) obtained using LASSO were less than the 5% statistical threshold used in this study. The study concluded that the board of directors of commercial banks in Nigeria should ensure that they appoint board members who have expertise and experience in the establishment of asset liability management since its interaction with board characteristics showed a statistically significant impact on the financial performance of the bank.

Keywords: financial performance; commercial banks; asset liability management; board characteristic.

JEL Classification: G21; G10; C10; C58; E44.

Introduction

Commercial banks in Nigeria (also called deposit money banks) play a central role in the country's economic development because, without their funding strategies, industrial growth will be impossible (Ilmiani and Meliza, 2022). Furthermore, the National Bureau of Statistics (2024) in Nigeria reported, that the contribution of the service sector, which also comprise of the banking industries, resulted in the growth of the gross domestic product (GDP) to ₦58,865,142.27 million in nominal terms, indicating a year-on-year nominal growth of 14.86%. This performance was higher than the first quarter of 2023 which stood at ₦51,242,151.21 million. The strategic role of the banking industry in the service sector is one of the major reasons stakeholders attach so much importance to its financial performance. In an ideal situation, the financial performance of banks should be at its optimal. However, in the last decade, some banks have reported unstable financial

performance, while other banks reported losses. Extensive studies have been conducted on the financial performance of commercial banks revolving majorly on the determinant of financial performance. However, one of the understudied factors, that may impact financial performance in the banking sector and has not been critically examined is asset liability management. Existing studies on the impact of asset liability management on financial performance emphasised a mixed relationship and inconclusive between both variables. Since, some of these studies (Abebe 2022, Wike *et al.* (2024), established that both positive and negative associations exist between asset liability management and financial performance.

The inconclusive results between asset liability management and financial performance may be attributable to the non-consideration of board characteristics as a moderator in the statistical model of existing studies, despite the strategic role of the board. Theoretically, the resource dependence and upper echelon theories position the board as an important resource that can strengthen or diminish the financial performance of the banks, as well as generate innovative ideas for strategic direction and execution. Therefore, the novelty of this study is that it seeks to contribute to knowledge by introducing board characteristics as a moderator in the association between asset liability management and financial performance. Existing studies (*e.g.*, Kazeem and Adeoye 2020; Isamail, *et al.* 2023; Wike, *et al.* 2024), only focus on the effect of asset liability management on financial performance of banks.

The manuscript is structured as follows: Section 2 presents the literature review and hypotheses. Section 3 describes the methodology Section 4 Research results Section 5 Discussion 6, Conclusion and further reading.

1. Literature Review

Asset Liability Management entails risk quantification and deliberate decision-making focused on the minimisation of risk and maximization of profit (Dsouza, *et al.* 2022) It is a management risk strategy focused on strengthening the shareholder's wealth by reducing risk and maximizing the return of the shareholders, thereby, enhancing the financial performance of the bank (Neves, *et al.* 2020). The board of directors of the banks can sustain the improvement of shareholder's wealth by ensuring the assets and liabilities of the shareholders are invested in only safe investment, thereby, protecting the capital of the shareholders from sudden economic crises (Dewasurendra, *et al.* 2019; Barmuta, *et al.* 2018; Almaqtari, *et al.* 2019). Asset liability management can also be defined as the management of the assets and liability of the bank by the board of the bank (Choudhry 2011), This also means that it is the responsibility of the board of the bank. Asset liability management was measured in this study using Liquidity risk, credit risk and interest rate risk. Liquidity risk was represented by customers' deposits, credit risk was represented by loans and advances of the bank while Interest rate risk was determined using the prevailing interest rate of the bank. The study of Novickytėa and Petraitytė (2014) also used only customer deposits, loans, and leverage, to represent asset liability management. Furthermore, the studies of (Lysiak, *et al.* 2022; Li, *et al.* 2022; Chen, *et al.* 2022) established that the board of commercial banks are responsible for determining the optimal risk management strategy, which is also a subset of asset liability management since, this will help to minimise liquidity risk, credit risk and interest rate risk of the bank and will help to mitigate sudden financial crisis that could erode the wealth of the shareholders.

Performance measurement is a highly fundamental factor that must be considered by financial institutions because it helps them survive the highly competitive environment where currently operate and also creates rapid opportunities for them to their performance (Surjan and Srivastava, 2019). Performance can be defined as a business's capacity to generate optimal returns. Banks introduce measures to improve their financial performance because of the risky nature of their business (Wonglimpiyarat, 2014). Financial performance is defined as the result of measuring the financial performance of an organisation in monetary terms. The financial performance is measured in this study using return on asset. Return on assets is a financial metric that indicates how well an organisation has utilised its earnings to fund its assets. It is the most commonly used in studies relating to asset liability management because it holistically addresses the fundamentals of corporate performance and the operational capacity of the bank (Issah, *et al*, 2017; Al-Matari *et al.* 2014). However, other asset-liability management studies adopted return on equity to measure financial performance. But, Issah *et al.* (2017), further, reinterred that return on asset is more suitable than the return on equity used by some other asset-liability management studies because the return on equity can be easily manipulated through financial engineering, particularly the equity components of the return of equity's formula, Although, (Mcclure, *et al.* 2021) opinned that even though the return on assets is not the only optimal financial ratio for the financial performance of an organisation the appropriate , It is the most dependable, effective, and extensively used financial indicator for determining performance.

The board is the apex organ in the banking industry. The experience and expertise of the board members may determine the extent of improvement in the financial performance of the bank (Ogan, and Kornom-gbaraba 2024). The metrics used for board characteristics in this study include; board size (Wokeh 2018), board independence (Ebire *et al.* 2024) and board gender diversity (Chuma and Yahaya 2024). Chen (2024) opined that weakness in the board characteristics of a financial institution was the main cause of the 2008 financial crisis. Wokeh (2018) posited that a large board size is less effective than a small one. In this study, it is computed based on the total number of directors.

Furthermore, as regards board independence, Ebire *et al.* (2024) documented that the higher the proportion of independent board members the more improved the financial performance of the banks, however. Ebire *et al. (*2024) showed that the presence of an independent director has a negative effect on the financial performance of the organisation while (Liu, *et al.* 2015) confirmed that a negative relationship exists between independent director and financial performance. Whereas (Mohapatra, 2016) confirmed that no relationship exists between independent boards and financial performance. In this study board independence is shown as a ratio of the number of executive directors/to the number of executive and non-executive directors. Similarly, according to the study of Chuma and Yahaya (2024), it was established that the existence of a balance between the male and female gender on the board of directors often creates more opportunities to increase the financial performance of the bank. In this study, it is obtained by dividing the number of female directors by the total number of board members (that is, both male and female board members).

Bank size can be described as the bank's capacity to earn and maintain a profit over a period of time (Almazari, 2014, Teimet *et al.* 2019), It is one of the control variables considered in this study because it certainly affects financial performance, asset liability management, and board characteristics. However, existing literature on bank size, showed that the relationship between bank size and financial performance as well as asset liability management is mixed because Alfadhli, M and Alali, M (2021) opined that a insignificant relationship exists between bank size and financial performance while Siebenbrunner *et al.* 2017 documented that the effect of bank size on financial performance and risk management, which is also a major part of asset liability management is positive. It is measured in this study, with a logarithm of the total asset and this was supported by the study of Mester (2010) claimed that bank size is calculated as a logarithm of total assets. Financial leverage is defined as the use of debt to finance business operations, it is preferred by most businesses because its inclusion in a given capital structure mix produces a lower weighted average cost of capital, thus improving the bank's returns and consequently leading to improvement in the financial performance. It is also one of the control variables in this study, it is measured in this study using the ratio of liabilities to assets. Niresh and Velnampy, (2012) opined that most bank managers depend on leverage to smoothly carry out their operations because it often has longer repayment terms thus creating room for financial improvement. Furthermore, Santos *et al.* (2023) posited that debt financing opens up several opportunities for financial institutions, some of which include stable interest rates, tax deductions and enhanced financial performance.

Board characteristics is a corporate governance mechanism that ensures the board of directors of deposit money banks minimises risk and uncertainty by adopting best practices in asset liability management policies thus, causing an improvement to the financial performance of the banks (Lysiak *et al.* 2022; Dsouza *et al.* 2022). This also implies that it will be non-scientific to explain the relationship between asset liability management and financial performance without considering the board characteristics element since it is the board of directors of the bank that is responsible for establishing the asset liability management which eventually gives direction to the financial performance of the commercial bank. This was also in tandem with the study of Ogan and Kornom-gbaraba (2024) who established that the board of directors of commercial banks are responsible for putting in place an asset liability management structure that will mitigate risk and uncertainties in the bank's operation thus improving the financial performance of banks, It is important to see the association between board characteristic, asset liability management and financial performance because asset liability management is the prerequisite for the stability and continued improvement in the financial performance of financial institutions (Mulyungi and Mukasinayobye 2017; Ajibola 2016), However, existing studies (*e.g.* Dsouza *et al.* 2022; Neves *et al.* 2020; Dewasurendra *et al.* 2019*;* Barmuta *et al.* 2019; Almaqtari *et al.* 2019) examining the effect of asset liability management on the financial performance of banks have not included board characteristics variable in their statistical model. To this end, the hypothesis for this study is formulated as follows:

H1: Board characteristics have no moderating role in the association between asset liability management and the financial performance of deposit money banks in Nigeria.

2. Methodology

The research adopted panel data, covering the period from 2012 to 2021. This period was chosen because Nigeria effectively adopted the International financial reporting standard in 2012. Also, the study encompassed all the twenty-three (23) quoted banks as of 31st December 2021 (CBN, 2021). These twenty-three (23) banks comprised fourteen (14) publicly listed banks and nine (9) privately listed banks. However, out of these twenty-three (23) banks, only eleven (11) were purposively chosen for this study, based on the following three (3) criteria. (i) The selected banks had complete annual reports from 2012 to 2021 on their official websites, (ii) the annual reports of the selected banks were presented using the domestic currency (Naira), and (iii) the selected banks were publicly quoted companies. Furthermore, the statistical analysis of the study was based on Descriptive and Inferential statistics. The Descriptive statistics included; mean, median, standard deviation, maximum and minimum while the inferential statistics included LASSO (Least absolute shrinkage and selection operator) variable reduction technique. Pairwise Correlation, Breusch-Pagan test, Panel Cross-section Heteroskedasticity

LR Test, Arellano-Bond Serial Correlation Test, and Hausman test, According to Tibshirani, (1996), this LASSO statistical technique ensures regularisation of variables and accurate variable selection which eventually lead to accurate statistical discussion of results technique. This was also supported by the study of Kumar, (2023), who emphasised that the LASSO statistical technique eliminates some variables in a model because they may contain some outlier values that may affect the correct interpretation of statistical results.

Table 1. Measurement of Variables

S/N	Variable Name	Measurement/ Indicators/proxy	A priori Expectation	Sources
1.	Financial performance (Return on Asset).	It was represented by return on asset which was obtained with the ratio of profit after tax to total assets.	Positive	Kazeem and Adeoye (2020)
2.	Liquidity risk	It was represented by the customer's deposit from .2012-2020.	Negative	Kazeem and Adeoye (2020)
3.	Interest rate risk	It was represented by the interest rate of deposit money banks starting from 2012 to 2020	Positive	Kazeem and Adeoye (2020)
4.	Credit risk	It was represented by loans and advances from 2012 to 2020.	Positive	Kazeem and Adeoye (2020)
5.	Board Characteristics	It was represented by i. Board size (this was the addition of both Executive and non-executive Directors shown under the corporate governance section of the various deposit money banks). ii. Board gender Diversity (This was derived by dividing the number of female directors by the total number of directors in the bank).	positive Positive	Ogan and Kornom-gbaraba (2024)
	Board Characteristics(Continuation)	iii. bboard meetings (This refers to the number of meetings held by the board of directors, shown under the cooperate governance section in the annual report) iv. Board independence (This was derived by dividing the number of Non-executive director by the total number of directors in the banks)	positive positive	Ogan and Kornom-gbaraba (2024)
6.	Leverage	It was represented by the ratio of the total liabilities to total asset	Positive	Niresh and Velnampy (2012)

Source: Literature review

Data for asset liability management, board characteristics and financial performance were obtained from annual reports of banks, and this was similar to the approach adopted in the studies of (Ajibola 2016; Njogo *et al.* 2014; Onaolapo and Adegoke 2020), While data on control variables were also obtained from the bank's annual report and World Bank Development Indicator Database available on the internet (WDI 2015). The statistical model to examine the moderating effect of asset liability management, board characteristics and financial performance of Nigeria banks adopted for this study is stated as follows

$$ROA_{it} = \beta_0 + \beta_1 LQR_{it} * \beta_2 GEN_{it} + \beta_3 LQR_{it} * \beta_4 BSIZ_{it} + \beta_5 LQR_{it} * \beta_6 DEPD_{it} + \beta_7 LQR_{it} * \beta_8 MEET_{it} + \beta_9 CRR * \beta_{10} BMEET + \beta_{11} CRR * \beta_{12} GEN + \beta_{13} DEPD * + \beta_{14} CRR + \beta_{15} INT * \beta_{16} BMEET + \beta_{17} INT * \beta_{17} GEN + \beta_{18} DEPD * \beta_{19} INT + \beta_{20} LEV_{it} + \beta_{21} BkSZ + e_{it}$$

Where:

- ROA means the return on an asset which represents the financial performance

- $LQR_{it} * GEN_{it}$ means liquidity risk interacted with board gender diversity

- $LQR_{it} * DEPD_{it}$ means liquidity risk interacted with board independence

- $LQR_{it} * MEET_{it}$ means liquidity risk interacted with board meetings

- LQR_{it} * BSIZ means liquidity risk interacted with board size
- CRR_{it} * GEN means credit risk interacted with board gender diversity
- $CRR_{it} * \beta_2 BSIZ_{it}$ means credit risk interacted with board size
- $CRR_{it} * MEET_{it}$ means credit risk interacted with board meetings
- $CRR_{it} * DEPD_{it}$ means credit risk interacted with board independence
- $CRR_{it} * GEN_{it}$ means interest rate risk interacted with board gender diversity
- $INTRR_{it} * BSIZ_{it}$ means interest rate risk interacted with board size
- $INTRR_{it} * DEPD_{it}$ means interest rate risk interacted with board independence
- $INTRR_{it} * MEET_{it}$ means interest rate risk interacted with board meetings
- $INTRR_{it} * GEN_{it}$ means interest rate risk interacted with board gender diversity
- BkSZ means Bank size (Control Variable) represented by the natural logarithm of total asset
- LEV means leverage (Control Variable) represented by Total liability / Total Asset
- β_0 means Intercept
- β_1 to β_{20} = Regression Coefficient.
- i = Individual deposit money banks used in the study
- t = Time frame in the study

4. Regression Results

The result of the descriptive statistics conducted on the variables used in achieving the objective of this study, which was, to evaluate the moderating/interactive effect of asset liability management, board characteristics and financial performance of commercial banks in Nigeria are reported in this section. Table 1 contains the descriptive statistics of the variables such as the mean, median, standard deviation, minimum and maximum. The statistics aided the study in assessing the quality of the data and identifying the presence of outliers which might affect the robustness of the model. The average value for return on asset was 0.01609 and the standard deviation was 0.0199. This implied that the mean of return on assets of the banks had close variation to the standard deviation. The maximum return on asset was 0.061307 and the least was -0.110538, the median of 0.013594 indicated that more than 50% of the bank return of asset clustered around the mean because the value of the mean and median were almost the same.

Furthermore, the liquidity risk (LQR) of the banks reported an average of 27.85 and a standard deviation of 1.9751. While the maximum was 34.24 and the minimum was 22.394. The log of the loans and advances showed that most of the banks were less exposed to liquidity risk because the mean and the standard deviation were close in value. This also implied that the banks had a holistic liquidity risk strategy which helped them to minimize their exposure to liquidity challenges. The financial leverage of the banks showed that on average the ratio of debt to asset was 0.8705 the minimum ratio was 0.00063 and the maximum was 3. The Bank size reports an average of 28.4780 and a standard deviation of 1.6987. The maximum was 35.282 and the minimum was 25,62. The interest rate on average was 8.233 and the maximum was 13.5961. The lowest interest rate was 0.4459. The standard deviation of the interest rate was 3.112. The credit risk and log of business growth report an average of 27.45021 and 24.87029 respectively. The lowest CRR was 22.37423 and the maximum was 33.78002. The log of business growth was 19.03982 and the maximum was 31.20932. The result of the normality test showed that all the variables were not normally distributed with p-values less than 0.05.

Furthermore, Table 1, also, showed that the board size (BSIZ) of the banks showed an average of 13.745 and a standard deviation of 2.928. The maximum was 20.00 and the minimum was 6.000. Board independence of the banks reports an average of 0.5778 and a standard deviation of 0.0923. The maximum was 0.9090. The financial leverage of the banks showed that on average the ratio of debt to asset was 0.8705 the minimum ratio was 0.00063 and the maximum was 3. The Bank size reports an average of 28.4780 and a standard deviation of 1.6987. The maximum was 35.282 and the minimum was 25,62. Gender diversity on average was 0.2199 and the maximum was 0.4545. The board meeting had an average of 5.8818 and a median of 5.000. This showed that on average the bank's board held 5 meetings. The variable of INF reported an average of 12.3660 and a standard deviation of 3.1120. The minimum of INF was 8.060 and the maximum of the INF was 16.950. The log of business growth was 19.03982 and the maximum was 31.20932.

4.1 Pairwise Correlation Result

Tables 2 and 3 presented the pairwise correlation of the variables used in assessing the effect of asset liability management, board characteristics and financial performance of banks in Nigeria. The correlation analysis was carried out among the independent variables of the study to ascertain the degree of independence of the explanatory variables. The

result revealed that the independent variables included in the study exhibited weak correlations with each other, which implies that all the independent variables are very suitable for the model. This is in tandem with the study of Damodar (2004), who posited that the correlation coefficient among regressors will be suitable for regression analysis if it does not exceed a benchmark value of 0.80. LASSO (Least Absolute Shrinkage and Selector Operator), Pairwise Correlation, Breusch-Pagan test, Panel Cross-section Heteroskedasticity LR Test, Arellano-Bond Serial Correlation Test and Hausman test Result for the Interactive Effect of Board Characteristics and Asset Liability Management on Financial Performance of Banks in Nigeria.

Table 4 shows the regression outputs of the interactive effect of board characteristics and asset liability management on the financial performance of deposit money banks in Nigeria. The study adopted LASSO (*i.e.* least absolute shrinkage and selection operator) by incorporating it with the backward elimination method. The result revealed that board meetings, board gender diversity and board independence were the only proxies of board characteristics selected by the LASSO statistical technique, these three variables then interacted with variables representing asset liability management (liquidity risk, interest rate risk, credit risk) to produce a statistically significant effect on financial performance of the bank. Also, according to Kumar (2023), the LASSO statistical technique eliminates some variables in a model because they may contain some outlier values that may affect the correct interpretation of statistical results.

Furthermore, the findings showed that the regression model produced an R-squared value of 65.8% which implied that the dependent variable was adequately accounted for by the independent variable. The f-value of 8.5922, showed that the independent variable was jointly significant at 5%. The result further revealed that board meetings positively interacted with credit risk to affect the financial performance of the banks since the P-valued (0.03) obtained was less than 5%, Also interest rate risk positively interacted with board meetings because the result of the P-value was (0.03) and this was also less than the 5% statistical threshold used for this study. This also implied that the higher the number of board meetings held by the board of directors the more effective the asset liability management, as well as, financial performance of the bank since, the board meeting often create an opportunity for the directors to critically, professionally review and evaluate activities of the bank and align themselves with shareholders interest over some time, although this might not always translate to improvement in interest rate risk and credit risk management (Allegrini and Greco 2013). Furthermore, Gender diversity and credit risk showed positive interaction with the financial performance of the banks because the p-value (0.02) that was less than the 5% statistical threshold used in this study. This is in agreement with the study of (Garba and Abubakar, 2014) who confirmed that the presence of female board members will enhance the bank's financial performance as well as asset liability management.

Table 2. Descriptive Statistics

Variable	Mean	Median	Maximum	Minimum	Std. Dev.	Observations
ROA	0.016	0.0135	0.0613	-0.1105	0.0199	110
BSIZ	13.7454	14	20	6	2.9286	110
DEPD	0.5778	0.5893	0.909	0.1666	0.0923	110
GEN	0.2199	0.2085	0.4545	0.0555	0.0786	110
BMEET	5.8818	5	16	1	2.3451	110
LQR	27.85545	27.78851	34.24457	22.39474	1.975101	110
INT	8.233726	6.455521	13.59615	4.522189	3.133655	110
CRR	27.45021	27.27761	33.78002	22.37423	1.700678	110
LEV	0.8705	0.8676	3.0074	0.0006	0.3422	110
LGBGWT	24.8702	24.8913	31.2093	19.0398	2.3065	110
INF	12.366	12.155	16.95	8.06	3.112	110
BKSZ	28.478	28.2231	35.2827	25.6282	1.6987	110

Source: Author's Computation, 2023.

Similarly, board independence another proxy of board characteristics revealed a significant interaction with the liquidity risk and credit risk. Since the p-values (0.01 and 0.005) obtained using LASSO were less than the 5% statistical threshold used for this study. This statement was corroborated by the studies of (Abu *et al.* 2016; Muller 2014) who emphasised that increases in the number of independent board members expose the banks to professional expertise which causes improvement in the asset liability management structure as well as the financial performance of the bank. Thus, it can be inferred that the interaction of board characteristics and asset liability management has a statistically significant influence on the financial performance of the bank. This is in agreement with the studies of (Bathula 2008; Javed *et al.*

2013) who emphasised that the board of director have a statistically significant influence on asset liability management and the financial performance of the bank. Furthermore, the result of the Arellano-Bond Serial Correlation Test Panel Cross-section Heteroskedasticity Likelihood Ratio Test and Breusch-Pagan Test revealed that the model residual value failed to violate the assumption of no serial correlation and heteroskedasticity of a least square regression model. Also, the Hausman test, confirmed that the Redundant Fixed Effects Test is the most appropriate for the study, since its P-value (*i.e.* 0.00000) was less than the 5% statistical threshold used for this study.

Table 3. Correlation Matrix for asset liability management and control variables

Correlation									
Probability	ROA	BSIZ	DEPD	GEN	BMEET	LEV	LGBGWT	BKSZ	INF
ROA (r)	1.0000								

BSIZ (r)	-0.0258	1.0000							
(p-value)	(0.7883)	-----							
DEPD (r)	0.0119	-0.0723	1.0000						
(p-value)	(0.9017)	(0.4526)	-----						
GEN (r)	-0.0784	-0.2065	-0.0211	1.0000					
(p-value)	(0.4154)	(0.0304)	(0.8265)	-----					
BMEET(r)	-0.0765	0.3188	0.0319	0.0308	1.0000				
(p-value)	(0.4266)	(0.0007)	(0.7402)	(0.7489)	-----				
LEV (r)	-0.0096	0.1394	-0.0004	-0.0004	-0.0772	1.0000			
(p-value)	(0.9207)	(0.1461)	0.9960	(0.9966)	(0.4223)	-----			
LGBGWT (r)	-0.0259	0.0047	-0.0898	-0.2146	0.1061	-0.0205	1.0000		
(p-value)	(0.7878)	(0.9611)	(0.3504)	(0.0243)	(0.2697)	(0.8315)	-----		
BKSZ (r)	0.0700	0.2328	-0.0695	-0.3029	-0.1208	0.3859	0.0624	1.0000	
(p-value)	(0.4668)	(0.0144)	(0.4706)	(0.0013)	(0.2086)	(0.0000)	(0.5172)	-----	
INF (r)	-0.0055	0.0537	0.0229	0.0171	-0.1025	0.1413	-0.1061	0.1294	1.0000
(p-value)	(0.9537)	(0.5768)	(0.8116)	(0.8589)	(0.2862)	(0.1407)	(0.2699)	(0.1777)	-----

Source: Author's Computation, 2023.

Where (r)= correlation coefficient value, p-value= probability value, LEV= Financial leverage, LGBGWT= Bank growth, BKSZ= Bank Size INF=Inflation, BMEET=Board Meeting, GEN=Gender, BSIZ=Board Size ROA=Return on asset, DEPD= Board dependence.

Table 4. Correlation result for board characteristics and control variables

Correlation								
Probability	ROA	LQR	LEV	BKSZ	INF	INT	CRR	LGBGWT
ROA	1.0000							

LQR (r)	-0.0230	1.0000						
(p-value)	(0.8110)	-----						
LEV (r)	-0.0096	0.0281	1.0000					
(p-value)	(0.9206)	(0.7704)	-----					
BKSZ(r)	0.0699	-0.0300	0.3859	1.0000				
(p-value)	(0.4679)	(0.7555)	(0.0000)	-----				
INF (r)	-0.0057	0.1407	0.1413	0.1294	1.0000			
(p-value)	(0.9527)	(0.1426)	(0.1407)	(0.1777)	-----			
INT (r)	0.1018	0.0680	-0.0626	0.0755	0.0861	1.0000		
(p-value)	(0.2896)	(0.4799)	(0.5155)	(0.4329)	(0.3708)	-----		
CRR (r)	-0.0440	0.3594	0.0131	-0.1550	0.003844	-0.1087	1.0000	
(p-value)	(0.6475)	(0.0000)	(0.8913)	(0.1059)	(0.9682)	(0.2579)	-----	
LGBGWT(r)	-0.0262	-0.0499	0.0086	0.0569	0.0333	-0.0804	-0.1558	1.0000
(p-value)	(0.7851)	(0.6045)	(0.9285)	(0.5545)	(0.7294)	(0.4034)	(0.1040)	-----

Source: Author's Computation, 2023.

Where ROA**=** Return on asset LGBGWT=Bank growth CRR= Credit risk INT =Interest rate INF = Inflation BKSZ = Bank size LEV = Financial leverage LQR = Liquidity risk, (r) = Correlation coefficient, (p-value) = probability value

Table 5. LASSO Result showing the interaction of asset liability management board characteristics and financial performance of banks in Nigeria.

	Pooled OLS			Fixed Effect			Random Effect Model		
	Coef.	t-value	p-value	Coef.	t-value	p-value	Coef.	t-value	p-value
BMEET*LQR	0.0820	0.812372	0.4185	0.075644	1.016295	0.3122	0.082067	1.134121	0.2595
CRR*BMEET	-0.0888	-0.881092	0.3804	-0.083419	-2.124061	0.0361	-0.088811	-1.230059	0.2216
INT*BMEET	0.0192	0.780309	0.4371	0.022461	2.201587	0.0300	0.019248	1.089359	0.2786
GEN*LQR	-0.0344	-0.019126	0.9848	1.551450	1.169406	0.2454	-0.034424	-0.026700	0.9788
CRR*GEN	-0.1058	-0.058095	0.9538	-1.639584	-2.225834	0.0283	-0.105894	-0.081105	0.9355
INT*GEN	1.0059	1.587895	0.1155	0.356119	0.748975	0.4558	1.005931	2.216798	0.0289
DEPD*LQR	-2.2982	-1.922373	0.0574	-2.289601	-2.525409	0.0133	-2.298286	-2.683749	0.0085
DEPD*CRR	2.6155	2.220845	0.0286	2.530643	2.837613	0.0056	2.615550	3.100434	0.0025
DEPD*INT	-0.4318	-1.248917	0.2146	-0.213808	-0.804790	0.4231	-0.431892	-1.743563	0.0843
LEV	-0.0439	-0.084977	0.9325	1.217936	2.569813	0.0118	-0.043962	-0.118634	0.9058
C	-1.6719	-1.187362	0.2379	-1.839035	-1.513522	0.1337	-1.671955	-1.657630	0.1006
R-squared	0.2602			0.6588			0.2602		
Adjusted R-squared	0.1855			0.5821			0.1855		
F-statistic	3.4836			8.5922			3.4836		
Prob(F-statistic)	0.0005			0.0000			0.0005		

Source: Author's Computation, 2023.

5. Discussion

The findings of this study revealed that the moderating effect of board characteristics on asset liability management and financial performance of deposit money banks was statistically significant since the result of the LASSO statistical technique showed that some of the variables representing asset liability management and board characteristics (*e.g.* interest rate risk and board meeting) had a statistically significant effect on the financial performance of the banks. This was supported by the output of the LASSO statistical technique which gave a p-value (p=0.0300) that was less than 5% level of significance. The implication of this is that that increase in board meetings provided the board members with the opportunity to discuss proactively the success of the bank. This narrative was in tandem with the view of (Allegrini and Greco 2013), who emphasised that an increase in board meetings leads to professional evaluation of the previous performance of the banks, to maximise the interest of the shareholders.

Conclusion and Further Research

The main goal of this study is to advance knowledge about the moderating effect of, board characteristics on asset liability management and financial performance of banks in Nigeria. It statistically established that the interaction of the proxies of board characteristics (board gender diversity, board independence and board meeting), as well as the proxy of asset liability management (credit risk, liquidity risk and interest rate risk), analysed using the LASSO (least absolute shrinkage and selection operator) statistical technique, produced a statistically significant effect on the financial performance of banks.

The study further concluded that since, this study has statistically shown that the board of director has significant impact on the asset liability management policy as well as financial performance of the banks. The Chairman of the bank and the other board members must ensure that they attend seminar that enhance their ability to effectively and efficiently manage the asset liability management policies and structure of the bank.

The study suggested that further research should be conducted on other countries in Sub-Saharan Africa, since the conclusion was only based on data obtained from Nigeria.

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Credit Authorship Contribution Statement

Oluwafemi Philip Akinselure: Conceptualization, investigation, Methodology, Project administration, Software formal analysis, Writing - original draft, Supervision, Data curation, Validation, Writing-review and editing, Visualisation, funding acquisition
Tajudeen John Ayoola: Conceptualization, investigation, Methodology, Project administration, Software formal analysis, Writing - original draft, Supervision, Data curation, Validation, Writing-review and editing, Visualisation, funding acquisition.
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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Declaration of use of Generative AI and AI-Assisted Technologies

The authors declare that they have not used generative AI (a type of artificial intelligence technology that can produce various types of content including text, imagery, audio and synthetic data.

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Strategy for the Development of the Investment Potential of the Tourism Industry of Ukraine in the International Economic System

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Abstract: The purpose of this study is to establish a robust strategic framework for the development of investment potential within Ukraine's tourism industry during the post-conflict period. The methodology involves a systematic approach encompassing literature review, conceptual framework development, measurement of corporate responsibility, creation of indicative indicators, implementation stages, and cross-border cooperation. As a result, the article presents a model of the functional platform of the international economic system, which forms the concept of the State's investment policy on the basis of corporate socio-economic responsibility and implements the strategy of development of the tourism industry. From the standpoint of a holistic view of the strategic development of the investment potential of the tourism industry, the range of measurement of corporate socio-economic responsibility of joint investment institutions and their partnerships is presented. A methodical approach to the formation of indicative indicators of the first and second levels, which activate the investment development of the tourism industry in the regions of the country, has been developed. The stages of implementation of measures for the strategic development of the investment potential of the tourism industry in the context of international turbulence are presented. The developed proposals can be successfully implemented when planning programs for the development of the tourism industry of Ukraine on the basis of cross-border cooperation of regional associations, in order to support the national economic system of Ukraine.

Keywords: investment capacity; development programs; post-conflict recovery; tourist destinations; socially oriented market economy.

JEL Classification: D25; E22; H56; P33; P45; R11.

Introduction

The revival of Ukraine in the post-war period involves a system of measures and tasks aimed at overcoming the post-war crisis in the tourism sector, reviving travel by building a model of strategic development of the investment potential of the tourism industry, strengthening the investment attractiveness of territories, forming a resort landscape and recreation areas. It should be noted that the tourism sector in Ukraine is a structural link of the state's national economy and adapted to the principles of targeted use of investment resources, which are an integral part of the international economic system. However, in wartime, the low level of investment activity of tourism market subjects in the absence of a complex of domestic state support led to an increase in crisis investment processes and the inability to diversify the development of the tourism industry, due to global challenges and threats in the country (Puzyrova 2022). Currently, in the "stressful" war period, which, according to international organizations, has weakened its own model of forecasting the further development of the tourism industry, led to the loss of some connections, complicated the timeliness of international investment in the resource component of the tourism sector, increased investment risks and weakened the country's investment policy (Smochko *et al.* 2022). Therefore, the harmonization of international relations regarding the restoration of a high level of confidence of foreign investors in doing business in the tourism industry, in particular in the matter of overcoming the spatial polarization of investment flows, should be regulated through the introduction of new reforms in the country's economy, related to the additional attraction of investment resources for resource provision and economic activity of the subjects of the tourist market.

In the post-conflict period of development of the national economy of Ukraine, the share of tourism services in the structure of gross domestic product (GDP) and its consumption will grow. The latest information and communication technologies, e-commerce and other resources of the information economy will be intensively integrated into the tourism industry. Investment processes in Ukraine, which at the current stage have low dynamics of development in the tourism industry, will in the near future be coordinated by new mechanisms for investing in tourist infrastructure in accordance with international requirements, taking into account the potential of tourist resources, which is integrated into the country's macroeconomic development strategy, based on innovative forms of management tourist activity, as well as the principles of diversification of the development of the economic system of the state as a whole. In accordance with the requirements of the international tourist space and the threats associated with the operation of the visa-free regime with the giant countries of the European tourism business and the implementation of a transparent investment policy with the gradual transition of Ukraine to a new paradigm of strategic development of the investment potential of the tourism industry, state regulation of investment processes of the tourism market is being developed in the post-war period, in order to increase the economic integration of the subjects of the tourism market (Apakhayev *et al*. 2017).

Tymoshenko (2021), Serhiienko and Baranova (2022), Trusova (2020) have paid a lot of attention to the directions of investment development of the tourism industry in countries around the world in their own studies. Thus, in the study of the concept of smart tourism management, Tymoshenko (2021) formulated proposals for the introduction of public administration mechanisms in the field of tourism at the regional and local levels, considering the decentralisation reform, using the concept of "smart tourism destination", which will help in the development of a modern system of sustainable management of tourist destinations and regions. An integral analysis of investment attractiveness in Ukraine was carried out by Serhiienko and Baranova (2022), the results of which revealed the regions with the greatest attractiveness for the development of tourism (Lviv, Odesa, and Kyiv). Scientists have also conducted a reduction of indicators in the direction of narrowing the number of investment attractiveness factors of the tourism sector using factor analysis.

Scientists Radchenko and Horbachenko (2021), Dombrovska *et al.* (2016), Getzner and Moroz (2021), Melnyk and Kasianok (2017), Mozgovyi *et al.* (2015), Puzyryova (2022), Trusova *et al.* (2022a; 2022b) have been developing mechanisms for implementing the state strategy for the development of the tourism industry. In particular, Radchenko and Horbachenko (2021) defined the structural and functional content of the category "development of the tourism industry", which allowed to formulate the concept of the main parameters of the tourism industry development. The scientists proposed a mechanism for the adaptive and integrated use of Ukraine's existing tourist and recreational potential, and developed the main ways to implement the state's foreign policy in conditions of uncertainty (coronavirus pandemic, ban on free border crossing).

The negative impact of military conflicts on the regional development of Ukraine, in particular the tourism sector, was highlighted in the study by Getzner and Moroz (2021), who emphasised the need to consider public policy options that support territorial capital, namely, promoting the development of municipal investments within the national economy. Considering the key tasks of the tourism industry in Ukraine, Puzyryova (2022) emphasises that one of these tasks is the need to activate the mechanism for implementing the European integration strategy for tourism development in Ukraine, as this will revive the natural tourist flow. The scientist proves that comprehensive government actions to implement the European integration strategy for tourism development in Ukraine will contribute to increasing the competitiveness of national and regional tourism products, improving the quality of life of the population, developing tourism opportunities in accordance with European standards and creating new jobs.

However, fundamental scientific results did not acquire new substantiated methodological approaches, as well as practical recommendations regarding state regulation of the investment potential of the tourism industry at the national level and its revival in the post-conflict period. The purpose of this research is to establish a robust model for the strategic development of Ukraine's tourism industry investment potential in the post-conflict era. This model aims to create a comprehensive framework within the international economic system, facilitating the formulation of a national, regional, and cross-border investment policy. The main objectives of the study are:

– develop a comprehensive model for the strategic development of the investment potential of Ukraine's tourism industry in the post-conflict period;

– examine and analyse the international economic system to identify opportunities and challenges for the implementation of the proposed model;

– formulate a national investment policy that aligns with the strategic development model, emphasizing the role of the tourism industry in economic recovery.

1. Materials and Methods

The study was carried out by combining the following methods: system analysis (for quantitative and qualitative visualisation of indicators); mathematical modelling (for building an economic and mathematical model); abstraction (for identifying the main levels of international partnership); graphical, which allowed to present the results in the form of diagrams and figures; and summarising the results and drawing conclusions.

The theoretical basis of this work is the scientific works of Ukrainian, English, American and other scientists who have studied the problems of development of the investment potential of tourism in different countries. Application of the methods of system analysis allowed to carry out quantitative and qualitative visualisation of the main indicators of the investment status of tourism industry entities. Considering the stimulating and disincentive factors with the initial standardised indicators of the spheres of sustainable investment development of the region allowed to present a methodology for calculating the integral indicator of investment development. The method of abstraction allowed to identify the main levels of international partnership in the strategy of development of foreign investment potential of the tourism industry of Ukraine.

To assess the influence of local budgets on the differentiation of the regions of the state by the level of development of the investment potential of the tourism industry, considering the complexity of formalizing the influence of the specified factors, an economic-mathematical model built using fuzzy logic methods was used formula (1) (Goyko 1999; Kuklik 2011; Makukh and Stechyshyn 2009):

$$Y = f(x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8, x_9, x_{10}, x_{11}), \quad (1)$$

where, x_1– index "Reproduction of joint investment in the (region) of the country with the support of international partners"; x_2 – index "Financing of tourist destinations at the expense of local budgets in a disproportional investment environment of a region (country) with a weakened economic system"; x_3 – index "Reproduction of investment sustainability of tourist destinations in a disproportional investment environment of a region (country) with a weakened economic system"; x_4 – index "Reproduction of demand for tourist services in regions (countries) with a weakened economic system"; x_5 – index "Reproduction of the demographic situation in the disproportional investment environment of the region (country) with a weakened economic system"; x_6 – index "Social environment of the region (country)"; x_7 – index "Comfortable life in the region (country)"; x_8 – index "Welfare of the population in the region (country)"; x_9 – index "Dignity of labour in the region (country)"; x_{10} – index "Level of education in the region (country)"; x_{11} – index "Ecological environment in the region (country)".

Thus, the level of development of the investment potential of the tourism industry of Ukraine on the platform of the international economic system will be considered sufficient according to formula (2) (Goyko 1999; Kuklik 2011; Ryabih 2008):

$$\sum IP_{ti}^{Ukraine^{ies}} = \sum IR_{ijii}^{i} + \sum IC_{ip(p)rac}^{i},\ i = [1; \infty], \quad (2)$$

where, $IP_{ti}^{Ukraine^{ies}}$ – investment potential of the tourism industry of Ukraine; IR_{ijii}^{i} – the total volume of investment resources for the development of the tourism industry from the *i*-th subject of the branches of the economy of Ukraine, international institutions of joint investment, TNCs, interested investors of certain regions and states of the international partner community; $\mathrm{IC}_{\mathrm{ip(p)rac}}^{\mathrm{i}}$ – the total amount of investment capacity of projects (programs) for the development of the tourism industry in the *i*-th regional association of countries.

Then, the composite index of the investment capacity of projects (programs) for the development of the tourism industry of Ukraine will have the formula (3) (Goyko 1999; Kuklik 2011; Ryabih 2008):

$$I_{i}^{IC_{ip(p)rac}} = \frac{\sum IR_{ijii}^{i}}{\sum IP_{ti}^{Ukraine^{ies}}},\ i = [1; \infty], \quad (3)$$

For resource-seeking investors, the most important is the security rating, which can be determined by the corresponding ratio of the region's security with investment resources by the formula (4) (Goyko 1999; Kuklik 2011; Ryabih 2008):

$$C_{\underset{pir_{Ukraine}}{ra}} = \frac{\sum IP_{ti}^{Ukraine^{ra}}}{\sum IC_{ra}^{i}},\ i = [1; \infty], \quad (4)$$

where, $\mathrm{C}_{\underset{\mathrm{pir_{Ukraine}}}{\mathrm{ra}}}$ – coefficient of provision of investment resources for the development of the tourism industry of Ukraine from regional associations of the territorial and innovative type; $\mathrm{IP}_{\mathrm{ti}}^{\mathrm{Ukraine^{ra}}}$ – investment potential of regional associations of the territorial and innovative type for the development of the tourism industry of Ukraine; $\mathrm{IC}_{\mathrm{ra}}^{\mathrm{i}}$ – investment capacity of projects (programs) for the development of the tourism industry of Ukraine, implemented by regional associations of the territorial and innovative type.

For cost-oriented investors, the inverse index of specific investment capacity (formula (5)) is most in demand (Goyko 1999; Kuklik 2011; Ryabih 2008):

$$IC_{ra}^{ip_{tiUkraine}} = \frac{\sum IC_{ra}^{i}}{\sum IP_{ti}^{Ukraine^{ra}}},\ i = [1; \infty], \quad (5)$$

where, $\mathrm{C}_{\mathrm{ra}}^{\mathrm{ip_{tiUkraine}}}$ – index of specific investment capacity.

For market-oriented investors, both of the indicated ratings, adjusted for the size of the possible reinvestment of a share of newly created capital, can be of greatest interest (formula (6, 7)) (Goyko 1999; Kuklik 2011; Ryabih 2008):

$$C_{\underset{pir_{Ukraine}}{ra}} = \frac{\left(\sum IP_{ti}^{Ukraine^{ra}} + \Delta C_{ip_{ti}} \times C_r\right)}{\sum IC_{ra}^{i}}, \quad (6)$$

$$IC_{ra}^{ip_{tiUkraine}} = \frac{\left(\sum IC_{ra}^{i} - \Delta C_{ip_{ti}} \times C_r\right)}{\sum IP_{ti}^{Ukraine^{ra}}}, \quad (7)$$

where, $\Delta \mathrm{C}_{\mathrm{ip_{ti}}}$ – capital gain as a result of the implementation of investment projects (programs) for the development of the tourism industry of Ukraine, implemented by regional associations of the territorial and innovative type; $\mathrm{C_r}$ – reinvestment ratio.

Graphical, which allowed to present the results in the form of diagrams: a model of the functional platform of the international economic system and international partnership in the strategy for developing the investment potential of the tourism industry of Ukraine; the concept of the strategy for the development of investment policy of Ukraine in the tourism industry; and the formed levels of investment capacity of projects (programmes) for the development of the tourism industry in Ukraine.

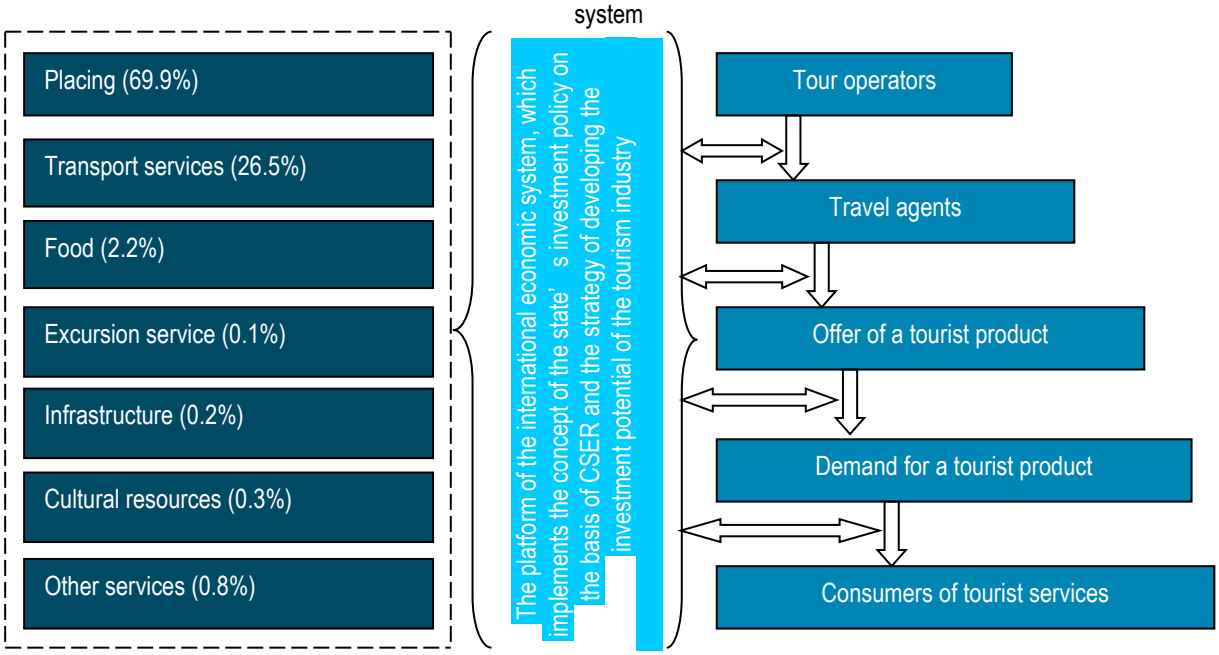
2. Results

2.1. Characterisation and Implementation of the CSER-Based Model

Depending on the tasks and the level of detailing of the stated goals of the state, the investment potential of the tourism industry is formed, which differs both in essence and in the form of its resource provision. All strategic areas of development of the investment potential of the tourism industry in any country can have a systemic

nature. They need to be considered and resolved in a close relationship on the platform of the international economic system and on the basis of Centre for the Study of Existential Risk (CSER) of the tourism business. The system approach, as a direction of the methodology of the tourism industry, defines it as an object with a whole set of elements connected by connections and partnership relations (Gribova 2020; Makukh and Stechyshyn 2009). It enables the construction of a high-quality model of the strategic development of the investment potential of the tourism industry on the basis of the international platform of the economic system, which realizes the corporate social and economic responsibility of the entities of the tourism industry and demonstrates the ability to invest investment resources, meet the needs of consumers and rebuild the economy in cooperation with the state (Goyko 1999). At the same time, the tourism industry, within which subjects of about 50 branches invest investment resources in the development of the economy, demonstrates the typology of interaction of two main groups of the tourist market (consumers of tourist services and subjects who provide these services (tour operators and travel agents)), is ensured by the international market situation and forms a holistic process of investing investment resources on the basis of corporate social and economic responsibility (Figure 1).

Figure 1. The model of the functional platform of the international economic system



Source: compiled by the authors.

From the standpoint of a holistic view of the strategic development of the investment potential of the tourism industry in the international economic system, the range of measurement of CSER of joint investment institutions and their partnership relations with the aim of achieving stability of economic results and another common goal is presented (Table 1).

Thus, taking into account the range of measurement of CSER of joint investment institutions as a holistic view of the strategic development of the investment potential of the tourism industry in the international economic system, the authors proposed to interpret it, which embodies: international partnership relations in the tourism industry, which arise on the basis of joint investment institutions between tourism corporations, on the one hand, and stakeholders on the other (in addition to shareholders, employees, managers, suppliers, consumers, governments of European states, local self-government bodies, territorial communities are involved), for the implementation of investment policy in the country, takes into account socio-economic and cultural characteristics, with respect for human rights, improvement of safe conditions for accommodation of consumers of tourist services in places of rest, provision of tourist transport services, catering, excursion services, expansion of infrastructure, improvement of safety of tourist activities, raising the level of well-being of the population, creating conditions for reducing and eliminating the negative impact of activities subjects of other branches of the economy on the environment and cultural heritage of tourist destinations (improvement of the condition), rational use of natural and cultural resources, growth of the economic stability of the state.

An important component of the process of developing the investment potential of the tourism industry is the evaluation of the effectiveness of strategic measures and their corresponding changes taking place in the

areas of military conflict and the rapid transformation of stereotypes of the old model of the state's investment policy (Makukh and Stechyshyn 2009).

Table 1. The dimension of CSER measurement of joint investment institutions of the tourism industry in the international economic system

Dimension	Coding of the dimension	Range of the dimension
Ecological dimension	Corporate responsibility of joint investment institutions of tourism business for the natural environment and cultural heritage of territories within the international economic system	cleaner environment; the amount of planned strategic measures to restore the natural environment and cultural heritage of tourist destinations; environmental problems in the economic activity of tourists
Social dimension	Corporate social responsibility of institutions of joint investment of tourism business in partnership relations; provision of investment policy and social needs of consumers of tourist services within the international economic system	conscious corporate social responsibility of joint investment institutions contributes to the stabilization of the development of the investment potential of the tourism industry in the state; signing partnership agreements on joint investment projects allows to ensure a sufficient volume of own and foreign investments for the formation of a positive social effect and to determine the state's ability to fulfil its social obligations to society (consumers of tourist services)
Economic and investment dimension	Economic responsibility of institutions of joint investment of tourist business and creation of a positive business image	conscious corporate economic responsibility and the contribution of joint investment institutions to the development of the investment potential of the tourism industry; maintaining profitability; efficiency of investment processes in the network interaction of the direct and indirect environment of the international economic system
Dimension of interested parties (investors)	Stakeholders or groups of stakeholders (private investors) and their integration into the international co-investment space	partnership interaction and responsibility of tourism industry subjects to interested parties (private investors); interaction of tourist operators and travel agencies with stakeholders (governments of European states, local self-government bodies, territorial communities); ensuring the needs of tourism firms in resources; interest in international partnership and integration of interested parties (private investors) into the international space of joint investment
Voluntary dimension	Partnership actions are not provided for and not regulated by the requirements of the international convention on joint investment on the basis of CSER, but have a holistic view of the investment process in the tourism industry	conscious actions of partners, based on ethical values, in addition to legal obligations; voluntary contribution to the development of the investment potential of the state's tourism industry

Source: compiled by the authors based on Lee (2020), Melnyk *et al.* (2018), Investment plans of the EU: Opportunities for Ukraine in the area of the European Green Deal implementation (2021), European Union (2021), Gourinchas and Rey (2014), Oleshko *et al.* (2023), McWilliams and Siegel (2001), Rudenko-Sudarieva and Krysyuk (2015), Sorochyshina (2018), Yevdochenko (2010).

Taking into account the steady departure from the real world towards formalized axioms and mathematical models, which have only an indirect relationship to reality in countries where there are military conflicts (provoked the break in the economic rise of the economy), forces the authors of the study to develop a new paradigm of the strategic rise of the tourism industry in post-war history and to invent a typology of mathematical tools with the symptoms of assessing indicators of the investment state and composite indices of investment sustainability of the tourism industry, taking into account the volumes of the pre-war flow of foreign investments into the country in conditions of international turbulence (Chernyatevych *et al.* 2019). In addition, without the constant development and improvement of scientific and methodological tools, which together form algorithms, means, methods and techniques of research models of the development of tourist territories, it is impossible to assess the real socio-economic problems in the country with a weakened strategy for solving them (Goyko 1999).

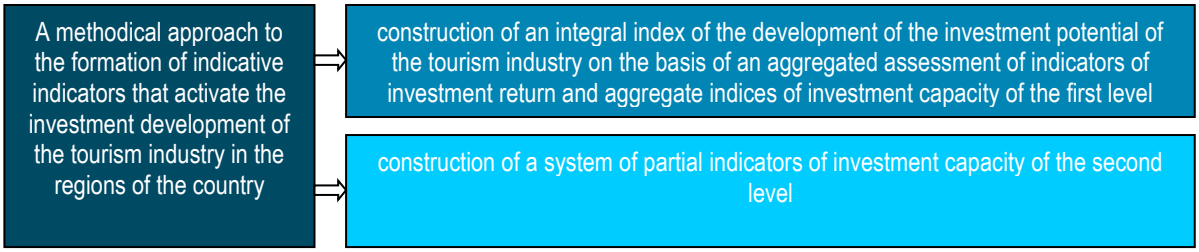
In the absence of an effective innovative structure in the country with a weak economic system for the development of the investment potential of the tourism industry in the regions and the lack of prerequisites for the implementation of its strategy in the international economic system, the primary task of the state is to increase the

possibilities of tourist destinations at the local level on the basis of the activation of the budget investment mechanism, stimulation of economic subjects of various types of sectoral subordination to the introduction of innovations in the development of territories and acceleration of investment processes (Trusova *et al.* 2023a). This proves that it is necessary to develop the investment potential of the tourism industry of the territorial and innovative type during the gradual integration of the regions of the state into the international economic system. Indicators of the investment state and composite indices of investment sustainability are useful methodical tools for assessing the level of investment potential of the tourism industry. With the help of methods of system analysis, quantitative and qualitative visualization of the indicators of the investment status of the subjects of the tourism industry is carried out. This makes it easier to display large amounts of information. Methods of evaluating composite indices of investment sustainability and development of the tourism industry are used mainly at the international and national levels (Kerimkhulle *et al.* 2022). However, the assessment of composite indices of investment stability and development of the tourism industry at lower levels, such as the state or region, is necessary to achieve the stability of economic results and investment activities of tourism industry subjects (Trusova *et al.* 2023b).

There are many initiatives in the field of assessment of investment status and analysis of strategic measures on the way to investment stability and development of the country's tourism industry in the midst of international turbulence (Lee 2020; Kliuchnyk *et al.* 2023). They differ in the method of assessment, the scope of application and the breadth of coverage of models, mathematical tools that determine the limits beyond which public (state) and individual (individual economic entity) unsustainable needs are achieved (Pokatayeva 2009). However, sometimes their actions lead to irreparable consequences for consumers of tourist services and the natural environment of tourist destinations. That is, in the conditions of a military conflict, the level of danger in the strategy of developing the investment potential of the tourism industry in its various manifestations is an extremely high priority for research. This applies to such issues as economics, politics, law, morality, religion, traditions. The security system in the strategy for the development of the investment potential of the tourism industry has its own interrelated national and international aspects, since the focus is not only on the sovereignty of the state, international partnership relations between stakeholders, interested parties (investors) and consumers of tourist services on the basis of CSER, but even separate non-coordinated concepts of national, regional and local importance, which regulate the stimulators and disincentives of joint investment in the programs of reproduction of tourist destinations (Makedon *et al.* 2022). As a result, the vector of investment sustainability of the state's tourism industry will be determined with the support of international partners with the development of specific measures and the determination of the amount of resource provision for their solution (Shayakhmetova *et al.* 2020).

The authors believe that when determining the integral index of the development of the investment potential of the state's tourism industry on the basis of an aggregated assessment of investment return indicators and aggregate indices of investment capacity, consideration should be given to the disincentives of the strategy of sustainable investment development of regions. It can also be the basis for further monitoring of the strategy of developing the investment potential of the tourism industry of a country with a weakened economic system in the international economic system and its recovery (Trusova *et al.* 2022a; Tsviliy *et al.* 2023). Therefore, at the initial stage of implementation of the strategy for the development of the investment potential of the country's tourism industry, it is necessary to use the proposed methodical approach to the formation of indicative indicators of the first and second levels, which activate the investment development of the industry in the regions (Figure 2).

Figure 2. A methodical approach to the formation of indicative indicators that activate the investment development of the tourism industry in the regions of the country



Source: compiled by the authors.

The advantages of this methodical approach are the implementation of a measurement base, which enables combining into a single analytical apparatus for calculating indicators with different units of measurement (financial-investment, socio-ecological-economic, innovativeness of infrastructural spheres of the tourism

industry), which covers the field of research and provides an integral index investment development of the region with a high degree of ability to implement the strategy of developing the investment potential of the state's tourism industry and integrate it into the international economic system.

In the context of the proposed methodical approach, a method of calculating an integral index based on stimulating factors and destimulating factors with initial standardized indicators of six spheres of sustainable investment development of the region is being developed. Precisely defined indicators of research areas will allow in the future to effectively make strategic decisions and activate the mechanism of development of the investment potential of the tourism industry of a country with a weakened economic system with the aim of introducing it into the international economic system and creating security criteria for the development of partnership relations, determining weighting factors using the method of main components, assessment of institutional components of joint investment taking into account effective implementation of regional programs (Makedon *et al.* 2020).

The results of the study will allow to improve the methodology of rating the regions in the country to solve the problem of disproportionality of their investment development in the form of integral cluster complexes that are interconnected and interdependent in the CSER system, for the introduction of strategic alternatives and scenarios for increasing the investment potential of the state's tourism industry. To reduce the disproportionality of investment development in each of the regions, on the basis of joint investment and CSER, a set of mechanisms is being developed that will stimulate socio-ecological and economic development and increase the competitiveness of tourist destinations (Sorochyshina 2018).

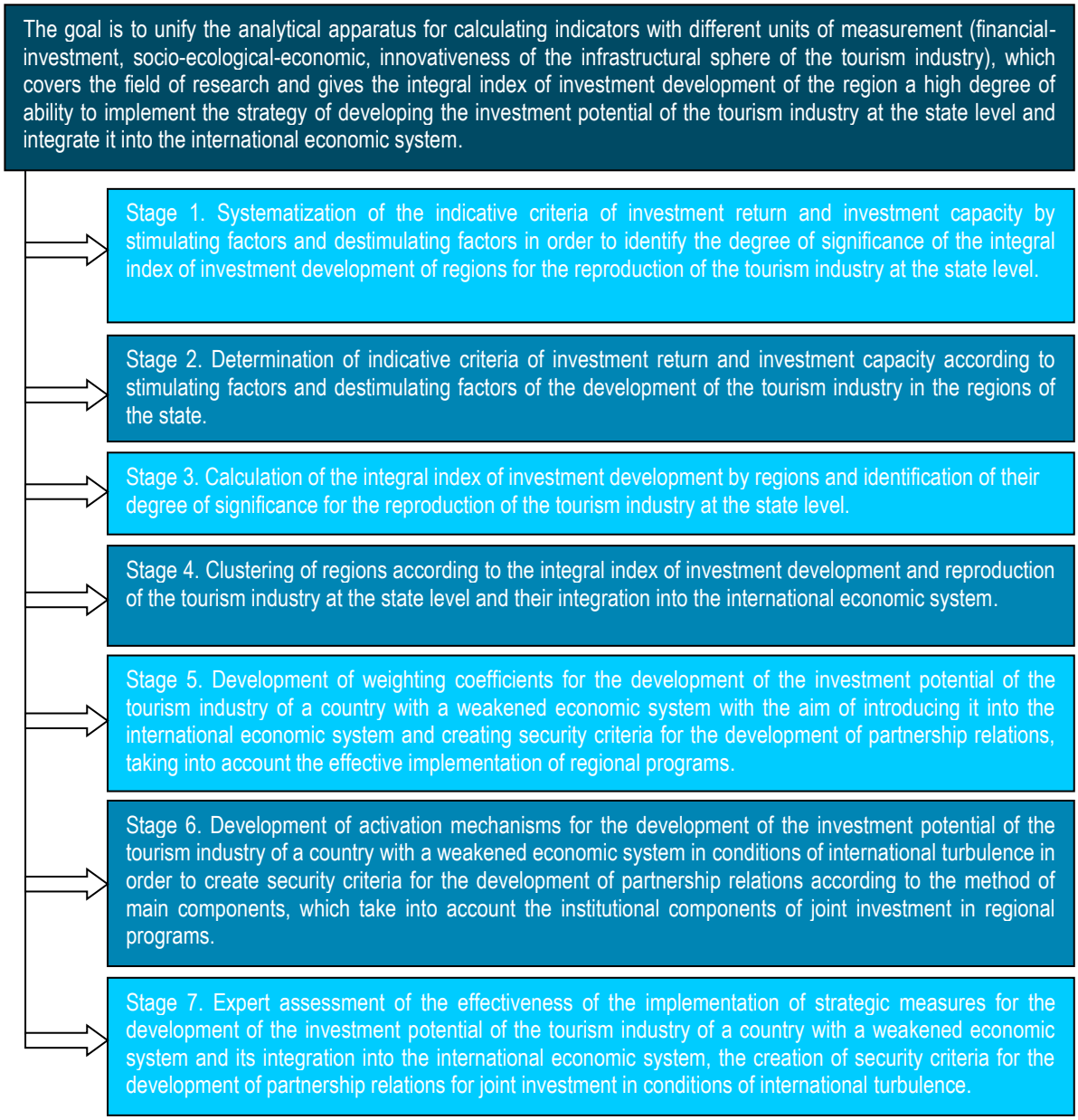
However, against the background of interregional disproportionality in the investment development of regions, additional disincentive factors for the assessment of intra-regional disparities of tourist destinations may arise (Trusova 2020). That is, there is a request for a methodical toolkit that embodies the assessment of intra-regional disparities in the investment development of tourist destinations in the absence of an accessible and high-quality array of statistical information on their investment activities on the margins. It should be noted that the more serious problem of the disproportionality of investment development is the divergences at the lower level (local level), which are not taken into account by the mechanisms of harmonizing the disproportional development of tourist destinations of the territorial and innovative type (Petkova 2012).

The assessment of composite indices of investment capacity and indicators of investment returns of regions for the development of the tourism industry takes into account a set of socio-ecological and economic determinants that satisfy the criteria of an active cycle of investment development, in the presence of own and direct foreign investment in a tourist product that is implemented according to the needs of consumers of tourist services in destinations of the territorial and innovative type, ensuring ethical and cultural values and education of the population, employment conditions, incomes and expenses of the population, production processes of other branches of the economy in the regions, their investment opportunities and foreign economic growth vector, as well as their participation in investment projects on development of the tourism industry in the conditions of digitization of the ecosystem (Trusova *et al.* 2022b). In general, the implementation of measures for the strategic development of the investment potential of the tourism industry in the conditions of international turbulence takes into account seven stages (Figure 3).

Socio-ecological-economic determinants that satisfy the criteria of an active cycle of investment development of regions in the presence of own and direct foreign investments in the tourism product allow to raise the social standards of the quality of life of the population living in tourist destinations of the territorial and innovative type with growing production potential, increasing the investment and innovative attractiveness, increasing reliability of energy supply and energy efficiency, resource conservation, established social dialogue and increasing corporate social and economic responsibility of the state, business and population (Oleshko *et al.* 2023).

Justifying the model of the development of the investment potential of the tourism industry in the destinations that form regions of the territorial-innovation type, it is necessary to evaluate the derived variables of the institutional components of joint investment in regional programs. They include socio-ecological-economic determinants in terms of tax accumulation in the structure of local budget revenues. Knowledge of these dependencies makes it possible to adjust the national investment policy of the state and the policy in the field of social and economic support of the regions. The given model is relevant because it creates integral, aggregate indices of the strategy for the development of the investment potential of the tourism industry and allows for an operational system analysis with the possibility of adjusting actions in the field of management at the regional and state level.

Figure 3. Stages of implementation of measures for the strategic development of the investment potential of the tourism industry in conditions of international turbulence



Source: compiled by the authors.

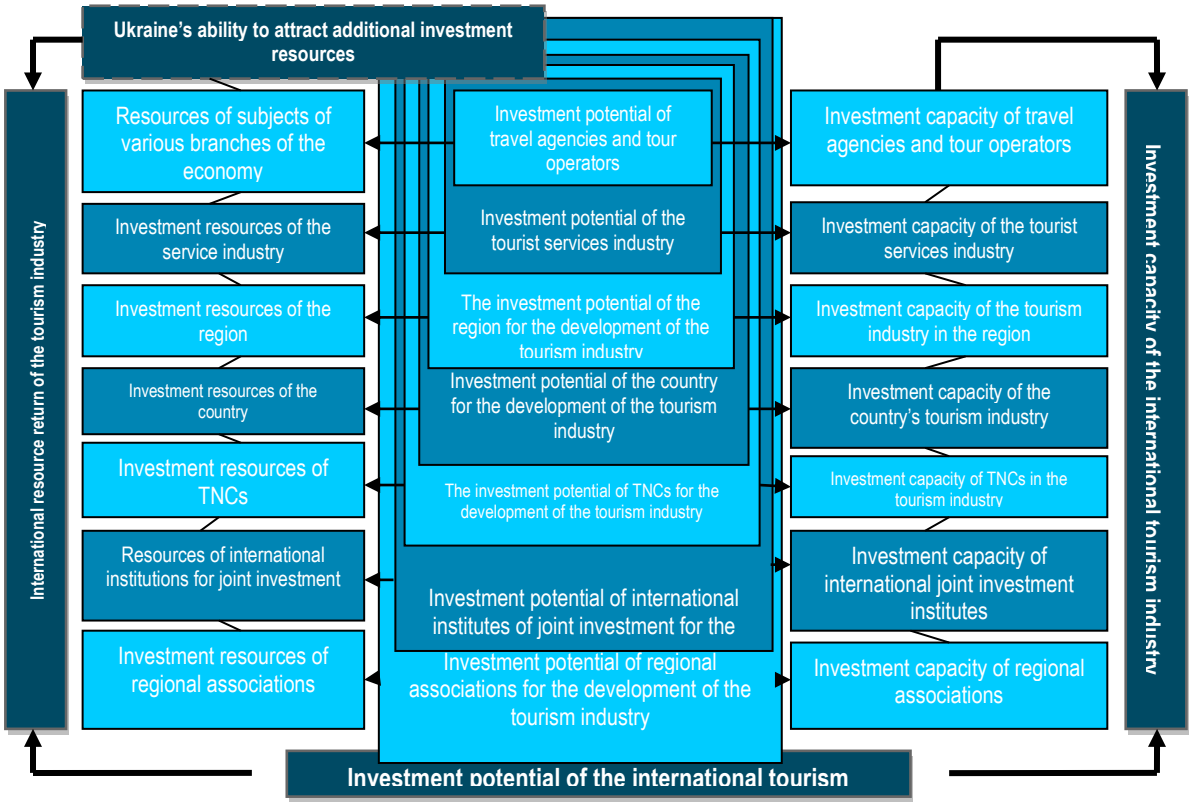
2.2. Implementation of the Model in the Context of Studying the Investment Potential of the Tourism Industry in Ukraine

A pronounced investment process in the tourism industry is characteristic both for subjects of tourist services and for individual branches of the economy that serve tourist destinations of the territorial and innovative type in the regions of the country, or regional associations of several countries on the platform of international cooperation and partnerships. In addition, the authors believe that the strategic development of the investment potential of the tourism industry is characteristic of transnational corporations (TNCs), since some of them have significantly larger amounts of investment resources and opportunities than individual states and exert a significant influence both on the investment processes of an individual country in weakened economic system, as well as investment processes of the entire international community (Kerimkhulle *et al.* 2023).

Another level of strategic development of the investment potential of the tourism industry, in the author's opinion, is the international institutions of joint investment, as they possess a large amount of investment resources and directly affect the development of such economic systems as a separate state, regional associations of countries and the international economic system in general. Thus, it can distinguish the following

main levels of international partnership in the strategy of development of the investment potential of the tourism industry in Ukraine: travel agencies and tour operators, the industry of tourist services, the region, the national tourism industry, the tourism industry of the regional association, international institutes of joint investment of the tourism industry, TNCs, the world economy of the tourism industry (Figure 4). Each level of the economic system is characterized by its own nature of strategic development of the investment potential of the tourism industry. If it goes from the general to the partial, then it should highlight 3 key characteristics that are characteristic of all levels of strategic development of the investment potential of the tourism industry: availability of own investment resources (ability to form own investment resources); the possibility of attracting investment resources; availability of the possibility of effective development of investment resources (investment capacity) (Ruda and Mazurik 2021; Ryabih 2008).

Figure 4. the model of international partnership in the strategy of development of the investment potential of the tourism industry of Ukraine



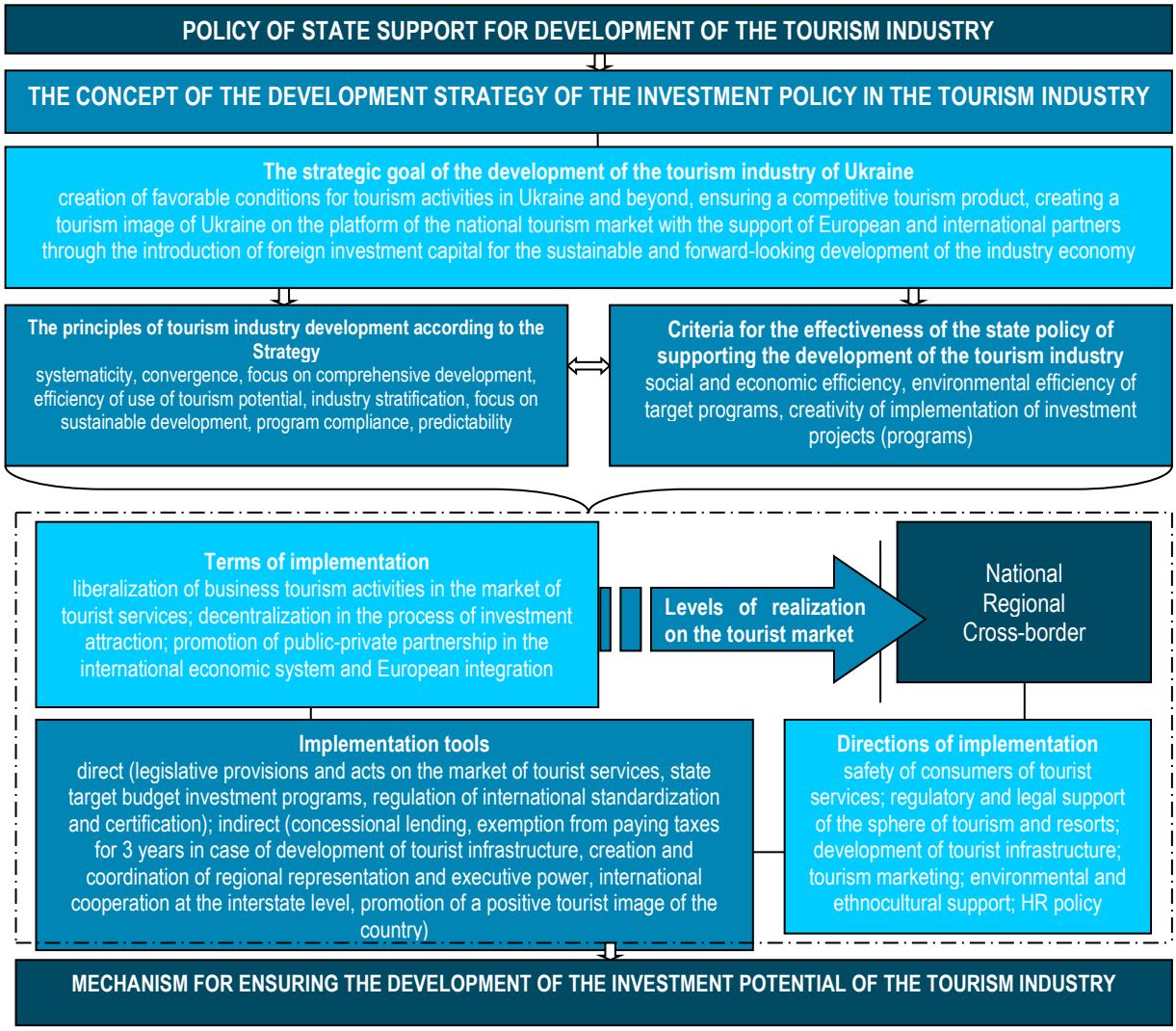
Source: compiled by the authors.

Thus, it is advisable to divide the sources of investment resources into internal (own) and external (involved, borrowed). According to the investment theory of Pokatayeva (2009), profit is divided into several parts: one part is consumption; the other part that was not consumed is savings. In his opinion, savings are a source of formation of investment resources. Therefore, the authors consider it fair that for all levels of economic systems, savings are one of the internal sources of investment resources. External sources of investment resources should include loan resources that can be attracted in the form of joint foreign investment in the tourism industry, investment lending, issuance of debt securities, or charitable and other types of contributions from interested parties (Rudenko-Sudarieva and Krysyuk 2015).

However, the main direction of the strategy for the development of the investment potential of the tourism industry in Ukraine should be the formulation of a clear concept of the development of the investment policy strategy in the tourism industry in the country, which contains a general systemic idea of the ways of transition from the current position of investment objects to the desired one. The expected results of the strategic development of the investment potential of the tourism industry cannot be obtained without the activation of an effective mechanism for the development of the industry's investment potential (Trusova *et al.* 2022b). Therefore, the tasks set for the development of the investment policy strategy of the tourism industry must be solved in the process of implementing strategic plans that will be developed on its basis. The Concept of the development of

tourism policy of Ukraine proposed by us (Figure 5) is based on the formulation of the main directions of the state policy of supporting the sphere of tourism and resort centres of Ukraine.

Figure 5. The concept of the development strategy of Ukraine's investment policy in the tourism industry



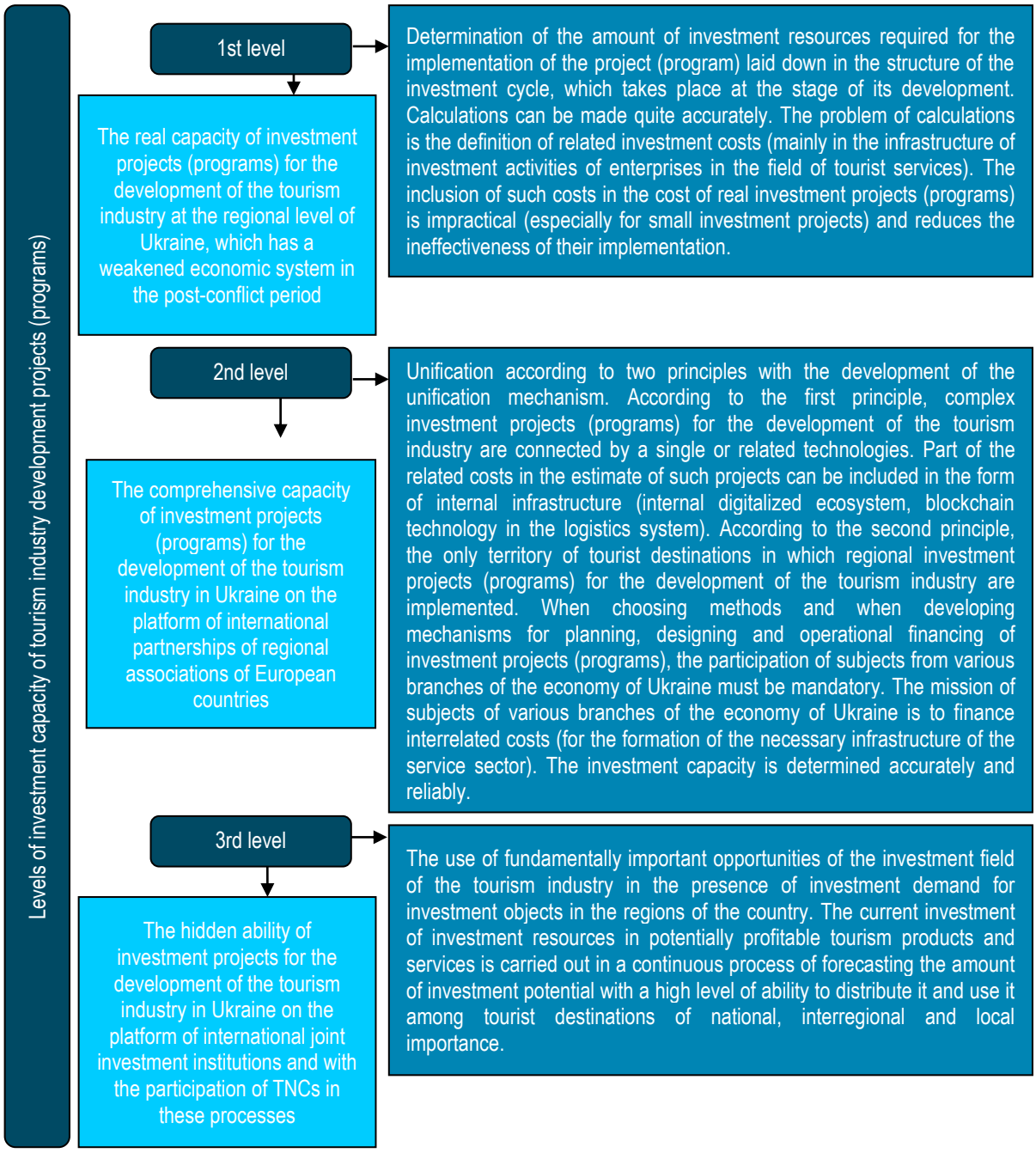
Source: compiled by the authors based on Law of the Ministry of Economic Development and Trade of Ukraine No. 1902 "On the approval of the plan of measures for the implementation of the Strategy for the development of tourism and resorts for the period until 2026 in 2018" (2017) and Order of the Cabinet of Ministers of Ukraine No. 168-p "On the approval of the Strategy for the development of tourism and resorts for the period until 2026" (2017).

The Concept is based on a systemic liberal state policy of tourism entrepreneurship and state regulation of the development of the tourism industry, which will make it possible to form an attractive and safe tourist market in Ukraine. The basis of the liberal state policy of tourism entrepreneurship and state regulation is precisely the direction of support and investment in the tourism industry and tourism activities, in particular in the private sector (Tsviliy *et al.* 2023). This direction involves a multi-vector policy of tourism development, which simultaneously develops both domestic and inbound tourism. Investment is made in the context of the development of market relations in the market of tourist services, as well as capital investment in domestic tourism. This is also due to the fact that 80% of Ukraine's tourist resources are historical and cultural monuments and sights, recreational resources of ecologically clean areas, industrial areas, scenic spots, rural areas, which are in great demand and have market advantages compared to other types of tourism (Sorochyshina 2018).

It should be noted that the model of liberal (European) state policy for the development of tourism entrepreneurship provides for the implementation of an effective strategy for the development of tourism, which includes economic calculations of the effectiveness of investing in tourism facilities, both public and private. Such objects owned by private enterprises of the tourism industry are included in the program of support and investment of tourism objects (Investment plans of… 2021; European Union 2021). A characteristic feature of the

investment potential of the tourism industry in Ukraine with a weakened economic system in the post-conflict period (military conflict) is the lack of opportunities to attract additional resources. In the author's opinion, the integration of the weakened economic system of Ukraine into the international space satisfies the needs of all participants of partnership relations in investment resources and allows to increase the investment potential of the country's tourism industry (Ruda and Mazurik 2021). It characterizes the investment capacity of the field of tourist services in the international economic system as a powerful element of the paradigm of strategic reconstruction of production capacities, implemented through investment projects, or complex targeted investment programs of regional associations between countries, through international institutions of joint investment, through TNCs, as well as individual interested parties investors from regions and states of the international community. It is in the process of investment design that the investment demand of travel agencies and tour operators for production design and implementation of a new tourist product is formed (Melnyk *et al.* 2018).

Figure 6. Form-forming levels of investment capacity of tourism industry development projects (programs) in Ukraine



Source: compiled by the authors.

At the level of the international economic system, the source of the formation of investment resources for the development of the tourism industry is that part of the added value that was produced (by all subjects of the international partner community) and was not consumed in the previous period. The investment capacity of projects (programs) for the development of the tourism industry in regional associations of countries on the basis of the platform of the international economic system can be considered according to territorial and innovative (regional) and industry characteristics. The investment capacity of projects (programs) for the development of the tourism industry, according to the territorial and innovative feature, represents a set of needs for investment resources of all regions of the international community for the implementation of innovations in the field of tourist services. The investment capacity of projects (programs) for the development of the tourism industry by sector includes a set of needs for investment resources for the development of the sub-sector of the economy that serves the tourism industry in the country (Trusova *et al.* 2023b). The investment capacity of projects (programs) for the development of the tourism industry in regional associations of countries on the basis of the platform of the international economic system should be considered at different levels of the formation of its value (international, national and regional influence, local) and determined by the degree of credibility (Figure 6).

It is natural that when considering this issue there is a need to analyse the ratio of investment resources (investment potential) and investment capacity in all its aspects indicated above. At the first two levels, it is the investment capacity of tourism industry development projects (programs) that determines the necessary investment resources, which, in turn, allows us to talk about the necessary investment potential of stakeholders and interested parties (investors or groups of investors) for the development of the service sector. In the third case, a mechanism should be developed to realize the hidden capacity of the relevant investment field into a valid investment demand for tourist products (Sorochyshina 2018).

In Ukraine, on the platform of the international economic system, there are three possible scenarios of the relationship between the investment potential of the tourism industry and the investment capacity of its development projects (programs) (Goyko 1999; Kuklik 2011):

1. Scenario I – investment potential is equal to investment capacity.
2. Scenario II – investment potential is greater than investment capacity.
3. Scenario III – the investment potential is less than the investment capacity.

Moreover, in the case of Scenario I it is necessary to consider the alternative: “investment potential is significantly greater than the investment capacity”, and in the case of Scenario II the alternative: “investment potential is significantly less than the investment capacity”. The equality of investment potential (supply of investment resources) and investment capacity (demand for investment resources) is considered as a market equilibrium, as a pure theoretical position that cannot exist long enough compared to the time of implementation of investment projects (programs) for the development of the tourism industry. Therefore, consideration of the mechanism of implementation of the investment potential of stakeholders and interested parties (investors or groups of investors) for the development of the service sector of the tourism industry focuses on two scenarios that remain.

In the case when the mechanism for realizing the investment potential of stakeholders and interested parties (investors or groups of investors) for the development of the service sector, according to the total assessment, exceeds the assessment of the actual investment capacity, then its main direction becomes the development of investment projects (programs), which allows to transform hidden (potential) real investment capacity. As long as investment capacity is in a hidden state, the mechanism of its interaction with investment resources cannot be implemented.

A similar situation developed in the pre-war period in Ukraine and is characteristic of many of its subjects in various sectors of the economy, which invested investment resources in the development of the tourism industry. There were potential stakeholders and interested investors whose significant investment resources had a gigantic investment field, but unfortunately, they did not have the scale of investment processes in Ukraine that would satisfy this demand (Melnyk and Kasianok 2017). In such a situation, the mechanism of using real investment processes by private investors and foreign patrons for the internal needs of tourist destinations in certain regions, where tour operators and tour agencies functioned more or less profitably, in the absence of proper support from the state budget financing of the tourism industry, was activated. Problems related to the intensification of investment activity in the tourism industry in Ukraine in the post-conflict (post-war) period must be considered in two aspects: as the extent of the excess of the total assessment of the investment potential over the assessment of the actual investment capacity and the time during which this situation persists (Trusova *et al.* 2023b).

A significant excess of the size of investment resources offered on the tourist market over the actual investment capacity of projects (programs) for the development of the tourism industry in Ukraine leads to the fact that investment resources offered in monetary form and in the form of securities form a closed circle. Basically, investment resources serve the negative processes of spending non-renewable natural resources of the country's recreational areas and promote the level of inflation, increasing the cost of tourist products. At the same time, the resources offered in material form become morally old and lose their investment attractiveness, and in the extreme dimension, the possibility of being invested. Therefore, one of the optimal options is a combination of a stakeholder and an interested foreign investor in one person for the developers of the investment project (in this case, the latter acts as the customer). In Ukraine, in most cases, domestic investors cannot act as customers, since during the times of vague "reforms" most of them lost the power to develop and design high-quality investment projects (programs) for the reproduction and development of the tourism industry according to international requirements and standards.

Ukraine, as a country with a weakened economic system in the post-conflict (post-war) period, should revise the paradigm of the outdated model of the economy and switch to a more pragmatic scenario of development of events, and in particular, to a new model of the development of the tourism industry under the conditions of international partnerships. In the current period, the country is able to exceed the indicators of the investment development of the regions within 20-25% of the volume of invested investment resources over the actual assessment of the investment capacity of projects (programs) of the development of the service sector and satisfy consumer demand for tourist products within its own borders, as a catalyst for the activation of domestic investment potential tourism industry, as potential stakeholders and foreign investors are vitally interested in the implementation of investment processes in Ukraine for its reconstruction and prosperity as a European country of the future (Trusova *et al.* 2023a; Tsviliy *et al.* 2023). To use the assessment of the investment rating of potential investors of the tourism industry in the international economic system, the typology of their behaviour is distinguished: "resource-seeking", "cost-oriented" and "market-seeking" (Petkova 2012; Ryabih 2008). In addition, the behaviour models of such investors are significantly different in the territorial and innovative typology of regional associations.

The developed proposals can be successfully implemented when planning the second level of investment capacity of projects (programs) for the development of the tourism industry in Ukraine on the basis of cross-border cooperation of regional associations (of European countries and countries of the leaders of the tourism business), in order to support the national economic system of Ukraine and its strategic directions regarding the reproduction and reconstruction of the fixed and working capital of the service sector and tourist destinations at the local level.

3. Discussion

Strategic directions for the development of the investment potential of the tourism industry are in the realm of economic theory and practice and are complex measures that require constant improvement of goals, improvement of the functions of joint investment institutions in the tourism sector and its individual components (transport infrastructure and hospitality in the hotel industry network), operating on the platform of the international economic system and on the basis of corporate social and economic responsibility (further CSER) of the tourism business. From the point of view of Leonow *et al.* (2019), the platform of the international economic system based on the CSER of the tourism business covers the economic, legal, ethical and discretionary expectations that the state receives from the activities of tourist organizations in a certain period of time. The scientists McWilliams and Siegel (2001) define the platform of the international economic system under the terms of CSER as the actions of subjects regulated by international law, leading to social and economic benefits beyond the interests of firms and a separate state.

Baron (2001) defines corporate socio-economic responsibility in the international economic system of the tourism industry as the general attitude of the tourism corporation to all interested parties (investors). These include customers, employees, owners, governments, suppliers and competitors. Elements of socio-economic responsibility of tourism business include investments in cooperation with economically active human resources, labour relations, creation and maintenance of employment, protection of the environment and cultural heritage, financial indicators. Gourinchas and Rey (2014) notes that developing business on the basis of partnership relations with a rethinking of approaches to one's own business image and joint responsibility within the direct and indirect environment of the international economic system provides conditions for the formation of an architectural structure of interaction between stakeholders, the state and interested parties (investors).

The European vector of strategic development of the investment potential of the tourism industry is focused on the operation of the international platform CSER, which extends to the tourism business through the general concept, according to which tourism companies decide to voluntarily make their investment contribution to the economic stability of the regions and the maintenance of the state's economy (Melnyk *et al.* 2018; Shandrivska and Yunko 2021). The concept, which is integrated by tourism companies in their activities, including, in investment processes, allows solving social, economic and environmental problems, regulating the regulation of interaction with interested parties (investors) on a voluntary basis (Investment plans of… 2021; European Union 2021). Firstly, the platform of the international economic system, which is developing within the framework of CSER tourism business, provides for the fulfilment of obligations between countries on the basis of joint investment institutions (formation of corporate, joint-stock and non-state investment funds) in order to create partnership relations, in accordance with the legislation of foreign jurisdictions on the basis of or in accordance with the contract, for the purpose of obtaining profit or achieving another common goal. This aspect is reflected in the results of the activities of tourism firms (tourist operators, travel agencies, hotel industry), which evaluate the impact of CSER action on the effectiveness of partnership relations and the results of their economic relations. Secondly, the investment processes of tourism industry entities within the framework of international partnership relations and CSER should go beyond the laws regulated by one state and exceed its "minimum obligations" (Amosha *et al.* 2018). Thirdly, the investment opportunities of tourism industry entities on the basis of CSER are discretionary and are implemented in the tourism business at the regional, national and cross-border levels (Lee 2020). Fourth, within the framework of the international economic system, the concepts of "society" and "social" are narrowed down to the concept of "stakeholders – interested persons (investors) – social needs of consumers of tourist services" (McWilliams and Siegel 2001). In contrast to stakeholders, who are forced to represent the interests of the state in the international arena and respond to the needs of consumers of tourism services in the international economic system, interested parties (investors) can represent their own interests at the regional, national and cross-border levels in order to expand their own influence on the formation of the investment potential of the tourism industry.

Tsviliy *et al.* (2023) believe that international partnerships in the tourism industry make it possible to:

- exceed the established minimum requirements for the use of investment resources;
- adhere to the principles of consistency of legislation and state regulation of investment activities of individual countries;
- stakeholders and interested parties (private investors) to voluntarily undertake the expansion of tourism business on the territory of any state;
- be responsible for the economic development of territories on the basis of transparency, ethical behaviour and socio-economic responsibility;
- provide investment needs from the international economic system.

At the same time, the authors agree with the opinion of Kalaganov *et al.* (2018) that international turbulence is rapidly entering all spheres of real life and, along with the advantages it brings to economic relations, problems are created for society, when in modern military conflicts there is a real danger of their development into international scale and even acquiring a global character. Incredible processes (merging of borders, cultural unification and loss of identity) level society's views and dreams of a beautiful future and transform its existence into the plane of rational thinking, as there is a struggle for military, political and economic superiority between countries in the international economic system. Also Abdulkarim (2023) emphasizes that taking into account the need to develop European integration, countries with a weak economic system and a significant socio-demographic crisis are forced to unite with developed countries in the international economic space in order to raise investment processes and stabilize economic growth. At the same time, international turbulence exacerbates environmental issues, and, especially, this applies to new destinations with a different mentality of cultural traditions and heritage. This directly applies to tourist destinations.

Sorochyshina (2018) believes that for a country with a weak economic system, where the investment policy and partnership relations in the tourism industry are weak, the model of endogenous strategic growth is more pragmatic and optimal. Such a model involves the maximum use of internal resources: capital, labour, investment potential, specific knowledge of the production process, as well as the ability of the internal economy to control the process of accumulation of investment resources at the regional and local level. In this context, the main task of the state investment policy is to create conditions for the formation of the investment potential of the tourism industry in the regions and the economic growth of innovative tourist destinations at the local level (Rudenko-Sudarieva and Krysyuk 2015).

Thus, the various aspects of the functioning of tourist destinations in the decentralized space of countries with a weak economic system require the substantiation of conceptual foundations, the improvement of methodology and the development of comprehensive research methods for the development of the tourism industry.

Conclusions

Thus, the strategic development of the investment potential of the tourism industry of Ukraine in the international economic system can launch an ultra-fast functioning mechanism in the post-conflict period that will create additional value of the tourism product. However, it should be noted that the formation and use of the investment potential of the country's tourism industry, based on the principles of the international economic system, may be characterised by the processes of creation and movement of investment capital that cannot be controlled. Therefore, its production through the investment capacity of projects (or programmes) related to the development of the tourism industry, subject to the expansion of the powers of international joint investment institutions and regional associations of European countries, will allow Ukraine to coordinate the pace of economic growth and adaptation of tourist destinations to international requirements and standards.

Ukraine is obliged to ensure the protection and safety of consumers of tourism services through coordinated actions of the government and international partners, and to ensure the ability and impartiality of the function to create new areas of security for the formation of tourist flows that require appropriate services during leisure and excursions in tourist destinations. This requires large investments, and thus the formation of sufficient investment potential in the tourism industry, particularly in the first years of the post-war period of economic recovery in Ukraine. The country needs the assistance of international joint investment institutions and regional associations of European countries to restore investment processes in the tourism business by preventing the development of corruption schemes for the misuse of investment resources.

Enhancing governmental functions is crucial for expanding joint investments, boosting tourism, and protecting tourists, all aligned with Ukraine's national interests. These interests include building civil society, ensuring human rights, fostering harmony among diverse groups, safeguarding sovereignty, and promoting a self-sufficient market economy. These efforts also aim to create a secure environment, preserve investment potential, strengthen the nation, and encourage diversity while integrating Ukraine into the global community, especially in Europe.

Credit Authorship Contribution Statement

Sergiy M. Tsviliy: Conceptualization, Project administration, Software, Writing – original draft, Supervision, Data curation, Writing – review and editing, Visualization;
Denys P. Mykhailyk: Investigation, Methodology, Formal analysis, Writing – original draft, Data curation, Validation, Writing – review and editing;
Darya D. Gurova: Methodology, Software, Formal analysis, Writing – original draft, Writing – review and editing;
Viktoriia O. Ogloblina: Investigation, Methodology, Formal analysis, Writing – original draft, Supervision, Validation, Writing – review and editing;
Olga M. Korniienko: Software, Formal analysis, Writing – original draft, Data curation, Validation, Writing – review and editing, Visualization.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Declaration of Use of Generative AI and AI-Assisted Technologies

The authors declare that they have not used generative AI and AI-assisted technologies during the preparation of this work.

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Integrating LGBTI Inclusivity and Innovative Capacity in India: Analyzing the Effects of Globalization

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Abstract: Globalization can have enormous effects if LGBTI people are well blended into the pool of resources and tapped efficiently. This research investigates LGBTI inclusivity and the effects of globalization on economic development since the 2009 legalization verdict favoring homosexuality. The theoretical prospects are trifold: trade liberalization and labor market de-regulation; Becker's theory of discrimination; and Heckscher-Ohlin-Samuelson postulate, along with a diagrammatic representation showcasing the impact of LGBTI inclusivity in the labor market. An OLS approach in conjunction to the ECI_{Trade} and $ECI_{Technology}$ has been employed to examine the integration of LGBTI individuals into the Indian economy considering capital stock, domestic credit, employment, population and human capital as default controls to the model and year dummies have been incorporated at a later stage of modelling to highlight the precision level. The study found that LGBTI inclusivity is positively correlated with India's ECI_{Trade} and $ECI_{Technology}$ value, increasing it approximately by 6.3% and 15.4%. Further, a number of robustness checks show that even after accounting for macroeconomic variables as default controls, the positive association continues to persist. The LGBTI inclusivity increases the ECI_{Trade} value by 13.2% and $ECI_{Technology}$ value by 24.4%, respectively. Consequently, the authors emphasized on the economic ramifications of inclusivity in relation to wage gaps, discrimination, and the development of human capital and have tried to exemplify the integration of LGBTI individuals in EPZs, trade and technological advancement, and skill development to justify the default conceptualized postulates in support of inclusivity.

Keywords: LGBTI inclusivity; Economic Complexity Index; globalization effects; wage gaps; indian facets.

JEL Classification: C53; E24; F15; F16; F63; J16; J24; J31; J82; K38; O30.

Introduction

The existence of significant and long-lasting disparities in economic prosperity across the country seems to be one of the most fascinating issues that researchers are grappling with (Knowles 2002). The LGBTI community's social exclusion, which leads to bigotry and hinders their ability to fully participate in a society that values equal opportunities and dignity, is a significant infringement on fundamental freedoms. They encounter a combination of acceptance and repulsion during occasions of faith, while also facing explicit prejudice in society as a whole (EPW, 2013).

LGBTI inclusion is something that evokes profound feelings in many countries. There is an increasing curiosity in understanding how innovations in technology and trade can impact the empowerment of individuals with diverse sexual orientations, gender identities, and expressions, as well as sexual characteristics (SOGIESC). While national legislation pertaining to job opportunities, social security, and various LGBTI issues has dominated

much of the current debate, the (World Bank and WTO 2020) have recognized the potential socioeconomic benefits of these discussions. There are two important considerations: the possibility of increased equity in trade incentive distribution, and the potential to promote progressive socioeconomic, cultural, and constitutional goals. Given the intricate connection between globalization and SOGIESC inclusivity, it is important to investigate the influence of trade practices and technological advancement on LGBTI communities. It is of the utmost importance to establish appropriate laws that encourage equity and fairness in this regard (Bos 2023).

The authors examine LGBTI people in relation to globalization drivers - trade and technology - and then connects them to significant economic development prospects. They highlight the prospects of trade and technology, significantly contributing to the fact that LGBTI integration into innovative capacity will add to the ultimate spectrum of development in the Indian economy as a whole.

1. Research Background

It is significant to safeguard LGBTI's entitlement to social assistance, access to financial services, academic and career development prospects, safe housing, and gainful work (Badgett, Waaldijk, and Rodgers 2019). Fostering consciousness about LGBTI experiences among law enforcement, the general public, and communities is essential to their eventual mainstreaming. Advocacy for LGBTI people will enable them to actively participate in all constitutional settings. Democratic and legal mechanisms in India must protect LGBTI people from infringements of human rights (Borloz 2023).

Earlier study evidence suggests that the omission of LGBTI subgroups from the economy exerts an influence on discrepancies in Gross Domestic Product (GDP) per capita (Duflo 2012). Numerous research studies have demonstrated that gender disparities in autonomy and welfare as a whole, such as in domains like educational attainment, healthcare, and career prospects, have a detrimental impact on economic development (Badgett *et al.* 2014).

Trade has the potential to significantly improve LGBTI people's participation throughout the economy, minimize inequalities, and expand their prospects for developing knowledge and expertise (Rocha and Piermartini 2023). Considering the economic advantages, the inclusion of LGBTI individuals in trade negotiations will likely result in substantial development, greater efficiency, and greater income for the economy. Researchers are examining how trade specifically affects the LGBTI community compared to cisgender individuals to fully understand its impact on gender parity (World Bank and WTO 2020). In a hypothetical case about the incorporation of LGBTI individuals into international trade, one can observe the beneficial consequences of development. This involves an upsurge in employment opportunities, greater financial security, enhanced standards of living, and improved health for the LGBTI community. Its overall inclusion will lead to better economic circumstances as it broadens the resources at hand and elevates the efficient use of economic resources. However, cis-gendered disaggregated data, coupled with the restricted accessibility of goods and services, impairs the engagement of the LGBTI community and, as a result, affects the economic independence of LGBTI individuals (Rocha and Piermartini 2023).

The LGBTI rarely share the same advantages of technological advances and innovation as cis-gendered individuals. This gender disparity hinders progress towards gender equality and autonomy for LGBTI individuals (UN Women 2019). It also prohibits the LGBTI community from collaborating as both producers and consumers of technological equipment that caters to their particular needs. To provide a clear understanding of the issue at hand, a gender-responsive approach must be implemented (UN Women 2019). This framework demonstrates how crucial it is to recognize and promote an understanding of gender inequalities. Its goal is to ensure that LGBTI people's issues and experiences are effectively and fairly considered when developing new products or services. It also highlights the need to examine gender conventions, positions, and interactions across the course of the innovation cycle. This strategy aims to ensure that LGBTI individuals play an integral role in all phases of the innovation cycle by creating a platform where they can share resources and knowledge and quickly expand innovative methods. LGBTI must inspire themselves to formulate their concrete goals and make an unwavering commitment at the organizational level to embracing a gender-responsive approach to innovation (UN Women 2019). This entails developing breakthroughs that cater to the needs of LGBTI individuals as recipients and monitoring the influence of these advances on the responsiveness of gender via the implementation of data-driven methodology. Furthermore, one must empower themselves with the authority to spearhead outreach efforts, employ innovative strategies, mentor other LGBTI personnel and community members, and create LGBTI-friendly products and services that address the unfulfilled needs stemming from the group's overall deprivation. When it comes to responding to growing issues and safeguarding the LGBTI community, LGBTI empowerment and technology are inextricably linked, enhancing creative ability in the economy as a whole.

The proposed study will utilize current data and research to gain insights into the correlation between globalization and LGBTI inclusion. It seeks to discover how trade might contribute to the progress of disadvantaged groups (Korinek, E. Moïsé, and J. Tange 2021). In order to build a robust and equitable future, it is essential to make significant investments in technological progress, trade, and research (Vu 2022). There is an immediate need for novel solutions to global problems, including international trade. Regrettably, the LGBTI community has come across hurdles in accessing and utilizing technological advancements. When breakthroughs serve as the primary catalyst for change, their impact amplifies. Examining the impact of technological advances and trade on the LGBTI community, this study addresses how their engagement in innovative skills may strengthen economic resources that contribute to increased development.

2. Materials and Methods

2.1. Data Repository

We analysed economic variables, including GDP per capita (PPP), employment, human capital, population, and capital stock data from 2009 to 2022, to determine the relationship between Indian ECI_{Trade} and / or $ECI_{Technology}$ and the rights of LGBTI people. We used the Economic Complexity Index (Data Wheel 2023; Simoes and Hidalgo 2011), World Development Indicators (World Bank 2024), the GILRHO Index (Badgett, Waaldijk, and Rodgers 2019), and the Human Capital Index (Davis, 2024). The table below summarises the variables undertaken for the study. (In each column, the formal name of the variable is listed in bold letters; the short name of the variable used for this study is listed in brackets; the source of data and timeline are also mentioned in Table 1.)

Table 1. Variables and Data Origin

VARIABLES	DATA ORIGINS
GILRHO Index (LGBTI) The William Institute 2009-2022	In GILRHO, nations are assigned index scores for eight types of regulations every year. These groups include 'decriminalization, anti-discrimination legislation, and couple recognition'. The scoring methodology enables a maximum of 8 points, with a 1⁄2 score allocated if the appropriate regulation pertains to or is applied exclusively to some areas of a nation (Badgett, Waaldijk, and Rodgers 2019)
Economic Complexity Index Trade Value (ECI Trade) / Economic Complexity Index Technology Value (ECI Technology) Observatory of Economic Complexity 2009-2022	An indicator of the economy's competence, the Economic Complexity Index (ECI) is derived from data correlating regions with the events that occur within them. It has been established that the ECI is capable of foreseeing significant socioeconomic outcomes, such as income distribution, economic expansion, income disparity, and emissions of greenhouse gases in an economy (Simoes and Hidalgo 2011).
Real GDP per capita (GDP) World Bank, 2009-2022	GDP per capita based on Purchasing Power Parity (PPP). It is the GDP converted to international dollars using purchasing power parity rates (World Bank 2024).
Total Labor Force (Employment) World Bank 2009-2022	Labor force comprises people ages 15 and older who supply labor for the production of goods and services during a specified period. It includes people who are currently employed and people who are unemployed but seeking work as well as first-time job-seekers (World Bank 2024).
Gross Capital Formation (% of GDP) (Capital Stock) World Bank, 2009-2022	It consists of outlays on additions to the fixed assets of the economy plus net changes in the level of inventories (World Bank 2024).
Total Population (Population) World Bank, 2009-2022	It is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship. The values shown are midyear estimates (World Bank 2024).
Human Capital (Human Capital) FRED Economic Data, 2009-2022	Index of human capital per person, measured in terms of years of learning and economic benefits (Davis 2024).
Domestic Credit to Private Sector (% of GDP) (Domestic Credit) World Bank 2009-2022	It refers to financial resources provided to the private sector by financial corporations, such as through loans, purchases of nonequity securities, and trade credits and other accounts receivable, that establish a claim for repayment. For some countries these claims include credit to public enterprises (World Bank 2024).

Source: Author

2.2. Material Incorporated

'Economic Complexity' is a measurement that gauges the level of proficiency within a society, as reflected in the range of products it produces. The calculation of a nation's economic complexity relies on the range of exports that it creates and their availability across nations. This considers the intricate nature of all nations that are capable of producing these exports (Data Wheel 2023; Simoes and Hidalgo 2011).

An assessment of economies' export baskets, measuring their level of diversification and complexity. Countries with a wide range of productive expertise, especially in heavy niches, create a variety of advanced merchandise. The complicated nature of what a nation exports is a strong indicator of its present economic levels. When a nation's export complexities exceed the benchmarks for its GDP level, it indicates a likely path towards greater prosperity in the future. ECI is a valuable indicator of progress in the economy (Data Wheel 2023; Simoes and Hidalgo 2011).

The Economic Complexity Index (ECI) ranks India as the 42nd most intricate homeland. The Indian economy has experienced significant expansion and advancement over the past decade, moving up ten spots in the ECI ranking (Data Wheel 2023). This indicates a greater level of complexity and improvement in the country's economic landscape. India's efforts to expand its export opportunities have contributed to its evolving complexity. In the future, India has the potential to capitalize on multiple chances to expand its production and diversify its offerings, leveraging its current expertise. The complexity of India's GDP level surpasses typical observations. Given the circumstances, we anticipate significant growth in the economy. According to the growth projections, India is expected to experience an average yearly growth rate of 5.2% over the next ten years, placing it in the most prosperous decile among nations worldwide (Data Wheel 2023).

2.3. Methods Employed

Panel data from the year 2009 to the year 2022 has been undertaken for analyses in this study, wherein two development indicators, namely, ECI_{Trade} $ECI_{Technology}$, have been observed in association with LGBTI Inclusion to know the influence of the LGBTI on the Indian economy. The dataset used for the LGBTI Inclusion, the GILRHO Index, has been developed by (Badgett, Waaldijk, and Rodgers 2019) and dataset for ECI has been considered by (Data Wheel 2023). Further, the development indicators have been considered by (World Bank 2024; Davis 2024). The data has been analyzed using EViews 12.

The objective is to assess the overall impact of LGBTI inclusion on the globalization of India, taking into consideration other relevant factors. An analysis is conducted on various economic factors in India from 2009–2022, including GDP per capita, employment, capital stock, population, domestic credit to the private sector, and human capital. The general effect of LGBTI integration on ECI_{Trade} and $ECI_{Technology}$ has been evaluated using a regression approach. The primary goal of the methodology is to establish a substantial relationship between LGBTI inclusion and macroeconomic conditions within the context of the rise of globalization. This is achieved through the use of graphical and statistical frameworks for estimating the expansion of the economy. A correlational analysis has been discovered between ECI_{Trade} and $ECI_{Technology}$ in relation to the GILRHO scores for India.

In addition, the authors include default controls that contribute to the expansion of our model to obtain a broader comprehension of the residual relationship that exists between inclusion and advancement, assuming all other factors remain constant. The analysis implements the OLS method and the authors have summarized the stacked models in Table 2 of the main text, details of which can further be extracted from *Tables A.1 and A.2 of the Appendix*.

For several models, Table 2 displays the predicted regression coefficient relating to the LGBTI Inclusion and ECI_{Trade}, or $ECI_{Technology}$. Rows A – C show the correlation between the LGBTI inclusion and ECI_{Trade} (column 3) or $ECI_{Technology}$ (column 4), depending on whether the control variables from column 2 are included in the model.

A thorough analysis of estimation techniques is presented in the Appendix. As a baseline model, an OLS Regression Model has been developed wherein globalization indicators (ECI_{Trade} and $ECI_{Technology}$ (Data Wheel 2023)) have been regressed over the GILRHO Index (Badgett, Waaldijk, and Rodgers 2019)) ("OLS" – Column 1 – Tables A.1 and A.2). A further estimation has been developed in consideration of macroeconomic variables to the existing framework as controls to the model, namely, 'Real GDP per Capita' (World Bank 2024), 'Total Labor Force' (World Bank 2024), 'Gross Capital Formation as a % of GDP' (World Bank 2024), 'Total Population' (World Bank 2024), 'Human Capital' (Davis 2024), 'Domestic Credit to Private Sector as a % of GDP' (World Bank 2024) ("Base + Index" – Colum 2 – Tables A.1 and A.2). In the final framework, year dummies were

instilled as a last step in the model ("Base + Index + Year" – Column 3 – Tables A.1 and A.2). This approach lets us evaluate LGBTI inclusivity and economic complexity models in solitude and in a full model with all explanatory factors. Each framework has been constructed in consideration of the statistical significance of 1%, 5%, and 10%.

3. Conceptual Framework

Globalization can have enormous effects if LGBTI people are well blended into the pool of resources and tapped efficiently. The effects of globalization on the community can be acquired from the remains of trade theories to gain a perspective on their inclusivity and enhance the innovative capacity of an economy. From a neoclassical viewpoint, a gender-based wage gap hinders trade liberalization. Three significant grounds for debate to overcome these obstacles are as follows:

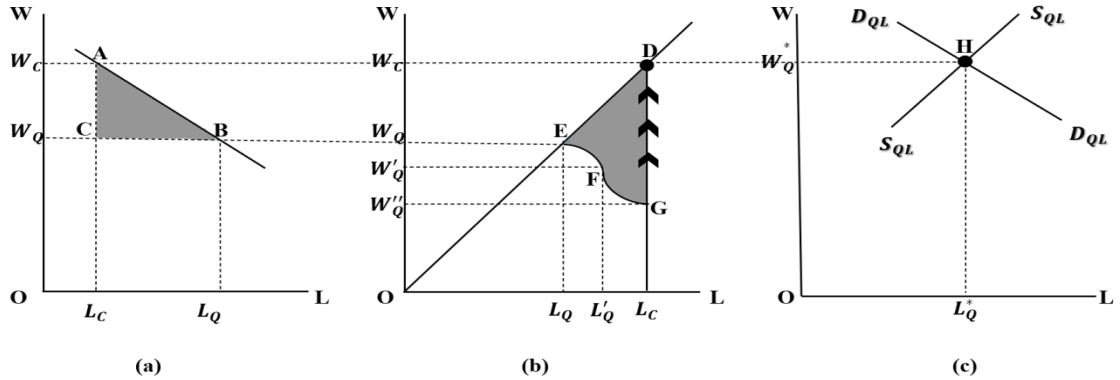
First, the repercussions of '***Trade Liberalization and Labor Market Deregulation'*** are likely to be major for the LGBTI community in comparison to the cisgender population (Dix-Carneiro 2014). When it pertains to this matter, trade associations increase wage rates above the point of equilibrium by inhibiting the supply of labor (Dix-Carneiro 2014). This eventually helps only a small number of people who hold influence over the market for labor. As a result of workforce reform, unions as well as employers have encountered greater challenges in restricting the supply of labor, which has led to their incapacity to sustain disproportionately high salaries (Dix-Carneiro 2014). Thus, there could be a significant increase in the overall level of employment for individuals who are not a component of the prevalent labor community, such as the LGBTI community. This would result in an *expansion of job prospects* for this specific section of the population. Therefore, it can be concluded that employment prospects for LGBTI individuals who come across public injustice would be considerably enhanced if unions were not creating ineffectiveness in employment markets (Çağatay 2005). Thus, it is apparent that an amalgamation of policies and legislation to stimulate employment and trade liberalization is expected to have beneficial consequences for the LGBTI community. It is important to recognize that achieving equitable socioeconomic status in the labor market is probably not going to happen by undermining the sway of cis-gendered labourers and wealth. On the contrary, it can be achieved by making sure LGBTI employees have equal exposure to resources and possibilities as cis-gendered personnel.

Second, according to ***Gary Becker's Theory of Discrimination***, disparities in wages between various categories of employees become less feasible as rivalry intensifies (Becker 1957). Organizations that engage in discriminatory practices face consequences as they opt not to hire competent employees at cheaper rates. When firms choose to hire personnel from a prejudiced group, they can gain an edge over rivals who remain involved in discriminatory hiring procedures (Becker 1957). However, just like an economist would indicate, as a growing number of companies try to capitalize on this economic edge, the wage rates of every staff member will eventually converge.

Third, ***Heckscher – Ohlin – Samuelson Model*** asserts, if emerging economies excel in producing goods that heavily rely on untrained labor, liberalizing trade might lessen the disparity in pay between workers with skills and those without (Mikić 1998). In addition, if less developed nations were willing to open up to trade, the "gender wage gaps"; would likely shrink, especially considering the larger percentage of unskilled labourers who identify as LGBTI. Therefore, increasing participation in trade, regardless of the circumstances, would likely reduce pay gaps between genders by making it prohibitively costly for organizations to discriminate (Çağatay 2005).

Panel (a) depicts the case of the mainstream labor market, the L_C quantity of Cis-gendered labor is employed at the W_C wage rate, and point A highlights the employment scenario for the Cis-gendered labor market. Now, as *trade liberalizes and the labor market de-regulates*, the inclusivity of queer labor in the market will widen the resource pool of the available workforce. When Queer Labor enters the market, they agree to work at a lower wage rate, which will be cost-saving to the employers, and they mutually agree to hire a greater number of Queer Labor for their produce. Therefore, as the queer labor workforce is employed, the L_Q quantity of queer labor is employed at the W_Q wage rate, as highlighted by point B. The effect of such a reform in labor market is highlighted by ***Area ABC*** (Figure 1).

Figure 1. LGBTI Inclusivity and Globalization



Source: Author

Note: For Ease of Diagrammatical Analysis, the author has used the word 'Queer' interchangeably for 'LGBTI'.

Where (a), W_C is the wage of Cis-gendered people, W_Q is the wage of Queer people, L_C is the quantity of Cis-gendered labor, and L_Q is the quantity of Queer labor.

Now, when an individual employer practices the hiring of queer labor in the market, as depicted by point E in Panel (b), it results as a cost advantage to the firm in terms of lessened wages, which further induces the fellow employers to hire the pool of queer labor resulting in a lower wage rate $W_Q^{'}$ for $L_Q^{'}$ quantity of labor, as depicted by point F. This drill continues as long as the employers are in a position to hire unskilled labor for returns of productivity in the market, here, until point G at $W_Q^{''}$ for $L_Q^{''}$ quantity of labor. The ***EFG Curve*** highlights the effect of the *theory of discrimination*. It is clear that the inclusion of queer labor benefits both employers and queer labor in the market, up to point G, where firms can compromise on specialization and expertise without compromising productivity.

The scenario at G swiftly changes the employment pattern in the market; that is, it induces the unemployed queer labor to indulge in skill development courses, and the employed queer tend to enhance their productivity with facilities such as on-the-job training, skill development programs, and other ways of being an efficient resource at work in order to attain employment security.

Beyond point G, the firm restricts the hiring of queer labor to maintain the quality of production; that is, the job roles require specialization and minimum educational attainment to uplift the pool of human capital in the market. This barrier tends to act as a motivator for queer labourers in and outside the workforce to upgrade their skills and literacy with respect to the requirements of their employers. Thus, increased literacy levels, training programs, and specialization eliminate the roadblock of unskilled queer labor, ultimately fostering competitiveness between Cis-gendered and Queer employees in the market.

Thus, as *human capitalization vis-à-vis capability theory* comes into play, the resource base of the queer population in the economy is more inclined towards designated job roles than easy money by way of conventional sources of livelihood. This increased capacity of queer labor eventually merges with the cis-population, and gradually the wage rate of both cis-gendered and queer labor is at par, as depicted by point **D**. The ***Area DEG*** in figure (b) highlights the *Heckscher-Ohlin-Samuelson postulation*.

Therefore, it has been established in Panel (c) that L_Q^* quantity of queer labor is employed at W_Q^* wage rate which highlights the equilibrium point of *Queer Labor Market* in the economy at point H. This will ultimately encourage the employers to support LGBTI inclusivity for enhanced globalisation at a macroeconomic glance.

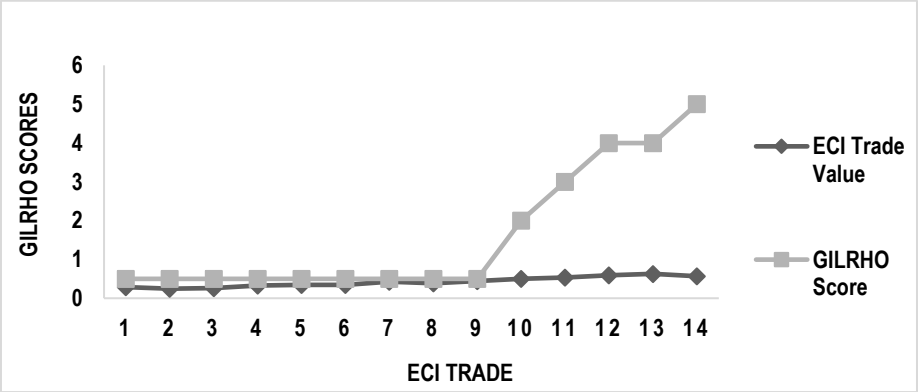
4. Research Results

4.1. Graphical Analysis

As an easy overview of the association between LGBTI inclusivity and Globalization, Figures 2 and 3 depict the values of the GILRHO Scores against different metrics of Globalization from 2009-2022. The Y-axis depicts the GILRHO Scores, with values varying between -0.50 and 5.00, and the X-axis reflects the globalization measurements, either ECI_{Trade} or the $ECI_{Technology}$ (varying between 0 and 1).

ECI_{Trade} and GILRHO for India

Figure 2. ECI Trade Compared to GILRHO Scores in India, 2009-2022



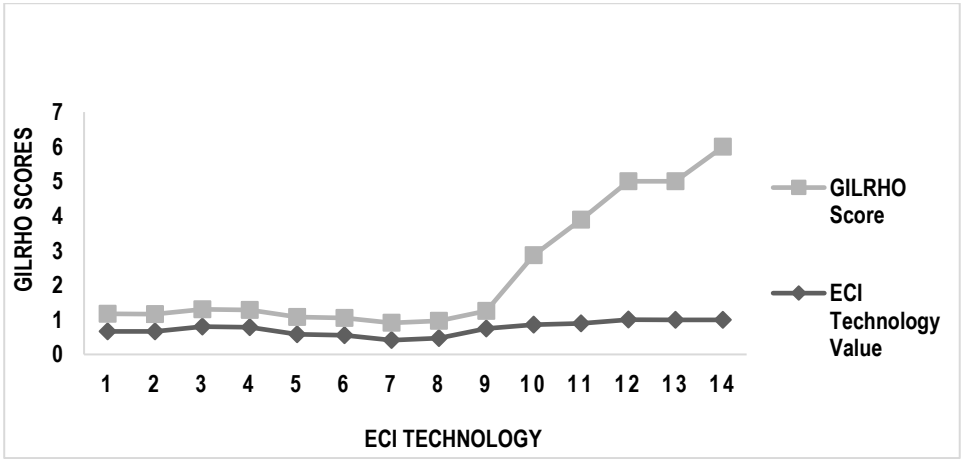
Source: Author

In Figure 2, in the year 2009, the leftmost point that appears on the GILRHO Scores graph had an ECI_{Trade}value of 0.289 in the and a score of 0.5 for GILRHO. The value of the GILRHO remained unchanged from 2010-2017. The dynamics transformed when homosexuality was decriminalized by Supreme Court of India in September 2018. Since then, the decision has been regarded as a major step forward for LGBTI rights in India. The GILRHO Score in 2018 was 2, and the ECI_{Trade} was 0.504 as demonstrated by the point on the graph. With the increase in LGBTI inclusivity since then, the GILRHO Score rose at a rate of approximately double than what it was before decriminalization. According to the graph, the value of GILRHO Scores in 2022 was 5, while the ECI_{Trade}value was 0.566.

It can thus be affirmed that an increase in GILRHO Scores in India tends to have increased levels of $\boldsymbol{ECI_{Trade}}$ ***value***, thus raising the economic development of both the LGBTI from a micro-level approach and the Indian economy from a macro-level approach vis-à-vis Globalization simultaneously**.**

$\boldsymbol{ECI_{Technology}}$ and GILRHO for India

Figure 3. ECI Technology Compared to GILRHO Scores in India, 2009-2022



Source: Author

In Figure 3, in the year 2009, the leftmost point that appears on the GILRHO Scores graph had an $ECI_{Technology}$value of 0.669 and a score of 0.5 for GILRHO. The value of the GILRHO remained unchanged from 2009-2017. However, the decision of 2018, has been regarded as a major step forward for LGBTI rights in India. The GILRHO Score in 2018 was 2, and the $ECI_{Technology}$ was 0.860 as demonstrated by the point on the graph. With the increase in LGBTI inclusivity since then, the GILRHO Score rose at a rate of approximately double than what it was before decriminalization. According to the graph, the value of GILRHO Scores in 2022 was 5, while the $ECI_{Technology}$value was 0.996.

It can thus be affirmed that an increase in GILRHO Scores in India tends to have increased levels of $\boldsymbol{ECI_{Technology}}$ ***value***, thus raising the economic development of both the LGBTI from a micro-level approach and the Indian economy from a macro-level approach vis-à-vis Globalization simultaneously.

4.2. Statistical Analysis. The Model

Relationship between ECI_{Trade} and LGBTI Inclusion:

The authors established a certain framework to investigate the association between the LGBTI Inclusion and globalization:

$$ECI_{Trade_i} = \alpha + \beta\, LGBTI_i + \gamma\, X_i + \varepsilon_i$$

where ECI_{Trade_i} is the Economic Complexity Index for Trade, a developmental indicator for nation i (i = 1, India, in this case). LGBTI stands for the LGBTI Inclusion (GILRHO) developed by (Badgett, Waaldijk, and Rodgers 2019). β estimates the anticipated impact of Inclusion on ECI_{Trade}. X represents the fundamental control parameters of GDP per capita, capital stock, domestic credit, employment, population, human capital. ε is the error term. Regression approaches may incorporate India's long-term ECI_{Trade} – LGBTI Inclusivity connection, which seems to be improving. This research examined factors from 2009 to 2022. The selection of variables is influenced by (Vu 2022; Badgett *et al.* 2014).

The results reveal a favourable correlation between LGBTI Inclusion and the country's ECI_{Trade}. For several models, Table 2 displays the predicted regression coefficient relating to the LGBTI Inclusion and ECI_{Trade}, or $ECI_{Technology}$. Rows A – C show the correlation between the LGBTI inclusion and ECI_{Trade} (column 3) or $ECI_{Technology}$ (column 4), depending on whether the control variables from column 2 are included in the model.

LGBTI inclusion boosts India's ECI_{Trade} value roughly by 0.3586. The mean ECI_{Trade} value in India from 2009-2022 was 0.4211; therefore, the influence of LGBTI Inclusion was 6.3% of the average. This seems to indicate a link between ECI_{Trade} and LGBTI inclusivity.

The favourable relationship persists after controlling for GDP per capita, capital stock, domestic credit, employment, population, human capital, which economists use to estimate ECI_{Trade}. Considering them enhances the LGBTI inclusivity impact on one component: Row B of Table 2 demonstrates that India's ECI_{Trade} improves by 1.093 for LGBTI inclusivity, or 10% of the average and 13.2% of initial influence. Table 2, column C, shows that when year dummies are included in the framework, the association increases to about 16.19% of the mean ECI_{Trade}, or 2.040 at the 10% threshold of significance. Thus, it can be asserted that with the **Strategic Modernization Framework** coming into play, LGBTI inclusivity boosts the trade of the Indian economy, thereby significantly contributing to the development process.

Table 2. Influence of LGBTI Inclusion on Globalization Indicators

	(1) Variable Effect	(2) Control Variables	(3) Influence on ECI_{Trade} in India, (2009-2022)	(4) Influence on $ECI_{Technology}$ in India, (2009-2022)
(A)	LGBTI Inclusion	None	0. 3586***	0.591***
(B)	LGBTI Inclusion	Basic macroeconomic variables (GDP per capita, Capital Stock, Domestic Credit, Employment, Population, Human Capital)	1.4516*	0.8351*
(C)	LGBTI Inclusion	Basic macroeconomic variables (GDP per capita, Capital Stock, Domestic Credit, Employment, Population, Human Capital) plus year fixed effect	2.0402*	0.8405*

*** Statistically Significant at 1% level
** Statistically Significant at 5% level
* Statistically Significant at 10% level

Source: Author

Relationship between $ECI_{Technology}$ and LGBTI Inclusion:

The authors established a certain framework to investigate the association between the LGBTI Inclusion and Globalization:

$$ECI_{Technology_i} = \alpha + \beta\, LGBTI_i + \gamma\, X_i + \varepsilon_i$$

where $ECI_{Technology_i}$ is the Economic Complexity Index for Technology, a developmental indicator for nation i (i = 1, India, in this case). LGBTI stands for the LGBTI Inclusion (GILRHO) developed by (Badgett, Waaldijk, and Rodgers 2019). β estimates the anticipated impact of Inclusion on $ECI_{Technology}$. X represents the fundamental control parameters of GDP per capita, capital stock, domestic credit to private sector, employment, population, human capital. ε is the error term. Regression approaches may incorporate India's long-term $ECI_{Technology}$ – LGBTI Inclusivity connection, which seems to be improving. This research examined factors from 2009 to 2022. The selection of variables is influenced by (Vu 2022; Badgett *et al.* 2014).

Based on the results, we can conclude that the LGBTI inclusivity is positively correlated with India's $ECI_{Technology}$ value. Each inclusion prospect is associated with an increase of approximately 0.591 in India's $ECI_{Technology}$ value (as presented in row A, column 4 of Table 2). In order to place this figure in context, the average $ECI_{Technology}$ value in India from 2009 to 2022 was 0.7453, so the LGBTI inclusion impact is equivalent to a 15.4% change in $ECI_{Technology}$. Since the shift in $ECI_{Technology}$ cannot be easily translated into a more instinctive metric, increased protections for LGBTI people in the Indian economy have been linked to higher levels of LGBTI healthcare, schooling, and earnings.

The statistically significant relationship continues to hold regardless of how analysts consider the effects of GDP per capita, capital stock, domestic credit, employment, population, human capital on $ECI_{Technology}$ projections. Taking them into consideration increases the significance of a single inclusion factor: Row B of Table 2 shows that for every prospect, India's $ECI_{Technology}$ value increases by 24.4% with respect to LGBTI inclusion. In addition, it is seen in Table 2, row C, that the association has risen to almost 9.5% of the average $ECI_{Technology}$ value at a level of significance of 10% after introducing year dummies to the model.

5. Discussions

Based on statistics from 2009 to 2022, both the $ECI_{Technology}$ and the ECI_{Trade} of India have increased over time. It is evident that with rise in each LGBTI inclusion over the period, both $ECI_{Technology}$ and the ECI_{Trade} values have increased favorably depicting a strong positive association between Rights for Sexual Minorities and Economic Development Indicators in India. To be precise, each addition of LGBTI inclusion factor in the Indian Economy tends to increase the ECI_{Trade} approximately by 13.2% and $ECI_{Technology}$ approximately by 24.4%.

Therefore, it is evident from the regression models that LGBTI Inclusivity is positively correlated to Globalization of the Indian Economy.

5.1. Economic Concerns for LGBTI Inclusivity

i) SOGIESC Based Wage Gaps: Studies have shown that in economies with a strong emphasis on technological progress and international trade, there is a relationship between gender disparities in wages in the manufacturing sector and expanded economic growth (Seguino 2000). The rapid rate of growth corresponding to the boom in global trade might appear at the cost of gender parity in job markets. A potential consequence is that global trade and investment reforms may lead different economies to slash the pay of LGBTI individuals to remain viable and lure foreign investment. Indeed, the policy-driven elevation in working conditions in (Export Processing Zones) EPZs and the lowering of employment standards in these areas are concerning, particularly given the expectation that LGBTI individuals will constitute a significant portion of the working population in these situations.

ii) SOGIESC Discrimination in the Trade and Technology Outcomes: Another aspect to consider is the examination of prejudice and bias based on SOGIESC within the framework of the 'Theory of Unequal Exchange' (Chandra 1986), which includes the P-S version (Nayyar 2000; Busse and Spielmann 2006). There is an observable relationship between the discrepancies in wages based on SOGIESC and the trade conditions. In economies such as India, there is a relationship between the degree to which LGBTI-based voids exist in the manufacturing industry as well as the Terms of Trade (ToT) with technologically advanced trade partners. More precisely, as these discrepancies increase, the Terms of Trade (ToT) associated with manufacturing decrease. Therefore, it indicates that while wage differentials determined by SOGIESC may boost India's innovation, they could also foster an upward trend in LGBTI personnel and influence the economy's Terms of Trade (ToT).

The exploration of SOGIESC interactions and imbalances has played an integral part in establishing the global economic system. The Prebisch-Singer Hypothesis (Cuddington, Ludema, and Jayasuriya 2002) emphasizes that inequality explains the obstacles faced by economically disadvantaged people who benefit from global trade. This theory has received consideration in light of current internationalization discussions and has discovered variations in trade, development, and economic growth. Addressing SOGIESC inequalities in

employment sectors ought to constitute an essential focus in the formulation of policies, not merely to encourage equitable treatment but also to boost the economic advantages generated by trade and technological advancements.

iii) SOGIESC Based Skills: There is insufficient evidence to support the notion that increased globalization has a significant impact on reducing wage disparities based on SOGIESC. Following closer inspection, it becomes evident that the diminution of the pay discrepancy based on SOGIESC has often occurred through the lowering of wages for cis-gendered people. This method is considered unacceptable. Additionally, the idea that increased economic rivalry might reduce the SOGIESC pay gap does not appear to hold in the majority of instances.

5.2. Economic Implications of LGBTI Inclusivity

The decrease in inequality in wages could have been a consequence of the disproportional decline in employment opportunities for unskilled individuals and low-paid LGBTI workers (Card and Dinardo 2001; Black and Brainerd 2004; Bhagwati 2021; Berik 2000). The perceived inflexibility of disparities in wages can be attributable to the adverse effects of capital mobility on the negotiating leverage of LGBTI employees. Various factors, including professional and economic inequality, academic achievement and skill appropriation, and the ability of employees to organize themselves, determine pay discrepancies in acquisition. Over time, specific distinctions are becoming less apparent, such as the discrepancy in educational attainment being more substantial among cis-gendered individuals.

It is anticipated that the patterns of inequality will lead to a reduction in pay and revenue imbalances. It is essential to have a thorough comprehension of the distinctions between acquiring abilities and having the capacity to become organized as employees. In addition, Becker (Becker 1957) supports the idea by highlighting the importance of skill development for SOGIESC individuals. He suggests that engaging in trade could potentially reduce wage bias for LGBTI individuals. However, the extent to which their earnings strengthen will ultimately depend on developing the skills of LGBTI individuals, enabling them to effectively compete with the cisgender population in increasingly competitive markets.

According to (Raquel and Wendy 2002) certain technologies used in export-oriented sectors may complement the skillsets of LGBTI individuals. Organizations often perceive LGBTI individuals as versatile, proficient, conforming, and receptive to authority. The study (UN Inter-Agency Network on Women and Gender Equality Task Force on Gender and Trade 2004) outlines competencies that are more effectively suited for a "Just in Time" group or "Total Quality Control." According to (Marzia, Susan, and Rachel 1998), a surge in market demand for expertise would result in higher earnings for LGBTI individuals in comparison to cisgender people. The increased demand for capabilities will end up resulting in an upsurge in the pay of LGBTI individuals when compared to the cis-population.

It is important to point out that the global economy frequently encounters greater joblessness for LGBTI individuals. This insight aligns with the projection that pay discrepancies will not instinctively reduce with expanded trade and technological progress. When LGBTI individuals enter the workforce, an imbalance in the income disparity between workers and investors often triggers their entry, leading to greater levels of layoffs. This also impacts the fair allocation of resources, as in multiple cases, the rate of integrating LGBTI individuals into the workforce surpasses the rate of employment, thereby sustaining wage inequality as determined by SOGIESC.

Conclusions and Further Research

If we effectively integrate LGBTI people into the pool of resources, globalization can have enormous effects. Various factors, such as connectivity, technological breakthroughs, and political, humanitarian, and ecological shifts, drive the expansion of globalization. The social exclusion of the LGBTI community, leading to bigotry and hindering their ability to fully participate in a society that values equal opportunities and dignity, is a significant infringement on fundamental freedoms. LGBTI inclusion is something that evokes profound feelings in economies. Fostering consciousness about LGBTI experiences among law enforcement, the general public, and communities is essential to their eventual mainstreaming. An economy can trace globalization through trade and technological advancements. Examining the impact of technological advances and trade on the LGBTI community, this study addresses how their engagement in innovative skills may strengthen economic resources that contribute to increased development.

The effects of globalization on the community can be acquired from the remains of trade theories to gain a perspective on their inclusivity and enhance the innovative capacity of an economy. From a neoclassical viewpoint, a SOGIESC-based wage gap hinders development. LGBTI inclusivity has been associated with three

significant concepts, such as trade liberalization and labor market de-regulation, Becker's theory of discrimination, and Heckscher-Ohlin-Samuelson's postulate, along with a diagrammatic representation showcasing the impact of LGBTI inclusivity on the labor market, thereby enhancing the resource pool of the economy.

The author showcased the importance of LGBTI inclusion to the economic ripple effect by comparing the GILRHO Index and the Economic Complexity Index for Trade and Technology (ECI_{Trade} $ECI_{Technology}$) values as two different regression models with other economic variables from 2009 to 2022. The goal was to find out how globalization drivers affected LGBTI inclusion in India, which could lead to important economic growth in the coming years by recognizing them as important contributors to the economy.

India's ECI_{Trade} $ECI_{Technology}$ had a sustained growth pattern from 2009 to 2022, as anticipated. The contemporaneous rise in LGBTI inclusion, ECI_{Trade} $ECI_{Technology}$ throughout the period convincingly indicates the positive association contributing to the economic prosperity in India. This indicates that with the adoption of a progressive policy regime concerning LGBTI empowerment, the drive to inclusiveness will eventually impact the economic well-being of the community as a whole. The authors have emphasized the economic ramifications of inclusivity in relation to wage gaps, discrimination, and the development of human capital. The authors exemplified the integration of LGBTI individuals to justify the default regime of conceptualized postulates in support of inclusivity. Further, a suggested policy framework has also been recommended in synchronization with the economic implications outlined in the study.

Recommended Policy Framework

Inclusivity of LGBTI in Export Processing Zones (EPZs): Global financial institutions are supporting developing nations in establishing EPZs as a component of export growth tactics (McCallum and Jamie K 2011). During periods of economic distress that pose an imminent risk to economically weakened nations, EPZs impart an immediate route to foreign marketplaces and global chains of production (Sukthankar and Gopalakrishnan 2012). In addition, they provide an effective solution for the absorption of excess labor. Business entities acknowledge the positive aspects of EPZs and diligently endorse their growth. They benefit from minimal taxation and tariff stipulations, as well as relaxed employment rules that enhance managerial authority in the work environment (Sukthankar and Gopalakrishnan 2012).

Policy inducing the inclusivity of LGBTI in Indian EPZs shall have an adverse effect on the economic scenario. GOI must ensure that labor laws, particularly for EPZs, incorporate LGBTI individuals as a significant workforce component, fostering favorable conditions for SOGIESC empowerment.

Inclusivity of LGBTI and Globalization Reforms: Globalization can enhance the economic engagement of the LGBTI community, reduce disparity, and improve their ability to acquire competencies and training. The emergence of new patterns of global commerce, such as the increasing prominence of amenities, the rise of Global Value Chains (GVCs), and the emerging digital economy, presents substantial economic prospects for the LGBTI community (World Bank and WTO 2020). However, to fully reap these benefits, nations must enact policy reforms that tackle discrimination against LGBTI individuals. At the same time, they should focus on developing the valuable workforce that these individuals possess.

Policy inducing the inclusivity of LGBTI in globalization reforms tends to enhance the Terms of Trade (ToT), access to participate in GVCs, etc. The Government of India (GOI) must guarantee that LGBTI individuals have access to these amenities and receive the appropriate level of exploitation, recognizing them as a significant economic resource.

Inclusivity of LGBTI to the pool of Human Capital: Investing in developing skills, health, schooling, and social infrastructure is crucial to boosting productivity. By strategically allocating resources across different areas, governments may encourage the LGBTI community to set themselves free from the downward spiral of intergenerational poverty, which often affects them substantially (Gajjalapurna and Irshad 2023). The acquisition of skills has a significant impact on workforce efficiency, but it goes far beyond just academic achievement. Individuals in the LGBTI community who possess lower fundamental competencies are more prone to experiencing negative health consequences and reduced participation in civic endeavours (World Economic Forum 2022). In addition, spending on educational and health infrastructure helps to create job prospects and enhance individual development. Enhanced social structures and increased accessibility to expertise can greatly boost revenue potential (Gajjalapurna and Irshad 2023). This, in turn, can empower the LGBTI community with greater influence over decisions, which is crucial for the well-being of both the community as a whole and society at large (World Economic Forum 2022).

Policy inducing the inclusivity of LGBTI as Human capital to the Indian Economy tends to be the key driving force to integrate them in the economic activities in the nation. Investing in Health and Educational

Attainment by GOI via flagship programs targeting LGBTI exclusively is the ultimate influence that is needed in order to anticipate the increased levels of LGBTI Employment, Life Expectancy of LGBTI and better standard of living of the community as a whole.

Limitations of the Study

First, this research only looks at the Indian scenario for the rights of LGBTI individuals and economic development from 2009–2022, hence its findings may or may not be applicable to economies beyond India.

Second, it may not be acceptable to explicitly establish if there is a link of causation between the LGBTI inclusivity and Economic Complexity Index with economic variables, but the data analysis does show a potential favorable relationship between the two.

Third, the methods used allowed only passive evaluation of economic development and globalized integration. LGBTI individuals in India may be less stigmatized than their entitlements under the law convey. Opinions evaluate rights, yet the cultural or institutionalized marginalization LGBTI people face may not mirror their beliefs. ECI_{Trade} $ECI_{Technology}$ omits discrepancies; therefore, expanding the economy will not improve LGBTI individuals' standard of living.

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Credit Authorship Contribution Statement

Kanika Chawla: Conceptualization; Investigation; Methodology; Software; Formal Analysis; Writing – Original Draft; Visualization
K. Nilavathy: Project Administration; Supervision; Data Curation; Validation; Writing – Review and Editing

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Declaration of Use of Generative AI and AI-Assisted Technologies

The authors declare that they have not used generative AI and AI-assisted technologies during the preparation of this work.

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Appendix

This study employs a comprehensive database of economic variables that India can use over time to analyse the relationship between LGBTI rights and economic development. The authors have examined various economic indicators, such as GDP per capita (PPP), employment, human capital, population, domestic credit and capital stock data from 2009 to 2022, to assess the correlation between Indian economic progress and the rights of LGBTI individuals. Various indicators such as the World Development Indicators (World Bank 2024), the GILRHO Index (Badgett, Waaldijk, and Rodgers 2019), the Human Capital Index (Davis, 2024) and ECI_{Trade} or $ECI_{Technology}$ (Data Wheel 2023) have been utilized in the study. Over a period, we can observe the impact of variations in the indices. The data assist in accounting for time-invariant effects, eliminating the possibility of bias due to omitted variables.

The study utilizes an Ordinary Least Squares Approach to account for heterogeneity, employing the EViews 12 software. This strategy considers unobservable components that can impact economic development but remain constant over the years. The time frame for the data series is sufficiently narrow to consider indistinct features as constant over time. Furthermore, the estimated projections are free of clustering standard errors, which helps mitigate possible discrepancies caused by a serial correlation in the dependent variables. Estimates also aim to be closer to true values.

Here are the complete models estimated in Tables A.1 and A.2. To analyse the potential connections between LGBTI rights and economic development, we conducted a series of nested models. We began with a baseline model that examined economic development outcomes, using OLS Approach to assess the impact of the GILRHO Index on ECI_{Trade} or $ECI_{Technology}$ as shown in Row A – Table 2 in the main text and Column 2 – Tables A.1 and A.2 in Appendix.

In the next model, we incorporate the important economic control variables, such as the logarithm of GDP per capita (PPP), domestic credit, employment, population, and capital stock. Using the OLS approach, we can analyse the impact of these variables on the coefficient for LGBT+ rights. The models obtained emphasize the fundamental *macroeconomic impact of LGBTI inclusivity*, as shown in Row B – Table 2 in the main text and Column 3 – Tables A.1 and A.2 in Appendix.

Next, we include the year dummies in the model to account for other obscured components that might impact economic development and change over time. We can examine different mechanisms linking LGBTI rights to economic development, both independently and within a comprehensive model that incorporates all the explanatory variables. The models obtained emphasize the fundamental microeconomic impact of LGBTI inclusivity in the Indian economy, Row C – Table 2 in the main text and Column 4 – Tables A.1 and A.2 in Appendix. We estimate these models for both ECI_{Trade} and $ECI_{Technology}$. The text reports statistical significance at the 1%, 5% and 10% levels.

The elaboration of the tables are as follows:

Table A.1: We can see the baseline controls for the main model in Column 2. In Column 3, the OLS method shows the controls for ECI_{Trade} and the year effects are depicted in Column 4.

Table A.2: Adopts the OLS method to account for the heterogeneity in $ECI_{Technology}$. We stack the baseline controls with alternative models, then estimate them further.

Determining the direction of causation from these regression models is not possible. There is a potential correlation between the expansion of LGBTI rights and economic development. Additionally, as India continues to progress economically, there may be an increased possibility of recognizing the rights of LGBTI individuals. The endogeneity problem could potentially influence the coefficient estimates on LGBTI rights, thereby compromising the accuracy of measuring the true causal impact of these rights on economic development. Therefore, we interpret the effects measured by the coefficients as correlations rather than causal relationships

Table I3. A.1: ECI Trade Value in India, 2009-2022

Dependent Variable: ECI Trade			
	OLS	**Base + Index**	**Base + Index + Year**
GDP Per Capita		3.8758* (1.5619)	1.6019** (0.6346)
LGBTI Inclusion	0.0547*** (0.0082)	0.0654* (0.0114)	1.7539** (0.1029)
Capital Stock		-0.0093* (0.0041)	0.0391 (0.0174)
Domestic Credit		-0.0136* (0.0031)	-0.0954** (0.0137)
Employment		-22.0454* (4.7268)	35.3408* (48.1825)
Population		37.1211* (6.3740)	18.6970** (4.8069)
Human Capital		-7.1404* (2.1110)	-4.9412** (1.5036)
Constant	0.3586*** (0.0210)	1.4516* (0.2179)	2.0402* (0.2421)
Adjusted R^2	0.90	0.99	0.99
N	14	14	14
Year Dummies	No	No	Yes

Table 4. A.2. ECI Technology Value in India, 2009-2022

Dependent Variable: ECI Technology			
	OLS	**Base + Index**	**Base + Index + Year**
GDP Per Capita		1.2111 (0.7165)	1.6811* (0.2212)
LGBTI Inclusion	0.0957*** (0.0197)	0.2211* (0.0596)	0.0389* (0.0014)_
Capital Stock		0.0331* (0.0151)	0.0029* (0.0003)
Domestic Credit		0.0227 (0.0159)	0.0016 (0.0004)
Employment		-4.7431* (2.1131)	-6.9325* (0.6155)
Population		5.225 (2.6266)	7.1984* (0.6574)
Human Capital		-1.3304 (0.9244)	-1.6523* (0.2343)
Constant	0.5914*** (0.0449)	0.8351* (0.7903)	0.8405* (0.2505)
Adjusted R^2	0.96	0.99	0.99
N	14	14	14
Year Dummies	No	No	Yes

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The Impact of the ChatGPT Platform on Consumer Experience in Digital Marketing and User Satisfaction

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Abstract: ChatGPT, an artificial intelligence (AI) chat platform, facilitates conversation between humans and bots. By integrating machine learning and natural language processing, it revolutionizes the way people interact with AI. Many people are excited about using ChatGPT because it has numerous potential applications and advantages compared to other similar programs. Therefore, this paper demonstrates that, in line with specific ethical considerations, ChatGPT has enormous potential to revolutionize and shape the future of marketing. We begin by questioning whether ChatGPT has a significant impact on consumer experience in digital marketing and overall user satisfaction. The methods used in the study include descriptive and inferential statistical methods, as well as the OLS method. The results show that the use of ChatGPT is continuously rising and increasingly being implemented in various industry segments, particularly in the field of digital marketing. Automation of customer care, increased productivity, automated research, and better understanding of consumers are ways it can assist marketing professionals.

Keywords: marketing; digital; ChatGPT; satisfaction; consumers.

JEL Classification: M00; M30; M31.

Introduction

Organizations are experiencing significant changes in content campaign creation, lead generation, reduction of customer acquisition costs, customer experience management, talent recruitment, and social media conversion rates thanks to AI-powered digital marketing. Real organizations in digital marketing abundantly utilize artificial intelligence (Van Esch *et al.* 2021).

Compared to human content writers, ChatGPT can produce marketing content such as product descriptions and promotional messages faster and possibly of better quality. ChatGPT's capacity to compress and analyze vast amounts of data enables the collection of consumer feedback and interactions on social media (Zielinski *et al.* 2023). In light of this, marketing studies could learn more about product perception in the eyes of customers regarding campaigns, attitudes, and vocabularies. To ensure that the specific needs and desires of each customer are met, it is possible to automatically create and modify personalized emails and recommendations with minimal human intervention. Problems with traditional chatbots, such as generic responses and indifferent tones, can be addressed by training chatbots to offer 24/7 service with a human touch. By automating the process of understanding user concerns, identifying relevant information, suggesting sustainable solutions, and responding more quickly, ChatGPT can help call center customer support workers save money and address issues more efficiently and accurately. By using ChatGPT to gather real-time data from many sources, the new product development team could learn about emerging user behavior patterns and create

innovative products. When properly applied, ChatGPT could cause a meteoric rise in the marketing industry in the years to come (Rivas and Zhao, 2023). The marketing industry is one that has been greatly influenced by the new age of artificial intelligence (AI) due to rapid advancements (Dwivedi *et al.* 2021). AI systems are becoming increasingly capable of analyzing large datasets, finding patterns, making predictions, and even making judgments with little or no human input. AI holds tremendous promise for digital marketing, which is defined by its fluidity and reliance on real-time data. AI has the potential to completely change how brands communicate with their customers online through features such as personalized customer experience and predictive analytics (Ziakis and Vlachopoulou, 2023). The future of AI-based digital marketing is entirely uncertain at this point. According to research, negative outcomes can result from poorly executed digital marketing (Roggeveen *et al.* 2021). For organizations looking to integrate artificial intelligence into their processes, this can be a challenge (Aceto *et al.* 2018).

Since artificial intelligence relies on accurate and high-quality marketing data, solid IT infrastructure is necessary for organizations that want to offer efficient AI-based digital marketing. Following a service quality study, there is a correlation between actual service delivery and users' previous expectations for potential support benefits (Nagy and Hajdú, 2021). Several studies have examined customer reactions to AI services, particularly regarding the quality of these services and their overall shopping experience (Chopra, 2020). Service quality in social organizations and AI-supported services is expected to vary greatly because AI services typically rely on innovations in self-management (Guha *et al.* 2021). The term "artificial intelligence" (AI) has gained additional significance due to the hu-man-like responses that systematic computing can provide (Goralski and Tan, 2022). In the past, discussions about artificial intelligence were stretched, much like those about space travel and other similar fantastic ideas. On the other hand, the COVID-19 pandemic and interest in real-time computing have made artificial intelligence (Lim *et al.* 2022) a reality and a necessity (Dwivedi *et al.* 2023), noting that the original intention of artificial intelligence was to solve problems rather than expand knowledge. As new computing capabilities became evident, the use of artificial intelligence evolved (Buhalis and Karatay, 2022). Using neural networks and algorithms, deep learning has been enabled in artificial intelligence (Lundmark, 2022; Moy and Gadgil, 2022). An increasing number of people are interested in chatbots that can respond to inquiries (Buhalis *et al.* 2023). According to Davis *et al.* (2009), chatbots offer a comparable service by providing real-time feedback.

This research brings novelty to the understanding of ChatGPT's impact on consumer experience in digital marketing and user satisfaction. While existing literature explores the application of AI in marketing, this study focuses on the specific role of ChatGPT in personalizing communication, improving customer support, and analyzing real-time feedback. Additionally, the research highlights how ChatGPT can reduce costs and increase the efficiency of marketing campaigns, opening up new opportunities for innovation in product development and customer experience.

The main idea of this paper is to determine the impact of ChatGPT on consumer experience in digital marketing and overall user satisfaction. The use of ChatGPT is on a continuous rise and is increasingly being implemented in various industry segments, with growing application in the field of digital marketing.

Research hypotheses:

Hypothesis 1: The variable technological knowledge will positively moderate the variable consumer experience in digital marketing.

Hypothesis 2: The variable type of business will positively moderate the relation-ship between the variable consumer experience using ChatGPT and the variable General impression of ChatGPT.

Hypothesis 3: Gender structure will positively moderate the relationship between the variable consumer experience using ChatGPT and the variable General impression of ChatGPT.

Hypothesis 4: Age difference will positively moderate the relationship between consumer experience using ChatGPT and general impression.

1. Consumer Experience and General Impression of Consumers

The general impression of consumers and their satisfaction is more likely when sellers provide reliable, relevant, up-to-date, and detailed product information, reducing uncertainty, eliciting positive attitudes, fostering psychological bonds, and leading to consumer readiness to purchase and repeat purchases of premium-priced brands. For example, Twitter bots can mimic human agents in providing reliable communication and satisfying customers, but they do so through digital tools and computer-mediated communication (Edwards *et al.* 2014; Lowry *et al.* 2009). Specifically, fashion companies use chatbot e-services to interact with customers, offer quick responses to inquiries, and provide comprehensive information to enhance customer satisfaction and reduce confusion (Chen and Xie, 2008; Mimoun *et al.* 2017).

This study suggests that satisfactory general impressions positively affect favorability in human-chatbot interactions. Previous studies in information systems have identified favorability as a result of satisfaction (Limayem and Cheung, 2008; Lee and Kwon, 2011; Lu *et al.* 2019). Authors also suggest that user satisfaction influences the continuous use of information technology (IT), and satisfaction significantly affects consumers' use of IT (Kim, 2010; Lin, 2012; Hew *et al.* 2016, Chiu *et al.* 2021). Addition-ally, several studies have shown that satisfaction affects favorability towards chatbots (Araujo, 2018; Johari *et al.* 2019; Rossmann *et al.* 2020). Namely, the available literature suggests that consumer experience is reflected in various effects that should be analyzed, including identified individualization, authenticity, reliability, and suitability (Liu and Lee, 2020; Zhang and Zhu, 2020).

2. Consumer Knowledge of Technological Advancements

In this research chapter, the impact of consumer familiarity with technological advancements on their satisfaction when using ChatGPT in digital marketing was examined. Consumers want to receive responses from chatbots that are simple, unique, fast, and usable. Additionally, they desire a chat interface that is easy to use. In the following table, we can observe that available chatbots do not provide an absolutely simple and easy way to use. We have presented several criteria that demonstrate the ease of use of the most popular AI chatbots.

Table 1. Display of the usability of various chatbots

	Fin Intercom's Fin	ChatGPT Open AI chatbot	Google Bard Google AI chatbot	Microsoft Bing AI Microsoft	Chatsonic Chatsonic.ai
The directions are crystal clear	2/5	2/5	4/5	4/5	4/5
Simple navigation	2/5	3/5	4/5	4/5	4/5
Response speed	4/5	4/5	4/5	4/5	4/5
Warnings and errors	3/5	3/5	4/5	4/5	4/5
Learning curve	4/5	4/5	4/5	4/5	4/5

Source: Author's own translation (Gordijn and Have, 2023; Klang and Levy – Mendelovich, 2023; Intercom, 2024)

Contemporary messengers and social media sites are filled with chatbots, which are easy to create and use due to the growth of chat platforms; however, AI-powered chatbots are still in their infancy. Most consumers dislike using chatbots because they are very difficult to teach to respond to human inquiries, and since chatbots are not perfect, consumers do not trust them (Tebenkov and Prokharov, 2021). On the other hand, some research adopts traditional and general variables to describe the characteristics of AI chatbots, such as information quality, perceived enjoyment, service quality, and perceived ease of use (Ashfaq *et al.* 2020; Li *et al.* 2021). We find two gaps in the literature on AI chatbot recommendations. Firstly, while some previous works examined AI chatbots in relation to e-commerce, most of them focused on e-commerce in general. As a key part of the online shopping process, sellers rely on customers to listen to product advice from AI chatbots during the pre-purchase phase. However, there has not been much research on how customers react to the advice offered by AI chatbots. Secondly, as predecessors, consumer attributes and perspectives have been the primary focus of research on consumer behavior regarding AI chatbot services (Chen *et al.* 2023).

Graph 1. Display of strengths, opportunities, challenges, and threats

Source: Jang *et al.* 2021; Ramaul, 2021, Kumar *et al.* 2024

Satisfaction with human-chatbot interaction, or 'authenticity,' is crucial for chat-bots. Research based on the Technology Acceptance Model and satisfaction theory has shown promise in numerous domains, for example, investigating the reasons individuals use virtual goods Kaur *et al.* (2020) and the extent to which they embrace technology providing internet information services (Luo *et al.* 2006). Acceptance depends on various factors, with privacy and security concerns, or 'risk,' in the context of online transactions being the most prominent. As it promotes audience initiative and challenges a passive view of audience experience, the satisfaction and use model is widely accepted. Consumer motivation research has shown that embracing such a theory is an effective framework for drawing useful conclusions (Rese *et al.* 2020). The hedonistic dimension of the chatbot experience can enhance its value by providing an opportunity for relaxation and escape.

3. Materials and Methods

This research involved consumers of digital marketing who utilized ChatGPT. Survey participants had to be of legal age and have used ChatGPT for digital marketing purposes at a certain point in time. The tabular presentation provides basic information from the questionnaire. The first segment of the questionnaire covers basic questions related to respondents' demographic characteristics. The second segment of the questionnaire covers questions related to technology literacy. The third segment of the questionnaire covers consumer experiences, while the last segment covers consumers' general impressions. A five-point Likert scale was used to assess these questionnaires.

Table 2. Display of Observed Variables and Questions

TECHNOLOGICAL LITERACY	
	When interacting with companies, I am comfortable using technology.
	I consider myself to be familiar with and understand well the tools used for digital marketing.
	I feel confident when using ChatGPT in digital marketing.
CONSUMER EXPERIENCE WHEN USING CHATGPT	

TECHNOLOGICAL LITERACY	
Identified personalization	
	Based on my specific requests, ChatGPT tailored the information it provided.
	ChatGPT understood my requests adequately.
	ChatGPT provided guidance that is relevant to my specific requirements.
Identified credibility	
	The data provided by ChatGPT were extremely credible for the requirements I outlined.
	The data and information were very useful and well-supported.
	ChatGPT provided me with comprehensive solutions.
Identified reliability	
	ChatGPT provided accurate information.
	ChatGPT provided me with up-to-date information.
	There is trust in the information provided by ChatGPT. Author
Identified suitability	
	ChatGPT was very easy to use.
	ChatGPT effectively responded to my query.
	ChatGPT shortened my time compared to other interaction methods.
OVERALL IMPRESSION	
	Interaction with ChatGPT was completely satisfactory.
	I intend to recommend ChatGPT to others.
	Given the opportunity, I would use ChatGPT again.
Type of business	
	Retail (*e.g.*, stores, online shopping platforms, product distributors)
	Healthcare industry (*e.g.*, medical facilities, healthcare professionals, pharmaceutical companies)
	Financial sector (*e.g.*, financial institutions, insurance companies, investment advisors)
	Travel and hospitality industry (*e.g.*, travel agencies, restaurants, transportation companies)
	Technology sector (*e.g.*, software companies, electronics manufacturers, telecommunications firms)
	Education sector (*e.g.*, educational institutions, online educational platforms, courses)
	Other (please specify)

4. Research Results

Application of Least Square Regression - OLS. By using the OLS methodology in the research, we conducted an examination of the correlation between various variables including technological knowledge, type of business, and age, with consumer experience and general impression.

The results obtained suggest that identified individualization has a statistically significant positive impact on consumer experience, while identified credibility and identified reliability have a negative impact. Identified suitability also shows a negative impact, but with lower statistical significance. Regarding the general impression, it is positively associated with technological knowledge but negatively associated with the type of business and age. However, not every hypothesis was confirmed. For example, the hypothesis of a positive relationship between identified credibility and consumer experience was not supported, while the hypothesis of a negative relationship between age and consumer experience was confirmed.

Table 3. Least Square Regression – OLS observed variables

Variables	OLS – Least Square Regression
Technological literacy - Consumer experience	
Identified personalization	0,485 (0,032)***
Identified credibility	-0,045 (0,038)
Identified reliability	-0,154 (0,045)***
Identified suitability	-0,123 (0,072)*
Technological literacy - Overall impression	
Overall impression	0,134 (0,031)***
Type of business - Consumer experience	
Identified personalization	0,106 (0,091)
Identified credibility	-0,090 (0,152)
Identified reliability	0,084 (0,127)
Identified suitability	-0,176 (0,080)**
Type of business - Overall impression	
Overall impression	-0.187 (0,183)*
Age - Consumer experience	
Identified personalization	-0.420 (-0.420)***
Identified credibility	-0.256 (0,096)*
Identified reliability	-0.144 (0,080)*
Identified suitability	-0.031 (0,051)
Age - Overall impression	
Overall impression Top of Form	-0.564 (0,113)***

*The data in parentheses represent the standard error, *, **,*** They represent statistical significance*

The following table provides an overview of the demographic characteristics of the respondents according to gender, age structure, level of education, and years of age.

Table 4. Overview of Respondents' Demographic Structure

Variables	Frequency n=384	%
Chatbot knowledge		
Yes	352	91,66
No	32	8,33
Gender		
Men	196	58,33
Women	188	41,66
Level of Education		
Primary and secondary vocational education	29	7,55
Undergraduate studies	160	41,66
Master's studies	187	48,69
PhD studies	8	2,08
Age		
18-25	121	31,51
26-35	155	40,36
36-45	61	15,88
46-55	47	12,23

The application of Spearman's coefficient and the statistical method ANOVA.
Significance level: () p > 0.001, () p > 0.01, and () p > 0.05.

Hypothesis 1: The technological knowledge variable will positively moderate the relationship between consumer experience in digital marketing. Spearman's coefficient was used to examine the role of technological knowledge in influencing the relation-ship between identified individualization (Spearman's = 0.498, $p < 0.05$), identified credibility (Spearman's = -0.074, $p < 0.05$), identified reliability (Spearman's = -0.172, $p < 0.05$), and identified suitability (Spearman's = -0.048, $p < 0.05$). The interaction be-tween the observed variables was statistically significant, indicating that the implications of identified individualization, identified credibility, identified reliability, and identified suitability on the general impression varied significantly among technological knowledge.

Hypothesis 2: The type of business will positively moderate the relationship be-tween consumer experience when using ChatGpt and the general impression of ChatGpt. To obtain results, we used ANOVA to establish the relationship between the type of business and the variables of consumer experience when using ChatGpt and the general impression of ChatGpt. The findings indicate that the type of business mitigates the association between identified individualization ($F = 0.815$, $p > 0.05$), identified credibility ($F = 1.59$, $p > 0.05$), identified reliability ($F = 0.364$, $p > 0.05$), and identified suitability ($F = 1.213$, $p > 0.05$) with overall satisfaction. The interaction between the observed independent variables and the variable related to the type of business was statistically significant, suggesting that the implications of identified individualization, identified credibility, identified reliability, and identified suitability on the gen-eral impression varied significantly among types of businesses.

Hypothesis 3: Gender structure will positively moderate the relationship between consumer experience when using ChatGpt and the general impression of ChatGpt. Testing the hypothesis, we applied the statistical method of Mann-Whitney U test to determine the moderating role of gender in consumer experience when using ChatGpt and the general impression of ChatGpt. The following results were obtained when determining the role of gender in identified individualization (MW = 18031.000, $p > 0.05$), identified credibility (MW = 18053.000, $p > 0.05$), identified reliability (MW = 18051.000; $p > 0.05$), and identified suitability (MW = 17398.500, $p > 0.05$). The results suggest that there is no difference in medians between male and female genders regarding consumer experience when using ChatGpt. Additionally, we explored the role of gender in the general impression of ChatGpt. The results (MW = 18013.000, $p > 0.05$) suggest that there is no difference between male and female genders regarding the general satisfaction with ChatGpt.

Hypothesis 4: Age difference will positively moderate the relationship between consumer experience when using ChatGpt and the general impression. ANOVA shows the moderating role of age in the influence of ChatGpt on identified individualization ($F = 41.34$, $p < 0.001$), identified credibility (14.45, $p < 0.001$), identified reliability ($F = 7.67$, $p < 0.001$), while there is no significant influence of age on identified suitability in the influence of ChatGpt ($F = 71.53$, $p > 0.001$). The average rating for consumer experience was higher among younger consumers compared to older ones, indicating that the favorable effect of ChatGpt was much greater among younger consumers. Also, analyzing the moderating role of age in the influence of ChatGpt on the general im-pression and satisfaction, we observe a significant moderating influence on the association between ChatGpt and the general impression, especially among younger consumers ($F = 31.99$, $p < 0.001$).

Table 5. Significance attributed to specific factors of user experience

	Mean	Std Dev	IP on .05 level
Identified personalization	3,894	0,855	0,80≤ 3,98
Identified authenticity	4,055	0,512	4,02≤ 4,08
Identified reliability	3,729	0,631	3,697≤3,761
Identified suitability	3,557	0,977	3,507≤3,606

Significance level: (***) $p > 0.001$, (**) $p > 0.01$, and (*) $p > 0.05$

In this case, ANOVA was used to determine the influence of educational level on the impact of ChatGpt on consumer experience. The results suggest a positive impact on identified individualization ($F = 9.92$, $p < 0.001$), identified credibility ($F = 9.72$, $p < 0.001$), identified reliability ($F = 6.84$, $p < 0.001$), while there was no statistically significant impact on identified suitability ($F = 1.29$, $p > 0.001$). Consumers with higher levels of education had significantly better results for consumer experience compared to those with lower levels of education, indicating that the impact of ChatGpt was much higher on consumers with higher levels of education. The research findings are consistent with studies (Siregar *et al.* 2023). Additionally, (Fu *et al.* 2024) mention certain drawbacks associated with ChatGpt that need to be overcome, such as plagiarism, while accuracy and reliability are considered important factors in ensuring consumer satisfaction. Roy *et al.* (2023) suggest that factors such as convenience, efficiency, and motivational factors influence the formation of a positive general impression on

users. In this sense, it is necessary to continue and expand research in this area, considering the importance and effects of this extremely current area (Denić *et al.* 2018).

Conclusions and Further Research

Although there is knowledge about the benefits provided by AI intelligence and chatbots, the impact of other factors on consumer experiences, as well as their overall impression and satisfaction with ChatGPT, has not been adequately explored in previous research. In this study, we aimed to determine the moderating role in cases of technological knowledge, type of business, gender, age, and level of education. Consumer familiarity with technology can greatly influence their consumer experience and their overall impression. This increases the likelihood that they will perceive and use chatbots as highly useful. Our findings indicate that the level of technological knowledge significantly affects consumer experience with ChatGPT and their overall impression in digital marketing.

Our research enables the use of alternative methodologies, a more detailed examination of the impact of technology on user interaction, the study of factors influencing the relationship between technology and user experience, tracking the lasting effects of technology use, and the use of qualitative research methods. Future research topics are based on observations and implications from our study and provide potential areas for further investigation. Future researchers can expand on our work by exploring these areas and other generative AI tools, leading to a deeper understanding of the complex interaction between AI technologies such as ChatGPT and the broader social environment in which they exist.

Credit Authorship Contribution Statement

Nikola Pavlović: Conceptualization, Project administration, Writing – original draft, Supervision, Data curation, Validation;
Marko Savić: Writing – original draft, Formal analysis, Visualization.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Declaration of Use of Generative AI and AI-Assisted Technologies

The authors declare that they have not used generative AI and AI-assisted technologies during the preparation of this work.

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The Credit Spread: Risk-Free Rate in the Model

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Abstract: This paper proposes a parsimonious credit spread estimation model for valuation of corporate bonds in data-scarce markets. We emphasize the importance of incorporating the risk-free rate directly into credit spread determination. Our model aligns with established literature and demonstrates the ability to capture the observed influence of risk-free rates on credit spreads across economies. We posit that models omitting the risk-free rate component may underestimate credit spreads, particularly impactful in emerging markets with elevated default probabilities and high risk-free rates. Finally, we discuss practical applications of the model, including exchange rate premium calculations, policy analysis, and negative yield spread analysis.

Keywords: default probability; emerging markets; risk free rate; scarce data; valuation; yield spread.

JEL Classification: C25; G12; G32; E44; E51.

Introduction

The ongoing evolution of financial markets presents new challenges and opportunities for investors. One key area of focus is the valuation of corporate bonds[3], which offers investors the potential for higher returns compared to traditional risk-free assets. This increased demand for corporate bonds highlights the critical need for accurate valuation methodologies for both investment and risk management professionals. (Schwarz 2019) emphasizes this importance, suggesting that investors with long time horizons may favor assets with higher yields, particularly if those yields reflect a shift in market dynamics rather than an increased risk of default. This perspective underscores the significance of understanding the yield spread structure, which refers to the difference between a corporate bond's yield and the yield of a risk-free bond with the same maturity (G-spread).

[3] For simplicity, we define bonds exposed to credit risk (non-government bonds and foreign currency sovereign bonds with lower ratings) as corporate bonds.

Yield spreads consist of two primary components: liquidity spread, which compensates investors for the potential costs of selling an illiquid asset, and credit spread, which compensates for potential default risk.[4] (Petitt, Pinto and Pirie 2015).

Our research focuses on credit spread estimation. This paper proposes a parsimonious credit spread estimation model tailored for valuation of corporate bonds in markets with limited data or depth. A key innovation of our model lies in its explicit incorporation of the risk-free rate.

Beyond credit spread estimation, our model has broader applicability. The model can be used to calculate implied default probabilities and exchange rate premiums for local currency bonds issued in emerging markets. We also showcase its utility in policy analysis by performing break-even analyses to determine the risk-free rate changes needed to offset increases in default probabilities.

The model presented here is a core framework that can be further enhanced. We refrain from imposing specific details regarding default probabilities and loss given default, but the model can be augmented with coefficients to account for business cycle fluctuations and incorporate the differences between historical and market-implied default probabilities.

The remainder of the paper is organized as follows:

- Section 1: Reviews the literature on the topic.
- Section 2: Discusses corporate bond valuation approaches and introduces a key formula used in our credit spread model derivation.
- Section 3: Addresses the use of default probabilities and recovery rates within the model, highlighting the connection between conditional and unconditional default probabilities.
- Section 4: Presents the derivation of the credit spread estimation model and explores its specific features.
- Section 5: Analyzes the modeling framework and discusses its applications in various contexts.
- Section 6: Concludes the paper.
- Appendices: Contain detailed derivations of the formulas.

1. Literature Review

As previously mentioned, yield spreads consist of credit and liquidity spreads. The relative importance of each component is a topic of research, with studies by (Chen, Lesmond and Wei 2007) and (Bao, Pan and Wang 2011), while (Longstaff, Mithal and Neis 2005) emphasize the importance of credit spread.

A vast body of literature explores the determinants of credit risk. For instance, (Boss, et al. 2009) analyze the drivers of default probabilities in economic sectors of Australia and (Castro 2012) investigates the credit risk of banking sector in GIPSI economies[5] by examining factors influencing non-performing loans. Another research strand focuses on deriving credit spreads from market data such as CDS spreads which are considered proxies for credit spreads (Longstaff, Mithal and Neis 2005), (Ericsson, Jacobs and Oviedo 2009), (Hull 2018) and (Specht 2023).

Our model falls within the reduced-form framework of credit spread modeling, prioritizing tractability and applicability in settings of limited data or depth. Existing literature offers two dominant credit risk-modeling approaches: structural models and reduced-form models. Structural models delve into the value determinants of a firm, subsequently linking them to credit spreads through firm-specific factors (Merton 1974), (Black and Cox 1976), (Leland 1994), (Longstaff and Schwartz 1995), (Maglione 2024), (Ben-Abdellatif, et al. 2024). Conversely, reduced-form models directly connect credit spreads to default probabilities and recovery rates (Pye 1974), (Duffie and Singleton 1999), (Driessen 2005). Our model aligns with the reduced-form approach, prioritizing tractability and applicability in markets with limited data availability.

While some reduced-form models acknowledge the indirect influence of the risk-free rate on credit spreads via its impact on default probabilities (Longstaff and Schwartz 1995), (Duffee 1998), we underline the direct effect as well. This aligns with the understanding that credit spreads reflect a confluence of both firm-specific factors and broader macroeconomic forces, with the risk-free rate serving as a crucial indicator of the overall investment environment (Fabozzi and Mann 2005). Excluding the risk-free rate from spread calculations

[4] Combined effect of credit and liquidity premiums is also discussed in the literature, for example (He and Xiong 2012), (Chen, *et al.* 2014). However, in our derivations we assume no combined effects.

[5] Abbreviation in (Castro 2012) meaning Greece, Ireland, Portugal, Spain and Italy

implies, theoretically, that credit spreads would remain constant irrespective of the risk-free rate environment[6]. However, empirical evidence suggests a clear relationship between the two (Ohyama and Sugimoto 2007), (Lepone and Wong 2009), (Radier, *et al.* 2016), (Arce, *et al.* 2024). Our model addresses this gap by explicitly incorporating the risk-free rate.

Our model builds upon the foundation of existing credit spread estimation approaches, particularly those suitable for tractability and applicability in data-scarce environments (Pye 1974), (Resti and Sironi 2007), (Voloshyn 2014), (Roggi 2015). Similar to these works, we prioritize a parsimonious model structure. However, a key distinction lies in our explicit incorporation of the risk-free rate. While some models, like "p*LGD"[7] (Hull 2018) implicitly address the risk-free rate through its influence on default probabilities, we underline the direct effect as well. This aligns with the understanding of credit spreads as a reflection of both firm-specific factors and broader economic forces (Fabozzi and Mann 2005).

2. Contractual and Expected Cash Flows

Our analysis considers a corporate bond with an assumed zero liquidity spread. We compare it to a government or benchmark bond with the same maturity (n coupon periods) and coupon rate (c). Corporate bond valuation can be achieved through two main equivalent approaches (Bessis 2002):

1. Discounting Contractual Cash Flows with Yield (which contains credit spread): This method reflects the risk premium demanded by investors for holding the corporate bond. The contractual cash flows (principal and coupon payments) are discounted using a yield that incorporates risk-free rate and a credit spread ($r + s$). This discounted value represents the price of the corporate bond denoted as $P(r + s)$.

2. Discounting Expected Cash Flows with Risk-Free Rate: This method focuses on the expected (probability-weighted) cash flows. Each contractual cash flow is weighted by its probability of occurrence and then discounted by the risk-free rate. The sum of these discounted expected cash flows represents the price of the corporate bond denoted as $P(r, \pi)$, where r is the risk-free rate and π is the unconditional probability of default. In this approach, investors are assumed to be risk-neutral.

When $P(r, \pi)$ is used, it assumes different functional form compared to $P(r + s)$ or $P(r)$, however for simplicity, assume *P* to represent the pricing function of a bond in general.

Expected Loss and Price Relationship

Alternatively, the price difference between the risk-free bond and the identical corporate bond represents the expected loss (EL) associated with the corporate bond. This expected loss reflects the potential shortfall experienced by investors if the corporation defaults (Garp 2011), (Petitt, Pinto and Pirie 2015). The corporate bond price can also be derived as the difference between the risk-free bond price $P(r)$ and the expected loss EL (see Appendix 1 for details). This approach reinforces the equivalence between the two valuation methods discussed earlier.

This relation can be expressed as follows:

$$P(r + s) = P(r, \pi) = P(r) - EL \tag{1}$$

After some transformations (Melik-Parsadanyan and Galstyan 2017), the price of the corporate bond with n coupon payments and c coupon rate can be expressed as follows:

$$\begin{aligned} P(r + s) = {} & \frac{c \cdot \left(1 - \sum_{k=1}^{1} \pi_k\right) + c \cdot \sum_{k=1}^{1} \pi_k \cdot RR}{(1 + r)^1} + \dots \\ & + \frac{c \cdot \left(1 - \sum_{k=1}^{i} \pi_k\right) + c \cdot \sum_{k=1}^{i} \pi_k \cdot RR}{(1 + r)^i} + \dots \\ & + \frac{(c + 100) \cdot (1 - \sum_{k=1}^{n} \pi_k) + (c + 100) \cdot \sum_{k=1}^{n} \pi_k \cdot RR}{(1 + r)^n} \end{aligned} \tag{2}$$

where RR is the recovery rate and π_k is the unconditional default probability in the $(k - 1, k]$ −th interval.

[6] *i.e.* in that case the credit spreads must be constant in theory when the alternative of risk-free investing is not available for investors

[7] The product of default probability and loss given default

Equation (2) plays an important role in deriving the credit spread formula presented in our paper (details in Appendix 3). The next section delves into the specifications of default probabilities and recovery rates, integral components of these derivations.

3. Modeling Framework

For robust credit spread calculations, our model framework necessitates clear specifications regarding loss given default (LGD) and default probabilities (PD). To ensure clarity and avoid misinterpretations, we explicitly define these building blocks.

The literature offers two primary approaches to calculating recovery rates (Duffie and Singleton, 1999). These approaches determine the recovery rate as a proportion of either the market value prior to default (Allen 2013) or the nominal value of the bond (Chan-Lau 2006). Our analysis adopts the market-value-prior-to-default approach for consistency.

A critical aspect of our model involves establishing a connection between unconditional (π_k) and conditional (p_i) default probabilities. This link is particularly relevant when incorporating historical default rates published by rating agencies[8] as surrogates for modeled unconditional probabilities. In practical applications, historical data often provides a more readily available alternative to complex credit risk modeling. Appendix 2 details the mathematical relationship between conditional and unconditional probabilities and their approximation by an average default probability.

For an average p default probability, it can be established that

$$p = 1 - \sqrt[i]{1 - \sum_{k=1}^{i} \pi_k} = 1 - \sqrt[i]{\prod_{k=1}^{i} (1 - p_k)} \tag{3}$$

where π_k is the unconditional default probability in $k-th$ coupon period, with this meaning that $\sum_{k=1}^{i} \pi_k$ is the cumulative default probability, and p_i is the default probability in the i-th coupon period conditioned upon prior survival.

The approximation of conditional probabilities using average value of p allows us to obtain an analytical solution to the equation (2) for a corporate bond price.

Particularly, given the relation(3), the equation (2) can be expressed as follows:

$$P(r + s) = \sum_{i=1}^{n} \frac{c \cdot (1 - p)^i + c \cdot \left(1 - (1 - p)^i\right) \cdot RR}{(1 + r)^i} + \frac{100 \cdot (1 - p)^n + 100 \cdot (1 - (1 - p)^n) \cdot RR}{(1 + r)^n} \tag{4}$$

4. The Credit Spread

Using the equations in the previous parts and the properties of modified duration, the credit spread formula is derived. Particularly, equation (4) can be transformed as follows (details in Appendix 3):

$$P(r + s) - P(r) = LGD \cdot \left(P\left(r + p \cdot \frac{1 + r}{1 - p}\right) - P(r) \right) \tag{5}$$

Using the properties[9]of modified duration, we derive the credit spread of a corporate bond as the following:

$$s \approx LGD \cdot \frac{p}{1 - p} \cdot (1 + r) \tag{6}$$

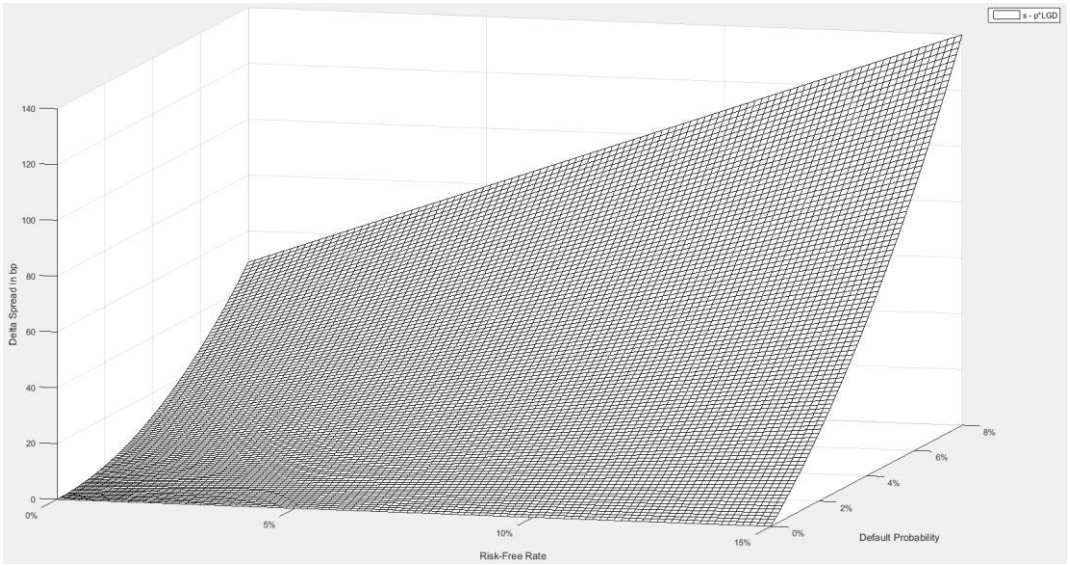
Equation (6) directly expresses the risk-free rate as an alternative investment, and shows an increased importance of the default probability. We compare our model with a model with no direct risk-free rate inclusion ("$p \cdot LGD$" framework) discussed in (Hull 2018).We show that the former approximation can underestimate

[8] See, for example, *Moody's Investors Service*, Corporates - Global: Annual default study: Defaults will rise modestly in 2019 amid higher volatility, *Exhibit 45*

[9]We consider the modified duration of the risk-free bond for a yield-to-maturity r as $\frac{P(r) - P(r + \Delta r)}{P(r)} = -MD \cdot \Delta r$. For the left-hand side of the equation(5) $\Delta r = s$ and for the right-hand side: $\Delta r = p \cdot \frac{1 + r}{1 - p}$

credit spreads compared to our model and the issue is of greater magnitude in the environments of high risk-free rates and default probabilities (Figure 1). The question is pertinent for the emerging market economies where the environment is described with high risk-free rates and high default probabilities.

Figure 1. Difference between the proposed spread and "$p \cdot LGD$" approach



Source: authors' calculations

5. Model Properties and Policy Implications

Our model offers valuable insights into the behavior of credit spreads under varying conditions. To isolate the effects of changes in default probability (p) and risk-free rate (r) we assume no causal relationship between them.

Credit Spread Sensitivities

Equation (6) reveals that both p and r have positive sensitivities on credit spreads[10]. In other words, an increase (decrease) in either p or r leads to an increase (decrease) in credit spread. However, the model suggests a stronger sensitivity to changes in p compared to r[11].

Monetary Policy Implications

This sensitivity has significant implications for monetary policy. To maintain a constant yield level when p rises, all else equal, the risk-free rate needs to be lowered. Our analysis indicates that, on average, a 72 basis point (bp) decrease in r is needed to offset a one percentage point increase[12] in p. This effect is further amplified in environments with higher initial interest rates. Also, the model can be used to analyze the impact of risk-free rate on corporate bond credit spreads and yields. This in turn can serve as another tool to analyze the monetary policy transmission channel.

Indirect Effects and Real-World Considerations

While the direct influence of risk-free rate on credit spreads is captured by our model, there are also indirect effects to consider. Existing literature (Longstaff and Schwartz 1995), (Duffee 1998) highlights the negative relationship between risk-free rate and credit spread[13]. In alignment with this established relationship, a rising r can lead to a decrease in p, which would then cause a decrease in credit spread due to the higher p sensitivity.

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[10] $\frac{ds}{dp} = \frac{1}{(1-p)^2} \cdot LGD \cdot (1 + r) > 0; \frac{ds}{dr} = \frac{p}{(1-p)} \cdot LGD > 0$

[11] $\frac{ds}{dp} > \frac{ds}{dr}$ $if\ r > p \cdot (1 - p) - 1, For\ the\ extreme\ case\ r > -0.75$. In reality, risk-free rates are above the extreme value.

[12] The average change is calculated over probabilities ranging between 0.5-8.5 percent. Additional -0.72 b.p. is needed for 1% increased initial interest rates. For example, on average 75.8 b.p. decrease is needed for 5% initial interest rate environment to offset 1% increase in default probabilities.

[13] Risk-free rates decrease during economic downturn, which implies increased defaults.

Break-Even Default Probability

An interesting application of the model lies in break-even default probability analysis. Assuming only the risk-free rate and credit spread contribute to the corporate bond yield, the break-even default probability is the point at which the yield to maturity reaches zero[14]. This concept can be mathematically expressed using the equation (7).

$$p_{b/e} = \frac{r}{r\ -\ LGD\ \cdot\ (1\ +\ r)} \tag{7}$$

For a given r and LGD, if the default probability is lower than $p_{b/e}$, the yield to maturity of that bond (without liquidity premium) is negative (Figure 2).

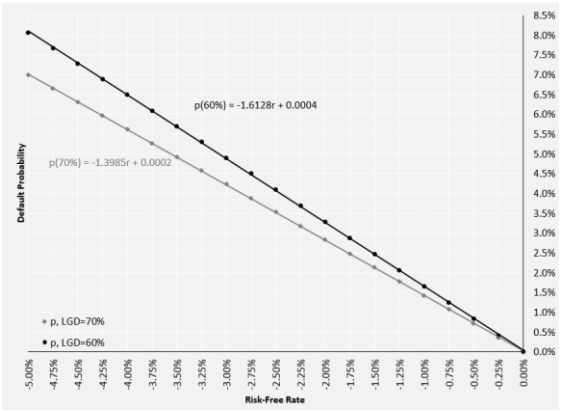
Yield Spreads

Another important point can be stressed using this analysis (Figure 3). The proposed framework allows to gain insight into liquidity and credit spread issues in negative yield spreads. An empirical analysis of this type can be found in (Bhanot and Guo 2011). For given rating grades, using the proposed model we can calculate risk-free rates at which the yields hold positive only due to liquidity premiums ($r\ +\ s = 0$).

Exchange Rate Risk and Local Currency Bonds

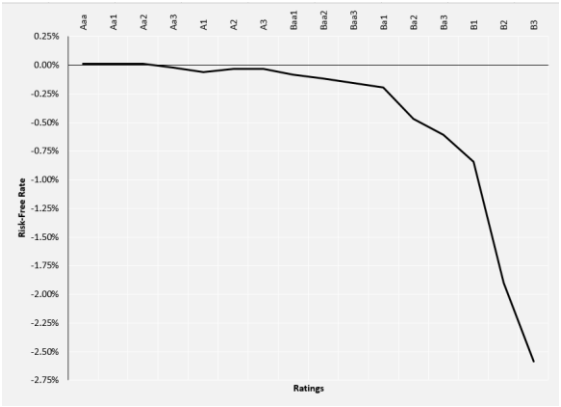
Moreover, taking into the consideration the link between risk–free rate and currency, the proposed framework enhances the analyses in the field of emerging market local currency bonds' valuation by constituting risk free rate as far as the exchange rate risk is priced in local currency bonds. In our opinion, the proposed framework can be used to derive exchange rate spreads of local currency bonds relative to foreign currency denominated bonds (for example, USD). Within this view, p is the probability of devaluation of local currency during the bonds' maturity, and LGD is the magnitude of the devaluation.

Figure 2. Break-even default probabilities vs negative risk-free rates



Source: authors' calculations

Figure 3. Ratings vs break-even risk-free rates



Source: authors' calculations

Conclusions and Further Research

This paper presents the development of credit spread estimation model that directly incorporates the risk-free rate as a crucial element, acknowledging its dual role as both a macroeconomic indicator and a competing investment option. This aligns with established financial theory regarding the relationship between risk-free rates and credit spreads.

The model's novelty lies in its significant applicability to emerging markets characterized by high risk-free rates and default probabilities. By incorporating risk-free rate into the model, it provides a new alternative for corporate bonds valuation in emerging markets with limited data or depth. Our analysis highlights substantial discrepancies between our model and the benchmark "p*LGD" framework in such settings (refer to Figure 1). Empirical testing is recommended to further validate the model's effectiveness in real-world scenarios.

Furthermore, the model offers practical advantages, particularly for timely decision-making. It allows for the incorporation of historical default probabilities, a readily available alternative to complex credit risk modeling. A formula within the model facilitates this integration.

[14] $y = r\ +\ s = 0, where\ s = \frac{p_{b/e}}{1 - p_{b/e}} \cdot LGD\ \cdot\ (1\ +\ r)$

Beyond credit spread estimation, the model extends to analyzing foreign exchange spreads for local currency bonds. Additionally, the break-even analyses presented offer valuable insights for investors, risk managers, and policymakers.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Declaration of Use of Generative AI and AI-assisted Technologies

The authors declare that they have not used generative AI and AI-assisted technologies during the preparation of this work.

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Appendix 1

In this section we provide the decomposition of corporate bond price into risk-free price and expected loss.

In the second method of valuation, the future cash flows are weighted by the corresponding probabilities of default and no-default. In the case of no default, the future cash flows comprise coupon payments (and the principal for the last period), and in the event of default the future cash flows are recovered values. Probability weighted cash flows are riskless (because in the scope of the probability the cash flows are considered certainly receivable) and are discounted at risk-free rates. Denote by RR and LGD the recovery rate and loss given default respectively ($0 \le LGD \le 1, RR = 1 - LGD$), by π_k the unconditional default probability in $(k-1, k]$ time interval, and the price of risk-free bond at i-th period by $P_i(r)$. The price of the bond $P(r, \pi)$ is expressed as follows:

$$P(r,\pi) = \sum_{i=1}^{N} \frac{c \cdot \left(1 - \sum_{k=1}^{i} \pi_k\right) + \pi_i \cdot RR \cdot P_i(r)}{(1+r)^i} + \frac{100 \cdot (1 - \sum_{k=1}^{n} \pi_k) + \pi_n \cdot RR \cdot P_n(r)}{(1+r)^n}$$

From the equation above, follows:

$$P(r,\pi) = \sum_{i=1}^{n} \frac{c}{(1+r)^i} + \frac{100}{(1+r)^n} - \sum_{i=1}^{n} \frac{c \cdot \sum_{k=1}^{i} \pi_k}{(1+r)^i} - \frac{100 \cdot \sum_{k=1}^{n} \pi_k}{(1+r)^n} +$$

$$+ \sum_{i=1}^{n} \frac{P_i(r) \cdot \pi_i}{(1+r)^i} - \sum_{i=1}^{n} \frac{P_i(r) \cdot \pi_i \cdot LGD}{(1+r)^i} = P(r) + \sum_{i=1}^{n} \frac{P_i(r) \cdot \pi_i - c \cdot \sum_{k=1}^{i} \pi_k}{(1+r)^i} -$$

$$- \frac{100 \cdot \sum_{k=1}^{n} \pi_k}{(1+r)^n} - EL = P(r) - EL$$

In the equation above, $P(r)$ denotes the price of the risk-free bond, and EL denotes expected loss.

The equation above holds, because:

$$\sum_{i=1}^{n} \frac{P_i(r) \cdot \pi_i - c \cdot \sum_{k=1}^{i} \pi_k}{(1+r)^i} - \frac{100 \cdot \sum_{k=1}^{n} \pi_k}{(1+r)^n}$$

$$= \left[\begin{array}{c} \frac{\pi_1}{1+r} \cdot \left(c + \frac{c}{1+r} + \ldots + \frac{c}{(1+r)^{n-1}} \right) + \\ \frac{\pi_2}{(1+r)^2} \cdot \left(c + \frac{c}{1+r} + \ldots + \frac{c}{(1+r)^{n-2}} \right) + \ldots + \frac{\pi_n}{(1+r)^n} \cdot (c + 100) \end{array} \right] -$$

$$- \left[\frac{c}{1+r} \cdot \pi_1 + \frac{c}{(1+r)^2} \cdot (\pi_1 + \pi_2) + \ldots + \frac{c+100}{(1+r)^n} \cdot (\pi_1 + \pi_2 + \ldots + \pi_n) \right] =$$

$$= \frac{\pi_1}{1+r} \cdot \left(c + \frac{c}{1+r} + \ldots + \frac{c}{(1+r)^{n-1}} - c - \frac{c}{(1+r)} - \ldots - \frac{c}{(1+r)^{n-1}} \right) +$$

$$+ \frac{\pi_2}{(1+r)^2} \cdot \left(c + \frac{c}{1+r} + \ldots + \frac{c}{(1+r)^{n-2}} - c - \frac{c}{1+r} - \ldots - \frac{c}{(1+r)^{n-2}} \right) +$$

$$+ \cdots + \frac{\pi_n}{(1+r)^n} \cdot (c + 100 - c - 100) = 0$$

Appendix 2

In this section we provide information regarding the link between conditional and unconditional default probabilities.

Denote by i_+ and i_- correspondingly the events of default and no-default in the $(i-1,i]$ time interval, the conditional probability of default in the i-th time period by p_i, where the event of default is conditioned upon the events of no prior default. These relationships mathematically are expressed as follows:

$$P\left(i_+ | \bigcap_{k=1}^{i-1} k_-\right) = p_i \qquad P\left(i_- | \bigcap_{k=1}^{i-1} k_-\right) = 1 - p_i$$

Consider particular cases of survival until i-th time period for $k = \overline{1,3}$.

- $k = 1 \Longrightarrow P(1_-) = 1 - p_1$;
- $k = 2 \Longrightarrow P(2_- \cap 1_-) = P(2_-|1_-) \cdot P(1_-) = (1 - p_2) \cdot (1 - p_1)$
- $k = 3 \Longrightarrow P(3_- \cap 2_- \cap 1_-) = P(3_-|2_- \cap 1_-) \cdot P(2_- \cap 1_-) =$
  $= (1 - p_3) \cdot (1 - p_2) \cdot (1 - p_1)$
- $k = 3 \Longrightarrow P(3_+ \cap 2_- \cap 1_-) = P(3_+|2_- \cap 1_-) \cdot P(2_- \cap 1_-) = p_3 \cdot (1 - p_2) \cdot (1 - p_1)$

Generally: $P\left(\bigcap_{k=1}^{i} k_-\right) = \prod_{k=1}^{i}(1 - p_k)$, $P\left(i_+ \cap \bigcap_{k=1}^{i-1} k_-\right) = p_k \cdot \prod_{k=1}^{i-1}(1 - p_k)$

Consider the sum of probabilities of default and no default in the i-th time period conditioned upon no default in prior two periods:

$$P(3_+ \cap 2_- \cap 1_-) + P(3_- \cap 2_- \cap 1_-)$$
$$= (1 - p_3) \cdot (1 - p_2) \cdot (1 - p_1) + p_3 \cdot (1 - p_2) \cdot (1 - p_1)$$
$$= (1 - p_2) \cdot (1 - p_1) = P(2_- \cap 1_-)$$

Generally:

$$P\left(i_+ \cap \bigcap_{k=1}^{i-1} k_-\right) + P\left(\bigcap_{k=1}^{i} k_-\right) = p_k \cdot \prod_{k=1}^{i-1}(1 - p_k) + \prod_{k=1}^{i}(1 - p_k) = \prod_{k=1}^{i-1}(1 - p_k) =$$
$$= P\left(\bigcap_{k=1}^{i-1} k_-\right)$$

Therefore:

$$P\left(\bigcap_{k=1}^{i} k_-\right) + P\left(i_+ \cap \bigcap_{k=1}^{i-1} k_-\right) + P\left((i-1)_+ \cap \bigcap_{k=1}^{i-2} k_-\right) + \ldots + P(2_+ \cap 1_-) =$$
$$= P(1_-) = 1 - p_1 \Longrightarrow P\left(\bigcap_{k=1}^{i} k_-\right) + P\left(i_+ \cap \bigcap_{k=1}^{i-1} k_-\right) + \ldots + P(1_+) = 1 \Longrightarrow$$
$$P\left(\bigcap_{k=1}^{i} k_-\right) = 1 - \sum_{k=1}^{i} P\left(k_+ \cap \bigcap_{j=1}^{k-1} j_-\right) \qquad (1')$$

Equation $(1')$ means that the event of no default until i-th time interval is the supplement of the events of no default in every prior interval, moreover the event of default is considered with the intersection of events of prior no default, e.g. $i_+ \cap \bigcap_{j=1}^{i-1} j_-$.

Denote by π_i the unconditional probability of default in the i –th interval with no prior default:

$$\pi_i = P\left(i_+ \cap \bigcap_{k=1}^{i-1} k_-\right)$$

Equation (1') can be expressed as $P\left(\bigcap_{k=1}^{i} k_{-}\right) = 1 - \sum_{k=1}^{i} \pi_k$, and as far as $P\left(\bigcap_{k=1}^{i} k_{-}\right)=\prod_{k=1}^{i}(1 - p_k)$, then

$$1 - \sum_{k=1}^{i} \pi_k = \prod_{k=1}^{i}(1 - p_k)$$

Assume that conditional probabilities of default are equally likely for every time interval. If the conditional probabilities of default are approximated by p, the relationship above can be expressed (Melik-Parsadanyan and Galstyan 2017) as follows

$$1 - \sum_{k=1}^{i} \pi_k = (1 - p)^i$$

Appendix 3

In this section we provide information regarding the derivations of the credit spread estimation model.

Equation 4 can be expressed as follows:

$$P(r + s) = \sum_{i=1}^{n} \frac{c \cdot (1 - p)^i \cdot (1 - RR) + c \cdot RR}{(1 + r)^i} + \frac{100 \cdot (1 - p)^n \cdot (1 - RR) + 100 \cdot RR}{(1 + r)^n}$$

From the equation above follows:

$$P(r + s) = \left[\sum_{i=1}^{n} \frac{c \cdot (1 - p)^i \cdot (1 - RR)}{(1 + r)^i} + \frac{100 \cdot (1 - p)^n \cdot (1 - RR)}{(1 + r)^n}\right] +$$

$$+ \left[\sum_{i=1}^{n} \frac{\mathrm{c} \cdot \mathrm{RR}}{(1 + \mathrm{r})^{\mathrm{i}}} + \frac{100 \cdot \mathrm{RR}}{(1 + \mathrm{r})^{\mathrm{n}}}\right] = (1 - RR) \cdot \left[\sum_{i=1}^{n} \frac{c}{\left(\frac{1 + r}{1 - p}\right)^i} + \frac{100}{\left(\frac{1 + r}{1 - p}\right)^n}\right] +$$

$$+ \mathrm{RR} \cdot \left[\sum_{i=1}^{n} \frac{\mathrm{c}}{(1 + \mathrm{r})^{\mathrm{i}}} + \frac{100}{(1 + \mathrm{r})^{\mathrm{n}}}\right] = (1 - RR) \cdot \left[\sum_{i=1}^{n} \frac{c}{\left(1 + \frac{r + p}{1 - p}\right)^i} + \frac{100}{\left(1 + \frac{r + p}{1 - p}\right)^n}\right] +$$

$$+ \mathrm{RR} \cdot \left[\sum_{i=1}^{n} \frac{\mathrm{c}}{(1 + \mathrm{r})^{\mathrm{i}}} + \frac{100}{(1 + \mathrm{r})^{\mathrm{n}}}\right]$$

It follows that the price of the bond can be decomposed into the following

$$P(r + s) = (1 - RR) \cdot P\left(\frac{r + p}{1 - p}\right) + RR \cdot P(r)$$

Where $P\left(\frac{r + p}{1 - p}\right)$ is the price of the bond with (c) coupon and (n) coupon periods discounted at the $\frac{r + p}{1 - p}$ rate, and $P(r)$ is the price of the same bond discounted at $r$rate.

Moreover, as far as $\frac{r + p}{1 - p} = r + \frac{p}{1-p}(1 + r)$, it follows that

$$P(r + s) = (1 - RR) \cdot P\left(r + \frac{p}{1 - p} \cdot (1 + r)\right) + RR \cdot P(r)$$

Subtracting $P(r)$ from both sides gives Equation (5)

$$P(r + s) - P(r) = (1 - RR) \cdot P\left(r + \frac{p}{1 - p} \cdot (1 + r)\right) + (RR - 1) \cdot P(r) =$$

$$= (1 - RR) \cdot \left[P\left(r + \frac{p}{1 - p} \cdot (1 + r)\right) - P(r)\right] =$$

$$= LGD \cdot \left[P\left(r + \frac{p}{1 - p} \cdot (1 + r)\right) - P(r)\right]$$

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Navigating the Maze: A Systematic Review of Empirical Studies on Tax Avoidance and Its Influence Factors

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Abstract: There is a wealth of research on the factors influencing tax avoidance, and it has gradually become a global topic of interest. However, few studies systematically identify which factors influence corporate tax avoidance and how they do so. Many studies on similar topics show significant differences in conclusions across countries. Therefore, a systematic review of the relevant literature on tax avoidance is necessary, as it will help us understand the current state of research and offer insights and directions for future exploration of the reasons behind these discrepancies and the discovery of new factors influencing tax avoidance.

This study analyzes 97 empirical studies on tax avoidance, aiming to clarify influencing factors by categorizing themes and summarizing findings. Literature was sourced via Scopus and divided into three sections: Factors influencing tax avoidance in Western countries, factors in China, and future research prospects. Tax avoidance is a complex issue vital to firms' high-quality development. The study underscores that differing methodologies may lead to varying conclusions, systematizing the literature and drawing comparisons among various perspectives. By enhancing understanding of tax avoidance, the effort provides a foundation for future investigations into practical strategies for firms, contributing to a comprehensive understanding of tax avoidance and emphasizing the importance of a coordinated approach among stakeholders.

Keywords: tax avoidance; listed firms; empirical studies; influencing factors; coordinated approach among stakeholders.

JEL Classification: H26; A12.

Introduction

Tax avoidance, a term reflecting an enterprise's strategic measures to minimize its tax burden (Hanlon and Heitzman, 2010), is a common and complex practice observed across the global business landscape. In developed economies like the United States, an upward trajectory in public firms' tax disparities is seen, increasing yearly and tenfold over a decade (Boynton *et al.* 2005). Such a surge likely stems from the growing aggression in firm tax avoidance practices, influenced by various legal, economic, and social factors (Mills, 1998; Wilson, 2009; Blaylock *et al.* 2011). Estimates suggest that over 10% of firms engage in tax evasion.

In contrast, China, the largest developing economy, exhibits more severe tax evasion among listed firms, demonstrated by 22,800 cases investigated in 2018 alone involving 560 billion yuan (Cai and Liu, 2009; Lin *et al.*

2018). This phenomenon's prevalence in different regions, coupled with the lack of uniform understanding of who is influencing tax avoidance and why firms should avoid tax, highlights the need for a cohesive examination and strategic alignment on a global scale.

1. Existing Literature and Divergence

While the existing literature on factors influencing tax avoidance is abundant and developed based on unique systemic contexts, significant variations exist between Western and Eastern studies. Western literature frequently explores how managerial characteristics such as gender and political beliefs influence tax avoidance (Francis *et al.* 2014; Francis *et al.* 2016). In contrast, Chinese literature emphasizes the country's unique aspects, including tax system reforms and mixed-ownership reforms (Wang *et al.* 2009; Wang *et al.* 2021; Zhai *et al.* 2021).

A striking divergence is observed regarding the economic consequences of tax avoidance. The complexities of measuring tax avoidance and the dichotomy between theoretical and empirical evidence further contribute to the fragmentation of knowledge in this area. This lack of a unified perspective diminishes the practical value of tax avoidance theory and perplexes policymakers, practitioners, and researchers alike.

2. Purpose and Contributions of This Study

This study's comprehensive approach aims to synthesize existing literature on tax avoidance, facilitating an understanding of previous research focus, primary perspectives, and prevalent disagreements. The effort is instrumental in constructing a systematic theoretical framework for tax avoidance.

2.1. Comprehensive Theoretical Framework for Tax Avoidance Factors

This contribution provides a coherent theoretical framework for understanding tax avoidance influence factors. The study proposes a three-factor model comprising managerial characteristics (the decision-maker), fundamental firm characteristics (intrinsic conditions and capacity for tax avoidance), and corporate governance (pressure faced by decision-makers and other stakeholders). Unifying these aspects broadens understanding of what factors influence corporate tax avoidance.

2.2. Understanding the Driving Factors of Tax Avoidance

Existing theories are mainly categorized into classical economic and tax agency theories. The former argues that obtaining tax-saving benefits for the company is the main driving force affecting tax avoidance; the latter believes that whether insiders can receive private benefits from tax avoidance is the main driving force. This study seeks to systematically collate and link these theories and their accompanying evidence, providing a comprehensive perspective. It attempts to bridge the gap between different viewpoints and present a nuanced understanding of the driving factors of tax avoidance.

2.3. Insights for Future Development

By enriching the body of research related to tax avoidance, this study offers valuable insights for balancing tax avoidance costs and savings. This work's extensive review of the theoretical framework could lead to high-quality tax avoidance strategies, thereby ensuring that the firm's motivations and the interests of external stakeholders are in harmony.

3. Structure of the Remainder of the Study

The remainder of this study is thoughtfully structured. It begins with an analytical framework exploring the three principal elements influencing tax avoidance decisions: the decision-makers, the internal environment, and the external environment. Second, a theoretical framework identifies three major factors affecting firms: management characteristics, firm fundamental characteristics, and corporate governance. Further, through the literature review, we understand how the above factors affect corporate tax avoidance in the Western context. In addition, this paper teases out how corporate governance affects tax avoidance by Chinese companies. Due to China's system's uniqueness, its existing interest relationships are unique, and it has particular reference significance for understanding the tax impact of other developing countries. Finally, the study concludes by comparing different theoretical perspectives within the same research topics, presenting in-depth discussions, and proposing a roadmap for future research directions.

4. Methodology

4.1. Literature Collection Methodology

4.1.1. Selection of Database and Search Criteria

The focal point of this study is situated on two vital components: 'firm tax avoidance' and 'influencing factors.' The methodology for collecting literature began with meticulously selecting the ideal database. Scopus was chosen for its extensive reach and capacity, especially in social sciences, arts, humanities, and business (Falagas *et al.* 2008; Mongeon and Paul-Hus, 2016). This preference for Scopus over other databases like Web of Science (WoS) and Google Scholar was also informed by a comparative analysis of the accuracy, content breadth, and relevance to the current research domain.

4.1.2. Search Process and Selection Criteria

Accessing the Scopus database on Sep 8, 2024, a systematic approach using the PRISMA process was initiated, integrating various stages and iterations (Figures 1 and 2). An exhaustive preliminary search utilizing the aforementioned key terms yielded 2154 documents.
(TITLE-ABS-KEY ("tax avoidance ") AND TITLE-ABS-KEY ("influence")) AND PUBYEAR > 1991 AND PUBYEAR < 2025)

Figure 1. Documents by year

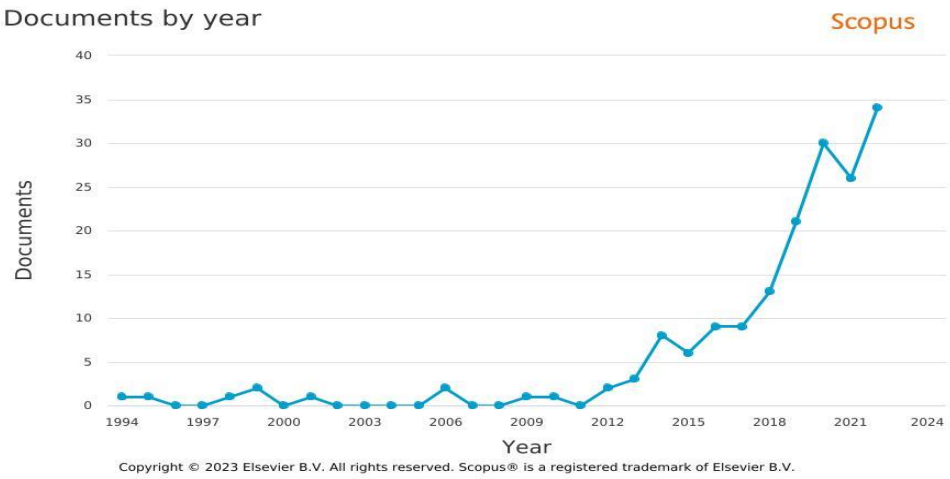
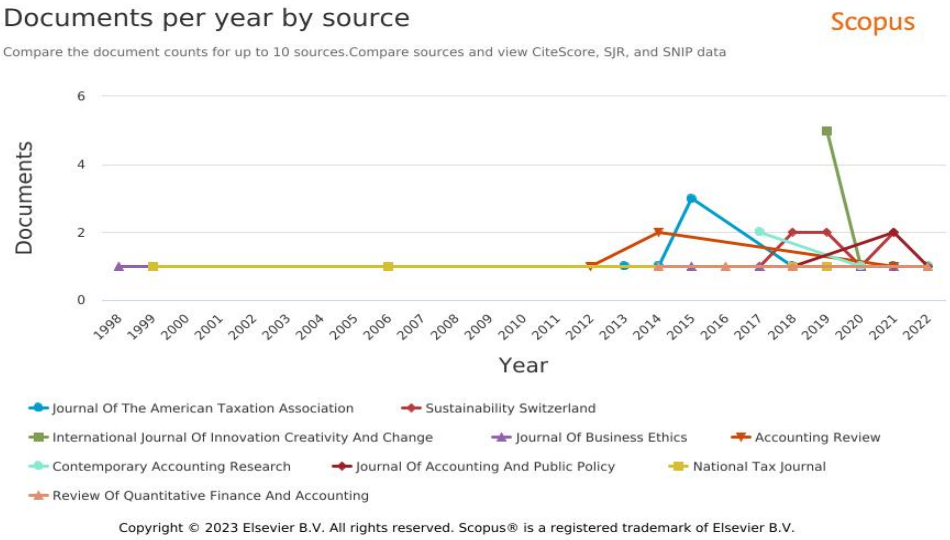


Figure 2. Documents per year by source



Source: Compiled and analyzed by the author based on searches conducted in the Scopus database.

To filter these results and align with the research objectives, several meticulous criteria were implemented:

(1) Publication Dates: Only articles published between 1922 and 2022 were considered to ensure a comprehensive overview, encapsulating the field's evolution.

(2) Document Type: The search was restricted to 'articles' to prioritize academic rigor and peer-reviewed insights.

(3) Source Type: Emphasis was placed on 'journals' to ensure a scholarly perspective.

(4) Language: Only articles published in English were considered to facilitate a coherent analysis.

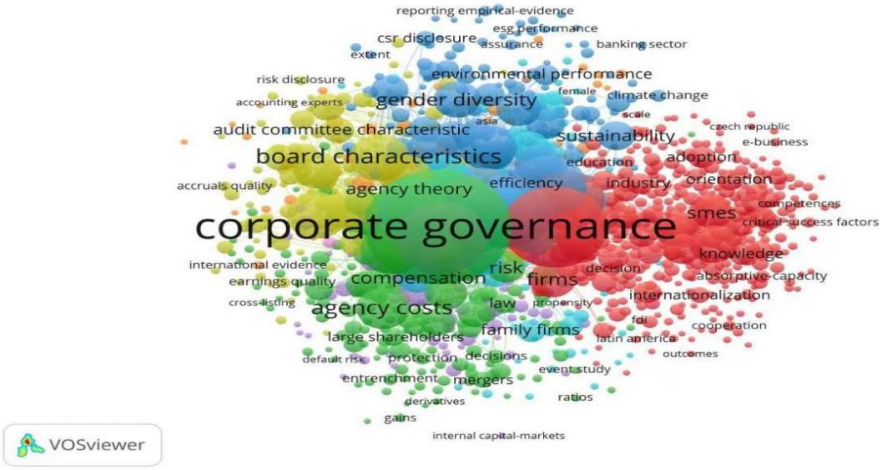
(5) The selection parameter was formulated in the following queries:

(TITLE-ABS-KEY ("tax avoidance") AND TITLE-ABS-KEY ("influence")) AND PUBYEAR > 1991 AND PUBYEAR < 2025 AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (SRCTYPE, "j")) AND (LIMIT-TO (LANGUAGE, "English"))

4.1.3. The Outcome of the Literature Search

The search's output culminated in a cohesive collection of 97 empirical studies (Figure 3). A comprehensive thematic analysis of these documents unearthed prevailing patterns, insights, and trends. Predominant themes emerged around managerial characteristics, fundamental firm attributes, corporate governance, and their respective trajectories over time.

Figure 3. Tax Avoidance Influencing Factors



Source : Compiled and analyzed by the author based on searches conducted in the Scopus database.

4.1.4 Limitations of Previous Research

The exploration also revealed limitations in the extant literature:

(1) A significant focus is on the first type of agency costs, neglecting the second type.

(2) A lack of comparative perspectives on taxation across institutional contexts.

(3) A strong dependency on tax avoidance measures largely emanated from US academia.

These limitations and insights provided a compelling rationale for the current study, filling essential knowledge gaps.

4.2 Theoretical and Research Framework

4.2.1 Theoretical Framework

Building upon classical tax avoidance theory, the study leverages theoretical insights to construct a nuanced understanding of tax avoidance as a dynamic interplay between firms and states. This theoretical perspective was enriched by dissecting the infamous Enron scandal, which revealed hidden complexities and triggered substantial theoretical reflections.

Two cardinal questions guided the theoretical exploration: who influences tax avoidance, and whether it benefits a firm's shareholders? Subsequent analysis unveiled tax avoidance agency theory, suggesting information asymmetry and potential exploitation of shareholders by information-advantaged managers (Desai and Dharmapala, 2006; Desai *et al.* 2007). This theoretical frame is an anchor, allowing the research to delve into intricate complexities.

4.2.2. Research Framework

Building on the theoretical foundation, a three-factor model affecting tax avoidance was formulated, providing a comprehensive perspective of the phenomenon. These factors include:

(1) Managerial Characteristics: The decision-maker's traits, beliefs, and strategies.

(2) Fundamental Firm Characteristics: The inherent conditions affecting the ability to avoid taxes.

(3) Corporate Governance: The policies, practices, and pressures that guide decision-making.

Simultaneously, the study explores tax avoidance risks across four dimensions, paving the way for a nuanced understanding of tax avoidance's economic consequences:

(1) Tax Risk: The threat to legal and compliance status.

(2) Accounting Information Risk: The risks associated with financial reporting and disclosure.

(3) Reputation Risk: The potential damage to a firm's public image.

(4) Financial Risk: The economic uncertainties stemming from tax avoidance strategies.

In summary, the research framework serves as an analytical tool, guiding the investigation into influencing factors, facilitating robust interpretation, and linking theoretical constructs to empirical observations. It provides the structural backbone, connecting multiple dimensions, enabling the synthesis of diverse insights, and shaping the overarching narrative of this study.

The thorough and multifaceted methodology adopted here ensures the research's rigor, coherence, and relevance, laying a solid foundation for further analysis and interpretation.

5. Analysis

Tax avoidance, a vital aspect of corporate finance, is shaped by various factors. The elements influencing tax avoidance can be categorized into four broad groups. This section provides an overview of these categories and sets the stage for a detailed exploration of each. The rationale for this division is rooted in the understanding that a firm is essentially a contractual coalition of parties aiming to minimize transaction costs (Jensen and Meckling, 1976). Consequently, the nature of firm tax decisions becomes a strategic action the contracting parties take (Chen and Chu, 2005; Lietz, 2013). Managers must, therefore, formulate tax decisions based on a comprehensive evaluation that considers the firm's situation and the interests of all involved parties.

The literature review for this study encompasses 97 empirical articles from the United States, China, and other countries, as displayed in Tables 1, 2, and 3.

Table 1. Summary of literature on factors influencing tax avoidance: Personal characteristics of managers (19 studies)

Authors	Country	Main Findings
Chyz *et al.* (2019)	United States	The relationship between CEO overconfidence and tax avoidance is explored by examining CEO departures. The study finds that CEO overconfidence reduces the extent of corporate tax avoidance.
Custódio and Metzge (2014)	United States	CEOs with financial expertise save on tax costs compared to those without.
Dai *et al.* (2017)	China	Firms tend to abandon aggressive tax avoidance strategies when female members in the executive team or when the proportion of female executives increases, suggesting that executive gender is an important factor influencing firm tax avoidance behavior.
Dyreng *et al.* (2010)	United States	The personal characteristics of senior executives, such as CEOs and CFOs, can significantly influence corporate decisions on tax avoidance behavior.
Francis *et al.* (2014)	United States	The authors compare the change in aggressive firm tax avoidance levels before and after the CFO gender switch. The authors develop the idea that women avoid taxes to a lesser extent than male CFOs.
Francis *et al.* (2016)	United States	Evidence that CEO political beliefs affect firm tax avoidance. The study shows that CEO firms with political affiliations have higher tax avoidance levels than those without.
Hoang *et al.* (2019)	Vietnam	Female CEOs pay higher total taxes and higher tax rates than male CEOs.
Hsieh *et al.* (2018)	United States	The relationship between CEO and CFO overconfidence and tax avoidance was examined, and it was found that overconfident CEOs or CFOs actively avoid taxes. At the same time, the personal relationship between the CEO and CFO also affects the impact of the relationship between the two.
James (2020)	United States	The older the CEO, the higher the firm tax rate, the smaller the tax differences in

Authors	Country	Main Findings
		the accounts, and overall, older CEOs are reluctant to engage in tax avoidance.
Koester *et al.* (2016)	United States	Firms with higher managers' capacity engage in more tax investment behavior.
Law and Mills (2017)	United States	CEOs with military experience pay more taxes, are less aggressive in avoiding taxes, and are less likely to use tax and other tax shelters.
Li *et al.* (2016)	China	CEO power significantly increases the firm's tax avoidance intensity. Still, the positive relationship between CEO power and the firm's tax avoidance intensity diminishes as customer concentration increases, indicating that customers, as external stakeholders of the firm, can play a certain governance role.
Liu and Lu (2015)	China	The study investigates the impact of managerial characteristics such as professional background, education, tenure, age, compensation, and shareholding level among the characteristics of firm managers on firm tax avoidance behavior and finds that personal characteristics of managers significantly affect the extent of firm tax avoidance.
Mcgee *et al.* (2012)	82 countries	Women are more tax-compliant than men and less likely to avoid taxes.
Tran (1998)	Australia	Examining ten years of data for 46 listed firms in Australia between 1983 and 1993, it was found that large firms have a more significant tax differential and bear a lower tax burden than small firms.
Wang and Yang (2019)	China	The stronger the CEO's overconfidence, the higher the level of tax avoidance.
Wen *et al.* (2019)	China	Academic CEOs significantly inhibit firm tax avoidance. The effect of academic CEOs on firm tax avoidance is more prominent in private firms than in state-owned firms. In addition, the inhibitory effect of high-level CEO academic experience on firm tax avoidance is more significant.
Xie and Tian (2014)	China	The more power the CEO has, the more aggressive the firm is in taxation.
Yan and Liao (2018)	China	The existence of an alum relationship between the CEO and CFO significantly contributes to firm tax avoidance, and this effect is more pronounced in areas with higher tax administration intensity. Further, the tax avoidance effect of CEO-CFO alum relationships significantly reduces firm value, especially in regions with high tax administration intensity. Finally, the extended studies find that firms' external financing constraints exacerbate the tax avoidance effect of CEO-CFO alum relationships.

Table 2. Summary of literature on factors influencing tax avoidance: Fundamental characteristics of the firms (23 studies)

Authors	Country	Main Findings
Blaylock *et al.* (2017)	United States	The relationship between tax differences and capital structure is investigated. It is found that the stronger the consistency of tax differences, the higher the proportion of firm debt, *i.e.*, tax avoidance is negatively related to leverage. It is mainly because lower tax differences lead to lower accounting information content and significantly higher equity compensation, forcing firms to choose debt financing.
Cao and Chen (2017)	China	The effects of the accelerated depreciation policy on fixed assets were examined using a difference-in-difference model and propensity score matching method with a sample of A-share manufacturing firms in Shanghai and Shenzhen from 2009 to 2015. The results show that the effect of the accelerated depreciation policy can be summarized as "the pilot firms' innovation investment increased significantly without substantial changes in the scale of fixed asset investment."
Chen *et al.* (2021)	United States	The authors examine several US multinationals with revenues close to zero and find that these firms have targeted income shifting, thereby minimizing global and domestic current taxes.
Dhaliwal *et al.* (1992)	United States	The lower the tax avoidance (the stronger the tax consistency), the higher the firm's leverage, *i.e.*, there is a substitution effect between tax avoidance and financial leverage.
Dyreng and Markle (2016)	United States	The study examines the impact of US multinationals on the amount and cost of repatriating income to the country. The authors find that if the cost of repatriating income to the US grows for US multinationals, they will prefer to keep the income

Authors	Country	Main Findings
		abroad and delay the release of domestic profits to reduce tax costs. It demonstrates that locational factors are among the most important factors influencing tax avoidance.
Frank *et al.* (2009)	United States	The study investigates the correlation between tax avoidance and the quality of accounting information. It controls for the effect of tax loss carryforward, a fundamental characteristic of the firm, on tax avoidance. Still, the results are insignificant, *i.e.*, tax loss carryforward has no significant effect on tax avoidance.
Gupta and Newberry (1997)	United States	The relationship between firm size, financial leverage, firm fundamental characteristics of ROA, and effective tax rate (ETR) is investigated, and it is found that financial leverage is significantly negatively related to tax avoidance, *i.e.*, substitution effect. Meanwhile, RandD expenditures are available for pre-tax deduction, leading to the insufficient incentive for tax avoidance, and the study supports the hypothesis that RandD reduces the degree of tax avoidance.
Han and Liu (2017)	China	Using the data of privately listed firms in GEM from 2013 to 2015 as a sample, the study uses a lagged variable model to test the effects of firm tax burden and add-on deduction policy on RandD investment. Then, the study examines the effects of political affiliation on RandD investment and the moderating role of political affiliation in the relationship between firm tax burden and RandD investment from the perspective of political affiliation. The results show that tax relief promotes RandD investment, and tax deduction policy generates a tax avoidance incentive effect.
Hope *et al.* (2013)	United States	The study investigates the relationship between the quality of accounting information reported on the earnings distribution of US multinational firms and firm tax avoidance. The results show that the quality of earnings accounting information is negatively related to tax avoidance, *i.e.*, lower-quality accounting information tends to hide unfavorable details on multinational firms, leading to a decline in the quality of accounting information. Furthermore, the authors controlled for the tax loss carry and its change value during the study in the current period. They found that both were significantly and negatively related to tax avoidance, *i.e.*, they supported the substitution effect of the credit for tax avoidance.
Liu *et al.* (2019)	China	Chinese investment firms domiciled in tax avoidance havens have significantly lower parent firm profits than other firms. It suggests that Chinese firms investing in tax avoidance havens are likelier to commit tax avoidance.
Markle and Shackelford (2012)	82 countries	The authors examined the firm tax burden in 82 countries worldwide. They found that Japanese firms had the highest taxes and multinational firms domiciled in tax havens had the lowest taxes, indicating that location is an important factor influencing tax avoidance.
Rego (2003)	United States	The study examined whether US multinational firms have a scale effect on tax avoidance. The results showed that the larger the size of the multinational firm, the lower the tax. These findings suggest that MNCs can use the complex resources of MNCs for tax avoidance to form a scale advantage.
Richardson and Lanis (2007)	Australia	Using Australian data to examine the relationship between firm size, financial leverage, RandD expenditures, and tax avoidance, the authors find a negative relationship between financial leverage and tax avoidance.
Richardson and Roman (2007)	Australia	The study selected a sample of Australian-listed firms from 1997 to 2003. After controlling for other factors affecting tax avoidance, they found that the larger the firm, the lower its effective tax rate.
Tran (1998)	Australia	Examining ten years of data for 46 listed firms in Australia between 1983 and 1993, it was found that large firms have a more significant tax differential and bear a lower tax burden than small firms.
Wang and Guo (2019)	China	Based on the capital structure trade-off theory, the impact of listed firms' tax avoidance on their capital structure was investigated. The conclusions show a significant negative relationship between tax avoidance and the gearing ratio of listed firms, and the hypothesis of substitution effect is confirmed. Furthermore, significant industry differences exist in the degree of tax avoidance and its impact on the gearing ratio. The degree of tax avoidance and its impact on the capital structure of non-state-owned enterprises is greater than that of state-owned enterprises.

Authors	Country	Main Findings
Wang *et al.* (2010)	China	Taking the firm income tax reform as an opportunity, the study first examines the impact of exogenous changes in firm income tax law on firm capital structure. Then, it tests the applicability of the Western debt tax shield and capital structure theory in China. It was found that after the income tax reform, firms with lower tax rates significantly reduced their debt levels. In comparison, firms with higher tax rates significantly increase their debt levels. The "tax shield with investment" obtained from the income tax reform is negatively related to the change in debt levels, which aligns with the theoretical expectation of the "substitution effect."
Wu *et al.* (2013)	China	Using a sample of Chinese GEM-listed firms from 2008 to 2011, the study investigates the effect of taxation on RandD activities. The authors argue that firms with higher tax burdens may be more inclined to invest in fixed assets to obtain external funds and enjoy the benefit of the pre-tax deduction for interest, thus reducing the investment in RandD activities, which supports the crowding-out effect.
Hossain and Mitra(2023)	United States	The corporate headquarters plays a pivotal role in information exchange, corporate governance, and strategic decision-making. The location of the headquarters may reduce tax avoidance by enhancing oversight and mitigating information asymmetry.
Nerudova *et al.* (2023)	European Union	The disparity between offshore and onshore tax rates in EU countries has a significant impact on tax avoidance. The greater the tax rate difference, the higher the degree of corporate tax avoidance.
Lei *et al.* （2023）	28 Countries and Regions	The higher the corporate carbon emissions, the greater the tax burden, while companies engaged in emission reduction enjoy lower tax liabilities. This relationship is more pronounced in countries that have implemented carbon taxes and boasts high media freedom, judicial independence, and sound legal frameworks.
Guo *et al.* (2024)	China	The development of digital finance is negatively correlated with corporate tax avoidance, and this effect is more pronounced in highly profitable and non-state-owned enterprises. There is a complementarity between digital finance and modern corporate governance mechanisms.
Chen *et al.* (2024)	China	An analysis was conducted on the impact of corporate digital transformation on tax avoidance, exploring how digital transformation reduces tax avoidance by lowering agency costs and increasing media and analyst attention.

Source: Compiled and analyzed by the author based on searches conducted in the Scopus database.

Table 3. Summary of literature on factors influencing tax avoidance: Corporate governance (55 studies)

Authors	Main Findings
Allen *et al.* (2016)	Firms with higher analyst attention are also less aggressive in their tax avoidance.
Allam *et al.* (2023)	The relationship between national culture and tax evasion reveals that cultural traits such as power distance and collectivism are positively correlated with levels of tax evasion.
Athira and Ramesh(2024)	The higher the uncertainty in economic policy, the greater the degree of corporate tax avoidance. However, in environments with higher governance levels, such as developed countries and companies subject to stricter auditing standards, the influence of economic policy uncertainty on tax avoidance is diminished. In unconstrained firms, this effect is more pronounced.
Badertscher *et al.* (2010)	The higher the proportion of private equity, the higher the degree of firm tax avoidance, indicating that private equity has a supervisory role in promoting firm tax avoidance and improving firm value.
Bauer (2014)	Firms with tax-related internal control deficiencies have lower levels of tax avoidance relative to other firms.
Brown *et al.* (2013)	Increasing bonus incentives for CEOs and CFOs can significantly reduce a firm's cash tax rate.
Cen *et al.* (2017)	Firms with close customer-supplier relationships can implement more tax avoidance. In addition, the quality of internal controls can also affect the level of firm tax avoidance.
Chen and Lin (2017)	Firms with higher analyst attention are also less aggressive in their tax avoidance.

Authors	Main Findings
Chen *et al.* (2010)	Tax avoidance is lower in family firms compared to non-family firms. It suggests that family firms are more concerned about the family reputation and long-term firm growth and are, therefore, reluctant to implement more tax avoidance.
Chen *et al.* (2016)	State-owned firms significantly reduce the level of tax avoidance during economic downturns. The greater the policy uncertainty, *i.e.*, the higher the risk that the central government replaces local government officials, the greater the incentive for firms to reduce their tax costs.
Chen *et al.* (2018)	The policy lowered pre-tax income rates and weakened politically connected firms' pre-tax income.
Cheng *et al.* (2012)	The higher the ratio of hedge fund holdings, the higher the degree of firm tax avoidance, indicating that private equity has a supervisory role in promoting firm tax avoidance and enhancing firm value.
Chircop *et al.* (2022)	The authors base their findings on Italian anti-mafia police operations as shock events that led to the disappearance of mafia firms. In addition, they found that peers reduced their tax avoidance behavior after these operations. Overall, government enforcement actions promote orderly competition in product markets and thus influence corporate tax avoidance behavior.
Chyz *et al.* (2013)	Firms with higher unionization have lower tax avoidance.
Deng *et al.* (2019)	Firms that receive more government subsidies reduce tax avoidance.
Desai and Dharmapala, (2006)	An increase in managers' incentives reduces firm tax avoidance based on an agency theory framework.
Eli *et al.* (2018)	There has been a significant decrease in firm tax avoidance in Israel after introducing a whistleblower mechanism for employees to report firm tax evasion.
Fan and Tian (2016)	The authors find that compared to locally promoted leaders, it is difficult to establish and maintain short-term government-business relationships in firms under outwardly transferred leaders, resulting in lower tax avoidance.
Feng *et al.* (2024)	Local gambling preferences are positively correlated with tax avoidance, a relationship that manifests through the weakening of corporate social responsibility, increased risk-taking capacity and reduced sensitivity to reputational damage.
Gaidi and Hu (2012)	A lower nominal tax rate leads firms to shift profits to years with lower tax rates to implement avoidance.
Gallemore and Labro (2015)	Firms with higher firm information environments have higher levels of tax avoidance and lower risk. To examine the effect of the accounting information environment on tax avoidance.
Henry *et al.* (2016)	Firms with high customer concentration have higher levels of tax avoidance.
Hill *et al.* (2013)	Firms engaged in tax-related political lobbying paid less in taxes.
Hogan and Noga (2015)	The higher the fee the firm pays for the auditor's tax services, the higher the level of firm tax avoidance and the corresponding lower tax risk.
Hoopes *et al.* (2012)	Increased IRS enforcement reduces the intensity of firm tax avoidance.
Huseynov *et al.* (2017)	Firms with lower levels of tax avoidance significantly increase their level of tax avoidance after being included in the SandP 500 index system.
Jiang *et al.*(2024)	There is a significant negative correlation between ESG performance and tax avoidance, particularly pronounced in regions with underdeveloped technology, companies with high agency costs, and those with lower audit quality.
Kanagaretnam *et al.* (2016)	Firms audited by international "Big Four" audit firms are less likely to engage in tax avoidance than other firms.
Kubick *et al.* (2016)	Firms with aggressive tax avoidance practices are more likely to receive a tax comment letter from the Securities and Exchange Commission. Firms receiving comment letters reduce their tax avoidance in anticipation of increased tax costs.
Lampenius *et al.* (2021)	Based on how the adoption of the two major tax reform acts of the United States, the Tax Reform Act of 1986 and the Tax Cuts and Jobs Act of 2017, affects the strategic choice of tax avoidance behavior of American multinational firms, the author uses the measurement method of separating tax rate and tax base to find that after the adoption of the two major acts, firm tax avoidance has changed significantly, indicating the important impact of government behavior on firm tax avoidance.
Li and Xu (2009)	The government-business relationship helps firms avoid tax avoidance. The

Authors	Main Findings
	positive effect of the government-business relationship is prominent when the government faces significant economic growth and fiscal pressure.
Li *et al.* (2016)	There is a significant positive relationship between board member similarity and tax avoidance. In addition, the authors also find that social donations significantly reduce the firm tax burden and are more pronounced for politically connected private firms.
Li *et al.* (2019)	Higher compensation incentives in private firms and firms with greater managers' power promote a degree of tax avoidance. Conversely, the effect of compensation incentives on the degree of tax avoidance is weaker for state-owned firms and firms with fewer managers' power.
Li *et al.* (2022)	Employee wages positively correlate with the degree of firm tax avoidance.
Liu and Wu (2014)	Tax avoidance is lower among SOEs in typhoon-prone locations, suggesting that government finances can influence firm tax decisions.
Liu *et al.* (2010)	The higher the degree of managers' incentives, the higher the firm tax avoidance.
Li (2024)	The tax incentives for managers are significantly positively correlated with their motivation for tax avoidance, indicating that management deliberately engages in tax avoidance.
Long *et al.*(2024)	Equity structure significantly affects tax avoidance. The study examined the influence of ownership structures, where both state-owned and non-state-owned shareholders coexist, on tax avoidance. It found that when the controlling shareholder is non-state-owned, tax avoidance is higher, whereas when the controlling shareholder is state-owned, tax avoidance is lower.
McGuire *et al.* (2011)	Firms with a higher degree of separation of DCS have lower levels of tax avoidance.
McGuire *et al.* (2012)	Firms with higher auditor industry expertise had higher levels of tax avoidance.
Mill and Newberry (2011)	Tax differences are more minor for publicly traded firms than for unlisted firms. Thus, firms with a public ownership structure have higher tax avoidance generation costs. Dual-Class Share Structure (DCS) is a unique ownership structure that separates cash and control rights. A greater degree of separation in a DCS means greater insider control, and comfort can lead to an insider's reluctance to make efforts to implement tax avoidance.
Powers *et al.* (2016)	The study examines how firm CEO incentives affect firm tax avoidance. The results find that CEO incentives significantly affect firms' adoption of different tax avoidance strategies. For example, firms using cash flow metrics report lower GAAP and cash effective tax rates than firms using earnings metrics
Rego and Wilson (2012)	Increasing the degree of CEO equity incentives induces them to adopt more aggressive tax avoidance, leading to an increase in the firm's tax exposure, suggesting that compensation incentives are an important factor influencing the degree of aggressiveness of CEOs in implementing tax avoidance.
Rego and Wilson (2012)	Increasing the degree of CEO equity incentives induces them to adopt more aggressive tax avoidance, leading to an increase in the firm's tax exposure, suggesting that compensation incentives are an important factor influencing the degree of aggressiveness of CEOs in implementing tax avoidance.
Richardson *et al.* (2015)	The higher the board independence, the higher the degree of tax avoidance.
Robinson *et al.* (2010)	Profit centers for firm tax departments have a lower effective tax rate than using cost centers for assessment. It suggests that profit center assessment can effectively incentivize tax department managers to actively engage in tax planning to increase firm value rather than just strict cost control.
Tan and Du (2015)	The authors investigate the correlation between internationalized boards and tax avoidance. They find that hiring expatriates as directors enabled them to monitor managers' self-interested and aggressive tax behavior, resulting in lower levels of tax avoidance than other firms.
Wang *et al.* (2009)	The market can identify tax avoidance behavior triggered by tax reform and positively respond to firms that adjust their profits. In addition, Wang (2014) finds that profit shifting due to tax reform is mainly concentrated in non-state firms and firms with a high proportion of managers' ownership.
Wang *et al.* (2010)	Private firms use the debt tax shield and employ more tax avoidance behaviors.

Authors	Main Findings
Wu (2009)	Lower levels of tax avoidance for state-owned firms relative to private firms.
Wu *et al.* (2009)	Firm tax avoidance intensity is lower when firm executives have a background in government service than other firms.
Wongsinhirun *et al.*(2024)	Companies where managers hold more shares, exhibit lower levels of tax avoidance, supporting the view that agency conflicts primarily drive tax avoidance.
Yong and Chao (2020)	Higher comparability of accounting information about firms makes it easier for investors to monitor managers' tax avoidance behavior, thus effectively reducing aggressive firm tax avoidance.
Zhang *et al.* (2018)	The closer the distance between the firm and the tax office, the higher the firm's tax avoidance level.
Zheng and Han (2008)	Lower levels of tax avoidance for state-owned firms relative to private firms.
Zhu*et al.* (2023)	During the pandemic, tax avoidance activities surged, especially in cases where International Financial Reporting Standards were adopted and in environments with higher levels of social trust.

Source: Compiled and analyzed by the author based on searches conducted in the Scopus database.

5.1. Managerial Personal Characteristics

Managerial personal characteristics form the first category of factors influencing tax avoidance. It involves traits, beliefs, ethics, risk preferences, and experiences of the managers in a firm.

Managerial idiosyncrasies critically inform approaches to tax planning and compliance. For instance, a manager's risk-averse disposition may constrain aggressive tax optimization strategies, while ethical predilections could prioritize adherence to explicit and implicit legal frameworks.

Recognizing the idiosyncratic traits of managers is pivotal for comprehending the nuanced decision-making processes that underlie corporate tax avoidance strategies. Varied interpretations of identical operational opportunities and limitations by different managers engender divergent tax avoidance tactics. Therefore, managerial attributes constitute a salient lens for dissecting the multifaceted phenomenon of corporate tax avoidance.

This section has furnished a cursory examination of managerial attributes' role in tax avoidance. Ensuing sections will explore other determinants, namely fundamental organizational traits, governance structures, and ancillary factors influencing tax avoidance behavior.

Managerial characteristics significantly influence a firm's tax avoidance strategies, as confirmed by upper echelons theory (Hambrick and Mason, 1984; Hambrick, 2007). Managers hold key decision-making roles within firms (Jensen and Meckling, 1976), and their "Tone at the Top" can shape tax-related behavior (Dyreng *et al.* 2010).

5.1.1 Gender and Risk Aversion

Gender is a well-studied demographic variable that impacts tax avoidance (Mcgee *et al.* 2014). Female managers generally exhibit less aggressive tax behavior due to social conditioning (McGee and Cohn, 2008), lower average age and experience (Klapper and Parker, 2010), and higher risk aversion (Byrnes *et al.* 1999; Swamy *et al.* 2001; Faccio, 2016). However, research by Dyreng *et al.* (2010) suggests that gender may not significantly impact corporate tax avoidance, differing from individual-level findings (Mcgee *et al.* 2012).

5.1.2. Managerial Expertise

Managerial expertise in finance can optimize tax costs effectively (Custódio and Metzger, 2014). Competent managers facilitate proactive tax-saving measures and lower tax rates (Koester *et al.* 2016).

5.1.3. Political and Ethical Stances

Managers' political leanings and ethical backgrounds also influence tax behavior. Ethical considerations make CEOs with military experience less tax-averse (Law and Mills, 2017). Firms with Democratic-leaning CEOs are more tax-averse than those with Republican CEOs (Francis *et al.* 2016).

5.1.4. Personality Traits

Overconfident managers are more prone to tax avoidance (Chyz *et al.* 2019; Hsieh *et al.* 2018). In contrast, managers with academic backgrounds are generally more risk-averse and less likely to engage in tax avoidance (Wen *et al.* 2019).

5.1.5. Managerial Power and Internal Relationships

Increased managerial power correlates with lower tax avoidance (Xie and Tian, 2014; Li *et al.* 2016). Alum connections between CEOs and CFOs can elevate tax avoidance within the firm (Yan and Liao, 2018).

5.1.6. Additional Factors

Other factors such as age, tenure, and education have been studied but show inconsistent effects on firm tax avoidance (Liu and Lu, 2015).

5.1.7. Regional Contexts

In China, female managers and high female workforce participation correlate with lower aggressive tax avoidance (Dai *et al.* 2017). Overconfident managers in China tend to favor aggressive tax strategies (Wang and Yang, 2019).

In summary, managerial characteristics are critical in shaping a firm's tax avoidance strategies. While traits like gender and expertise have more consistent impacts, other factors like political beliefs, power dynamics, and internal relationships offer more nuanced effects.

5.2. Influence of Fundamental Firm Characteristics on Corporate Tax Decisions

The literature on corporate tax decisions is abundant, with studies that use fundamental firm characteristics as control variables in regression models. These characteristics are instrumental in determining a firm's proclivity toward tax avoidance. Among these are firm size, leverage, profitability, tax loss carryforwards, investment activities, and locational factors.

5.2.1. Firm Size and Tax Avoidance

Existing literature offers conflicting viewpoints on the influence of firm size on tax avoidance. Some studies argue that larger firms are better equipped to lobby for tax benefits, leading to more significant tax avoidance (Stickney and Mcee, 1982; Tran, 1998; Richardson and Roman, 2007). On the contrary, others argue that larger firms may engage in less tax avoidance due to increased public scrutiny and political costs (Watts and Zimmerman, 1986; Rego, 2003).

5.2.2. Leverage as a Determining Factor

Leverage, represented by the ratio of a firm's debt to its equity, also has a nuanced impact on tax avoidance. While some studies claim that firms with higher leverage ratios are less likely to seek other avenues of tax avoidance due to the tax-shielding effects of debt (Modigliani and Miller, 1963; DeAngelo and Masulis, 1980; Tucker, 2006), others find a negative correlation between leverage and tax avoidance (Dhaliwal *et al.* 1992; Gupta and Newberry, 1997; Richardson and Lanis, 2007).

5.2.3. Profitability and Its Impact

Profitability also weighs heavily on tax avoidance. Some literature suggests that more profitable firms are motivated to avoid more taxes to maximize their earnings (Rego, 2003; Dunbar *et al.* 2010). In contrast, others argue that higher profitability could result in higher effective tax rates, thus discouraging tax avoidance (Gupta and Newberry, 1997; Richardson and Lanis, 2007).

5.2.4. Influence of Tax Loss Carryforwards and Investment Activities

Tax loss carryforwards can encourage and discourage tax avoidance (Frank *et al.* 2009; Hope *et al.* 2013). Similarly, a firm's investment activities can affect its tax avoidance strategies. Capital-intensive firms and those with significant RandD expenditures may enjoy tax benefits that influence their tax avoidance activities (Stickney and McGee, 1982; Gupta and Newberry, 1997).

5.2.5. The Role of Location Factors

The location also has a substantial impact. Firms with a more significant international presence, especially in tax havens (Dyreng and Markle, 2016; Chen *et al.* 2021; Markle and Shackelford, 2012)., the greater the disparity between offshore and onshore tax rates (Nerudova *et al.* 2023), the more pronounced the impact on tax avoidance, Tend towards higher levels of tax avoidance. Additionally, the location of corporate headquarters plays a crucial role in tax avoidance. Hossain and Mitra (2023) found that companies headquartered near urban areas

engage in fewer tax avoidance activities, whereas those located farther from cities exhibit higher levels of tax avoidance. This is attributed to the increased scrutiny from analysts and media in urban areas, which heightens the perceived tax risk.

5.2.6. Other Characteristics

Companies that actively engage in energy-saving and emission-reduction efforts are eligible for tax incentives, thereby reducing tax avoidance (Lei *et al.* 2023). Additionally, the widespread development of digital technologies (Chen *et al.* 2024; Guo *et al.* 2024) may further diminish corporate tax avoidance.

5.2.7. Chinese Context: A Gap in Research

While the existing literature essentially controls for these factors, studies specifically focusing on the Chinese context are limited. However, some noteworthy studies have been conducted. Wang and Guo (2019) found that higher leverage levels reduced tax avoidance in Chinese firms. Research on RandD expenditures in China indicates a positive relationship with tax avoidance (Han and Liu, 2017; Wu *et al.* 2013). Studies have also shown that location factors significantly influence Chinese firms' tax avoidance (Liu *et al.* 2019).

In summary, while each fundamental characteristic has been shown to affect a firm's tax avoidance strategies, the relationship is complex and can vary by jurisdiction and other contextual factors. Further research is needed, particularly within the Chinese context, to more comprehensively understand these relationships.

5.3. The Role of Corporate Governance in Tax Avoidance

Corporate governance is a critical variable in shaping a firm's approach to tax avoidance, given its broad impact on various stakeholders such as managers, investors, government bodies, and tax auditors (Slemrod, 2004; Chen and Chu, 2005). Unlike personal tax decisions, which primarily involve individuals and tax authorities, corporate tax decisions are influenced by a complex web of stakeholders, each with distinct interests.

The foundation of this complexity can be traced back to the agency theory, which posits a fundamental divide between firm owners and managers (Jensen and Meckling, 1976). While managers, as insiders, possess decision-making authority and informational advantages, other stakeholders act as outsiders. These outsiders may have concerns about potential malfeasance or neglect on the part of insiders, heightening the need for robust corporate governance as a protective measure.

Accordingly, effective corporate governance mechanisms can align a firm's strategic choices, including its approach to tax avoidance, with stakeholders' expectations. Such mechanisms function through a combination of incentives and oversight structures. Key dimensions explored in the current literature that influence corporate tax avoidance include compensation structures, board composition, ownership patterns, market pressures, the role of auditors, the influence of employees, government policies, and the importance of accurate accounting information (Hanlon and Heitzman, 2010; Lietz, 2013; Jost and Patrick, 2019).

Given that governance systems can vary greatly depending on the economic context, the impact of these dimensions is not uniform across all firms. This paper will review how these factors shape tax avoidance in developed economies like the United States and extend the discussion to emerging markets, focusing on Chinese firms.

5.3.1. The Impact of Compensation Incentives on Corporate Tax Avoidance

The role of compensation incentives in shaping corporate tax avoidance has been a subject of ongoing debate, with varying viewpoints on whether and how such incentives influence tax behavior at the managerial level.

(1) Differing Roles for Middle and Top Managers

One school of thought argues that compensation incentives are particularly effective in motivating middle-level managers - such as tax directors and regional managers—to engage in tax avoidance activities (Phillips, 2003; Robinson *et al.* 2010; Armstrong *et al.* 2012). For instance, Robinson *et al.* (2010) found that firms adopting profit-center assessments for their tax departments have lower effective tax rates than those using cost centers. This suggests that compensation based on profit outcomes encourages tax directors to seek tax-saving measures proactively. Armstrong *et al.* (2012) reinforced this by showing that tax directors could significantly reduce accrual-based tax rates when given amplified incentives.

However, the same studies found mixed results for top-level managers. While Phillips (2003) argued that performance incentives for divisional managers can significantly lower a firm's effective tax rate, no similar correlation was found for CEOs. This implies that middle managers may be more responsive to tax avoidance incentives than their top-level counterparts.

(2) The Contingency of Top-Level Incentives

Contrastingly, other research (Rego and Wilson, 2012; Brown *et al.* 2013; Powers *et al.* 2016) contends that incentives for top-level executives like CEOs and CFOs can foster more aggressive tax avoidance strategies. For example, Rego and Wilson (2012) found that increased CEO equity incentives correlated with increased tax avoidance measures. Powers *et al.* (2016) further nuanced this by suggesting that the type of incentive matters; CEOs driven by cash flow metrics engaged in lower tax accruals than those guided by accounting earnings. Similarly, Li (2024) found that tax avoidance incentives can prompt CEOs to direct more resources toward expanding the company's tax department, thereby increasing the level of tax avoidance.

(3) The Complexity of Incentives and Governance

However, some research counters these perspectives by arguing that heightened incentives do not necessarily lead to increased tax avoidance. Desai *et al.* (2007) use agency theory to suggest that while tax avoidance can enhance shareholder wealth, excessive incentives could deter managers from such practices, especially in firms with weaker corporate governance. Wongsinhirun (2024) argues that tax avoidance may serve as a facade for the rent-seeking behavior of insiders like CEOs. Thus, when management is provided with sufficient incentives, it aligns the CEO's interests with those of the company, thereby reducing the likelihood of the CEO exploiting tax avoidance for personal gain. Interestingly, Armstrong *et al.* (2015) proposed an inverted U-shaped relationship between managers' incentives and tax avoidance, indicating that the effect of incentives can vary based on existing levels of tax avoidance.

While compensation incentives undeniably play a role in corporate tax decisions, the extent of their impact appears contingent on various factors, including the level of management targeted and the firm's governance structure. These diverging viewpoints indicate that there is no one-size-fits-all approach to using incentives to guide tax avoidance behavior, thus warranting a more nuanced understanding and application of compensation incentives in corporate governance.

5.3.2. The Role of Board Structure in Corporate Tax Avoidance

The influence of a firm's board of directors on corporate tax avoidance can be examined from two contrasting perspectives. Elected by stakeholders by legal regulations, the board plays a pivotal role in delegating, motivating, and supervising managerial responsibilities (Fama and Jensen, 1983).

(1) Active Oversight for Increased Tax Avoidance

The first perspective argues that an effective board should proactively oversee managerial initiatives to increase tax avoidance (McClure *et al.* 2018; Jost and Patrick, 2019). This view is especially pertinent for firms in financial distress or at risk of insolvency, where aggressive tax avoidance strategies can result in much-needed tax savings. Richardson *et al.* (2015) support this viewpoint by establishing a positive correlation between board independence and the extent of tax avoidance; the more independent the board, the higher the likelihood of aggressive tax avoidance tactics.

(2) Supervision for Regulatory Compliance

The second perspective, in contrast, asserts that an independent board is more likely to ensure that managers adhere strictly to tax laws and regulations (Finkelstein and Mooney, 2003; Adams and Ferreira, 2007). In this view, board independence checks against overly aggressive tax avoidance strategies that skirt the edge of legality or veer into tax evasion.

In summary, the board's role in influencing corporate tax avoidance can be seen as a balance between active oversight for maximizing tax benefits and rigorous supervision for maintaining compliance with laws and regulations. While an independent board may be more proactive in tax avoidance under certain conditions, its primary function remains to ensure managerial actions align with stakeholders' interests and regulatory norms.

5.3.3. Influence of Ownership Structure on Corporate Tax Avoidance

Ownership structure plays a crucial role in corporate governance, particularly in shaping a firm's approach to tax avoidance. Different types of owners may have varying incentives and impacts on the company's tax strategies.

(1) Institutional Investors and Tax Avoidance

Institutional investors, such as private equity firms and hedge funds, are often vested in maximizing the economic benefits of tax avoidance due to their specialized governance knowledge (Bushee, 1998; Chung *et al.* 2002). Studies by Badertscher *et al.* (2010) and Cheng *et al.* (2012) demonstrate a positive correlation between institutional ownership and aggressive tax avoidance tactics. However, it is essential to note that such aggressive strategies may also result in non-tax costs, such as damage to the firm's reputation (Hanlon and Heitzman, 2010).

(2) Nature of Ownership and Tax Avoidance

On the one hand, compared to state-owned enterprises, family-owned businesses bear full financial responsibility, which gives them a stronger incentive to engage in higher levels of tax avoidance (Long *et al.* 2024). However, on the other han, family-owned firms appear less inclined to engage in aggressive tax avoidance, prioritizing family reputation and long-term business sustainability instead (Chen *et al.* 2010). These firms demonstrate that pursuing aggressive tax avoidance strategies is not universal across all ownership structures.

(3) Publicly-Traded vs. Unlisted Firms

Publicly traded firms generally exhibit a higher degree of tax avoidance than unlisted firms, potentially raising questions about the quality of their financial disclosures (Hanlon *et al.* 2005; Lennox *et al.* 2012). Supported by research from Hanlon *et al.* (2007), these suspicions are further validated by the observation that publicly traded firms have fewer tax adjustment errors, suggesting that these firms may be more capable of successfully engaging in tax avoidance. Mills and Newberry (2011) add another layer to this by noting that the cost of generating tax avoidance is generally higher for publicly traded firms due to the smaller tax disparities they experience.

(4) Dual-Class Share Structure (DCS) and Tax Avoidance

The Dual-Class Share Structure (DCS), which separates cash flow rights from control rights, also has implications for tax avoidance. Firms with a higher degree of separation in DCS tend to engage less in tax avoidance activities (McGuire *et al.* 2011). This could be attributed to the stronger insider control in such structures, which might reduce the inclination to pursue aggressive tax strategies.

In summary, the ownership structure can significantly influence a firm's approach to tax avoidance, with institutional investors typically favoring more aggressive strategies, family-owned firms opting for caution, and publicly-traded firms facing unique challenges and costs. The type of ownership can serve as an indicator of the likely direction and extent of a company's tax avoidance activities.

5.3.4. The Role of Market Pressure in Corporate Tax Avoidance

Market pressure is a significant governance variable, shaping how firms approach tax avoidance. The market's perception of a firm's tax behavior can sway corporate decisions, from affecting competitiveness to influencing reputational risk and transparency.

(1) Market Perceptions and Competitive Edge

On one hand, companies that engage in lower levels of tax avoidance are often perceived as less competitive in the market (Slemrod, 2004). Supporting this idea, Huseynov *et al.* (2017) found that after inclusion in the SandP 500 index, firms tend to increase their level of tax avoidance, suggesting that market expectations influence corporate tax behavior.

(2) Reputational Risks and Agency Costs

On the flip side, excessive tax avoidance comes with its own set of drawbacks. Firms engaged in high levels of tax avoidance may experience increased agency costs and can risk damaging their reputation significantly (Desai and Dharmapala 2006; Desai *et al.* 2007).

(3) Analysts' Influence on Transparency and Tax Avoidance

As key market players, analysts wield substantial influence over corporate tax decisions by interpreting and projecting tax-related information to investors (Allen *et al.* 2016; Chen and Lin, 2017). According to Allen *et al.* (2016), analysts can help bridge the information gap between a firm's internal and external stakeholders, thereby enhancing transparency. This improved clarity makes it more challenging for firms to engage in concealed tax avoidance activities.

(4) Impact of Decreased Analyst Attention

Interestingly, firms may escalate their tax avoidance efforts when analyst attention wanes. Allen *et al.* (2016) observed increased tax avoidance in firms that experienced diminished analyst attention due to exogenous events. Similarly, Chen and Lin (2017) noted a spike in tax avoidance when firms received less attention from analysts, a more pronounced trend in high-reputation firms.

Market pressures, encapsulating market perception, reputational risks, and analyst scrutiny significantly shape corporate attitudes and actions toward tax avoidance. Firms often adapt their tax strategies to these pressures, highlighting the complex interplay between market forces and corporate tax behavior.

5.3.5. Role of Auditors in Corporate Tax Avoidance

Auditors play a critical role in shaping a firm's approach to tax avoidance by ensuring the integrity and accuracy of financial reports (DeAngelo, 1981). Since tax information is chiefly disseminated through financial statements, the role of auditors extends beyond mere compliance to influencing corporate tax strategies.

Auditors face a dual incentive structure. On the one hand, they aim to uphold their reputation and avoid litigation risks by advocating for sound tax strategies (DeAngelo, 1981; Hanlon and Heitzman, 2010). This is especially true for international "Big Four" auditing firms, whose clients are found to engage in less aggressive tax avoidance than others (Kanagaretnam *et al.* 2016). On the other hand, auditors also derive substantial non-audit service fees from providing tax services, presenting a potential conflict of interest.

Adding complexity to this dual role, specialized auditors can leverage their expertise to reduce the firm's tax burden. Studies show that firms audited by industry experts engage in higher levels of tax avoidance (McGuire *et al.* 2012). Furthermore, the quality and extent of tax services directly relate to auditors' fees. Hogan and Noga (2015) found a positive correlation between the fees for auditor tax services and the firm's tax avoidance levels, suggesting that more expensive tax services often result in more aggressive tax avoidance strategies.

Therefore, auditors serve as a balancing act between limiting risky tax avoidance practices and leveraging their tax expertise to benefit the firm. Their role is shaped by the tension between upholding their professional reputation and capitalizing on lucrative service fees.

5.3.6. Employee Influence on Corporate Tax Avoidance

Employees hold a unique position in influencing the firm's approach to tax avoidance. While they do not bear the direct financial risks associated with the firm's activities, as shareholders do, their interests primarily lie in timely wage payments and benefit improvements rather than engaging in risky corporate behaviors (Faleye *et al.* 2006).

Several studies shed light on how employees and labor unions shape the firm's tax policies. For instance, introducing a whistleblower mechanism in Israel led to a notable decline in tax avoidance activities within firms (Eli *et al.* 2018). This suggests that employees when empowered, can act as internal checks against aggressive tax avoidance measures. Labor unions further amplify this employee influence. Chyz *et al.* (2013) found that a higher degree of unionization within a firm is correlated with reduced tax avoidance activities, indicating that collective labor power can serve as a moderating factor.

However, this influence is not always directed toward reducing tax avoidance. In a study examining the impact of rising minimum wages in various Chinese provinces, Li *et al.* (2022) found that increased wage costs drive firms to escalate their tax avoidance practices. The study highlights that external factors affecting employee compensation can indirectly stimulate a firm's pursuit of aggressive tax strategies.

Therefore, employees and labor unions serve as important governance mechanisms, shaping the firm's tax practices by acting as internal watchdogs or creating conditions that drive tax strategies. Their influence is complex, both a potential constraint and an accelerator for different forms of corporate tax avoidance.

5.3.7. The Government's Role in Shaping Firm Tax Avoidance

As a significant minority shareholder in firms, the government exerts a powerful influence over corporate tax avoidance through legislation and regulatory enforcement (Desai *et al.* 2007). In addition to mandating dividend payouts according to specific regulations (Slemrod *et al.* 1992), governmental agencies like the IRS and the Securities and Exchange Commission (SEC) play a critical role in monitoring and controlling firm taxation. For example, heightened IRS enforcement was shown to reduce firm tax avoidance (Hoopes *et al.* 2012). Similarly, Kubick *et al.* (2016) found that firms with aggressive tax avoidance were more likely to receive tax comment letters from the SEC, which often reduced tax avoidance activities, given the anticipated higher tax-related costs.

Interestingly, firms are not merely passive actors in this process. Evidence suggests that lobbying can effectively obtain favorable tax legislation (Siegfried, 1974; Stickney and McGee, 1982). Hill *et al.* (2013) revealed that companies involved in tax-related political lobbying were generally subject to lower tax liabilities, illustrating how firms can actively shape government policy to benefit their tax positions.

Moreover, major legislative acts can catalyze strategic changes in tax avoidance behaviors. A case in point is the study by Lampenius *et al.* (2021), which examined the impact of two significant US tax reform acts—the Tax Reform Act of 1986 and the Tax Cuts and Jobs Act of 2017—on US multinational firms. The study found noteworthy shifts in tax avoidance strategies in response to these legislative changes, underscoring the government's considerable influence in shaping corporate tax practices.

In sum, the government plays a dual role as an enforcer and a legislator in influencing corporate tax avoidance. It curtails excessive tax avoidance through regulatory bodies and catalyzes strategic shifts in tax avoidance behavior through its legislative actions.

5.3.8. The Influence of Upstream and Downstream Relationships on Tax Avoidance

Besides the governance mechanisms that affect a firm's tax avoidance practices, the firm's relationships with upstream suppliers and downstream customers, as well as the quality of its internal controls and accounting information, also have a bearing on its tax strategies.

High customer concentration levels amplify the business risks of losing key clients (Hertzel *et al.* 2008; Dhaliwal *et al.* 2020). This customer reliance pushes firms to invest in customer-specific assets (Wang, 2012) and exposes them to potential margin reductions due to customer bargaining power (Ravenscraft, 1983; Balakrishnan *et al.* 1996). Consequently, the financial pressures from these risks encourage firms to seek tax avoidance as a capital relief strategy. Supporting this view, Henry *et al.* (2016) reported that firms with higher customer concentration are more inclined to engage in tax avoidance.

In a different yet relevant context, Chircop *et al.* (2022) explored the influence of organized crime on business dynamics in Italy. They found that Mafia-controlled firms distort the competitive landscape, heightening survival costs for other companies. However, when the Italian police implemented purges against the Mafia, the competitive pressures and tax avoidance aggressiveness among rival firms were alleviated.

Supplier relationships are another influential factor. Firms enjoying robust relationships with their suppliers are more likely to engage in tax avoidance (Cen *et al.* 2017). The quality of internal controls within a firm also impacts its tax strategies. Effective internal controls and a conducive information environment can generate high-quality accounting information, assisting firms in making informed decisions and reducing tax liabilities (Brazel and Dang, 2008). Conversely, firms with deficiencies in tax-related internal controls exhibit less aggressive tax avoidance behavior (Bauer, 2014).

5.3.9. The Role of Accounting Information in Tax Avoidance

While many studies focus on various mechanisms influencing tax avoidance, the specific role of accounting information in shaping tax strategies remains relatively underexplored. Bauer (2014), for instance, did not directly address how the quality of accounting information could act as a determinant in tax avoidance behavior. However, subsequent studies have started to fill this gap.

Gallemore and Labro (2015) found a positive relationship between the quality of a firm's information environment and the degree of tax avoidance, noting that firms with better accounting information tend to have higher levels of tax avoidance while assuming lower risks. A robust accounting information system can facilitate more sophisticated and effective tax strategies.

Further underscoring the importance of accounting information, Yong and Chao (2020) investigated how the comparability of such information affects tax avoidance. Their research revealed that when accounting information is more comparable across firms, it allows investors to monitor management's actions better, resulting in less aggressive tax avoidance behaviors by the firm.

In summary, while the role of accounting information has not been the primary focus in existing literature, emerging research indicates its significance in shaping tax avoidance strategies by enabling firms to develop more refined tax plans and allowing for greater scrutiny by investors.

5.3.10. The Influence of Institutional Culture on Tax Avoidance

Culture is a significant factor affecting tax avoidance. Cultural traits such as uncertainty avoidance, power distance, collectivism, and restraint influence tax avoidance through institutional mechanisms such as the rule of law, regulatory quality, and government effectiveness (Allam *et al.* 2023). ESG, encompassing environmental, social, and governance dimensions, reflects a company's institutional environment and governance standards. Companies with higher ESG scores are less likely to engage in tax evasion (Jiang *et al.* 2024). Conversely, a poor cultural or institutional environment may foster tax evasion. For example, Feng *et al.* (2024) found that a gambling culture could undermine corporate social responsibility, leading to increased tax evasion.

5.3.11. The Impact of Uncertainty on Tax Avoidance

Increased macroeconomic uncertainty significantly raises the demand for precautionary funds, compelling companies to engage in higher levels of tax avoidance to conserve cash outflows. Zhu *et al.* (2023) found that tax

avoidance activities surged during the pandemic. Similarly, Athira and Ramesh (2024) observed that in regions with heightened economic uncertainty, the degree of corporate tax avoidance is notably higher.

5.3.12. The Impact of Corporate Governance on Corporate Tax Avoidance in Developing Countries: The Case of China

Tax avoidance in China is shaped by a complex interplay of managerial incentives, board composition, ownership types, market pressures, auditor roles, and government policies. These factors are backed by substantial empirical studies, providing a rich tapestry of influences between state-owned and private firms.

(1) Compensation Incentives

The impact of managerial shareholding on tax avoidance varies between state-owned and private firms. Liu and Lu (2015) argue that higher managerial shareholding in state-owned firms results in less tax avoidance. However, Liu *et al.* (2010b) note that private firms show a positive relationship between shareholding and tax avoidance.

(2) Board Structure

Board characteristics can shape tax avoidance behavior. Li *et al.* (2016) found that board similarity leads to more aggressive tax strategies. Contrarily, Tan and Du (2015) observe that internationally diverse boards result in less tax avoidance.

(3) Ownership Structure

According to existing literature, state-owned firms are less inclined to engage in tax avoidance than private firms (Wu, 2009; Wang *et al.* 2010). The government, acting as both a shareholder and tax collector, can influence these behaviors, as supported by Deng *et al.* (2019).

(4) Market Pressure

Analyst tracking and media scrutiny can affect tax avoidance, especially in private firms. This is supported by the studies of Lu (2010) and Liu and Guo (2019), who focus on analyst tracking and media coverage.

(5) Auditors

Auditing quality plays a significant role in controlling tax avoidance. Ding *et al.* (2019) found that larger auditing firms are more effective in mitigating tax avoidance.

(6) Government Influence

Local governments have a notable impact on tax behavior. Wu *et al.* (2009) argue that executives with government backgrounds engage in less tax avoidance. Additionally, Zhang *et al.* (2018) show that geographic proximity to tax offices affects tax avoidance levels.

(7) Policy and Regulatory Changes

Central government policy impacts tax avoidance across firms. Changes in tax-sharing reforms have been shown to influence tax behaviors, supported by the findings of Fan and Tian (2013) and Chen *et al.* (2018).

5.4. Factors Influencing Tax Avoidance: A Summary

Tax avoidance research has evolved to consider various factors as businesses face increasingly complicated internal and external landscapes. While initial research homed in on the decision-maker's traits and the inherent characteristics of firms, contemporary studies have branched out to include corporate governance and its intersection with country-specific events or institutional cultures. For example, Li *et al.* (2016) have explored how social relations impact tax avoidance in China, Desai and Dharmapala (2006) have examined tax law enforcement in Russia, and Chircop *et al.* (2022) have investigated the effects of anti-mob crackdowns on tax behavior in Mexico.

In summary, tax avoidance in firms across emerging economies is shaped by multifaceted influences. These range from the characteristics of the individuals responsible for making tax-related decisions to the firm's resources and external stakeholders' pressures. This complex interplay provides the framework within which tax avoidance strategies are devised.

6. Potential Contributions of this Paper

On one hand, this paper establishes a three-factor model of corporate tax avoidance, providing readers with a systematic and efficient understanding of the overall progress in factors influencing corporate tax avoidance. Although there is abundant research on these influencing factors, a systematic understanding of how and which factors exert influence is still lacking. By adopting a consistent theoretical framework, this paper reviews literature from the perspectives of managerial characteristics, corporate fundamentals, and corporate governance, facilitating readers' quick comprehension and construction of relevant structural frameworks. On the other hand,

this study offers fresh insights for future research. A comparative analysis reveals that whether and how specific factors influence tax avoidance varies significantly across countries and periods. This suggests that the factors influencing tax avoidance may be affected by other unexamined variables such as region, culture, institutions, and time. This divergence offers valuable perspectives for future exploration of these discrepancies.

7. Discussion

This study offers a comprehensive theoretical framework to understand the multiple influences on tax avoidance within emerging economies. Unlike developed countries such as the United States, where the scope and impact of tax avoidance remain subjects of ongoing debate, emerging economies like China present a unique set of challenges. These include rapid economic expansion, less robust governance, and more flexible approaches to tax enforcement.

This study focuses on three main areas: the role of managerial characteristics, firm-level attributes, and stakeholder influences in shaping tax avoidance practices. Managerial characteristics are vital, highlighting the balance managers must strike between their interests and those of shareholders and the government. On a firm level, the study delves into the traits that may incline a business towards aggressive tax avoidance strategies. Lastly, from a stakeholder viewpoint, we examine the external pressures that can affect a firm's approach to tax avoidance.

Given the urgent need for high-quality development in emerging markets, the study emphasizes improving governance structures. This is crucial for managing tax avoidance risks effectively and equitably distributing benefits among diverse stakeholders, particularly in economies like China experiencing rapid development and governance challenges.

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Chao Ge: Conceptualization, Writing – original draft, Validation, Visualization, Funding;
Wunhong Su: Project administration, Software, Formal analysis, Supervision, Visualization;
Wong Ming Wong: Methodology, Project administration, Software, Data curation.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Declaration of Use of Generative AI and AI-Assisted Technologies

The authors declare that they have not used generative AI and AI-assisted technologies during the preparation of this work.

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The Nexus of Fiscal Policy and Growth in the Optimal Control Framework

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Abstract: This research investigates the effect of fiscal policy on economic growth, focusing on the intertwined relationship between public goods provision, taxation policies, and their impact on economic dynamics and growth. The study aims to contribute to this research domain by introducing an economic model within the optimal control framework that integrates taxation policies into the social constraint and incorporates public goods into the social utility function, addressing recent limitations in this research area. Through numerical analysis, the study examines the potential effects of taxes and public goods provision on consumption and economic growth, as reflected by the level of capital. Results indicate that increasing government spending on public goods can decrease private goods consumption without significant economic growth benefits. At the same time, high tax rates could potentially hinder economic growth by overly relying on government intervention. The research findings highlight the importance of an optimal approach to fiscal policy, with policy implications including the need to carefully evaluate public funds' allocation, enhance public spending efficiency, and implement optimal tax to foster economic growth.

Keywords: tax; consumption; public goods; economic growth; optimal control.

JEL Classification: C62; E62; H30.

Introduction

The intertwined relationship between public goods provision, taxation policies, and their impact on economic dynamics has been a subject of intense scholarly inquiry and practical policymaking. Public goods, defined as non-excludable and non-rivalrous resources benefiting society collectively, encompass essential services such as national defence, sanitation, education, and infrastructure. Their provision is vital for societal well-being, economic growth, and the overall prosperity of nations. Public goods shape economic dynamics by influencing resource allocation, societal well-being (Lerch *et al.* 2022), economic growth, and development (Hazelkorn and Gibson, 2019). Taxation policies, on the other hand, serve as a mechanism for governments to finance the provision of public goods and other essential services (Paul and Robin, 2015). The structure and implementation of tax policies can influence business performance, government revenue, and economic growth. Understanding the effects of these public goods provision and taxation policies on the economy is paramount for policymakers and stakeholders to make informed decisions regarding public investments and resource distribution. Therefore, this research tries to explore these effects and provides additional knowledge for those related agents.

The provision of public goods is crucial for promoting societal well-being and addressing various socio-economic challenges. Access to education, healthcare, and infrastructure, for example, are essential components of public goods provision that contribute to economic growth and development (Hazelkorn and Gibson, 2019). Investments in these areas lead to positive externalities that enhance productivity, human capital development,

and overall welfare. For example, education serves as a cornerstone for economic progress by equipping individuals with the skills and knowledge necessary to effectively participate in the labour market. A well-educated workforce fosters innovation, entrepreneurship, and technological advancement, driving economic growth and competitiveness on a global scale. Furthermore, market failures, such as the inability of private markets to efficiently allocate resources, often necessitate government intervention to ensure the equitable distribution and provision of public goods (Paul and Robin, 2015).

Also, taxation policies play a critical role in shaping economic growth, business performance, and government fiscal sustainability, as the structure and level of taxation can influence investment decisions, consumer behaviour, and overall economic activity. While taxation is necessary to finance public expenditures, excessive taxation can hinder economic growth by imposing burdensome compliance costs and distorting market incentives. The impact of taxation on economic growth depends on factors such as the tax structure, tax rates, and the efficiency of tax administration. Personal income tax and social contributions, for example, have positive effects on economic growth, while distortionary taxes, such as those on income and property, can have a depressing effect on growth (Stoilova, 2017). Moreover, it was indicated that a high tax burden can significantly impact the economic viability of businesses. Thus, taxation policies can shape the business environment and economic landscape (Buliková *et al.* 2021) and the fluctuations in the tax burden can exert profound effects on industry and economic development (Cao and Liu, 2023).

The relationship between public goods, tax, and economic growth has been studied using various research methodologies, each providing unique insights into the dynamics of public goods, taxation, and economic growth. One study utilized a dynamic model of the Generalized Method of Moments (GMM) to analyze the effect of government expenditure on goods and services and capital on regional economic growth in Indonesia. It found that public spending positively affects economic growth, while local tax efforts negatively moderate this relationship, reducing the positive impact of capital expenditure on growth (Amri *et al.* 2023). Another research employed a Vector Autoregression (VAR) model to explore the relationship between economic growth and different types of tax revenues, including those on goods and services. The study concluded that tax revenue on income, profit, and capital significantly impacted economic growth, followed by tax revenue on goods, services, and international trade (Lim and Eng, 2023). A study in Nigeria used regression analysis to examine the relationship between taxation policy and economic growth, finding significant positive relationships between various taxes and economic growth (Kehinde *et al.* 2023). In the European Union, a study using ordinary least squares (OLS) and Granger causality tests found that total tax revenue positively impacts economic growth, while government spending has a negative effect. The study suggests that the structure of tax systems supports growth, with direct and indirect taxes being beneficial, whereas social security contributions are detrimental (Stoilova, 2023). In Türkiye, the augmented autoregressive distributed lag (A-ARDL) bound test approach was used to assess the impact of tax and public expenditure on GDP. The findings indicated that tax revenue positively impacts economic growth in the short run but negatively in the long run, while public expenditures generally have a positive impact (Celik and Köstekçi, 2024).

Understanding the complex interplay between public goods provision, taxation policies, and economic dynamics is essential for policymakers and stakeholders to formulate effective strategies for promoting sustainable growth, reducing inequality, and addressing societal challenges. By examining the effects of public goods provision and taxation policies on economic outcomes, policymakers can identify opportunities for enhancing resource allocation, fostering innovation, and promoting inclusive development to benefit the economy's sustainable growth and development.

This research provides a new perspective and contributes to the understanding of the interplay between public goods provision, taxation policies, and economic growth by integrating public goods and taxation into an optimal control framework that integrates taxation policies into the social constraint and incorporates public goods into the social utility function, addressing recent limitations in this research domain and apply stability analysis as well as the numerical approach to understand how these policies influence consumption and economic growth over time. To achieve these objectives, this research organizes the following sections. The second section will explore pertinent concepts concerning public goods, taxation, and the results of some previous studies. Section 3 will outline the research methodology employed in this study. Subsequently, the analysis results, discussions, and policy implications will be presented.

1. Literature Reviews

This section explores the concepts and the multifaceted impacts of public goods provision and taxation policies on the economy.

Public goods are non-excludable and jointly consumed, meaning one person's use does not diminish the availability for others, and individuals cannot be effectively excluded from using them. Examples include national defence, public education, clean air, and law enforcement. Governments typically provide these goods, funded through taxation, distinguishing them from private goods, which are paid for individually (Deneulin and Townsend, 2007). The unique nature of public goods often results in market failures, as traditional market mechanisms struggle to supply these goods adequately. This necessitates intervention through governmental or quasi-governmental organizations to manage their provision and consumption (Ostrom *et al.*,2013). A significant challenge in providing public goods is the "free-rider" problem, where individuals benefit from the good without contributing to its provision, posing sustainability issues (Holcombe, 1997; Besley and Ghatak, 2006). Public goods significantly influence the economy, impacting household consumption and Subjective Well-Being (SWB). By offering economies of scale, they reduce household expenditures on public goods, allowing increased private goods consumption and enhancing SWB (Li *et al.* 2020). The provision of public goods also shapes individual preferences and consumption patterns, generating positive externalities that benefit society. Transportation networks, for example, improve accessibility and quality of life, directly affecting private consumption patterns. Also, environmental protection influences consumption decisions as a public good, thereby affecting demand in specific sectors (Reiss, 2021). Public spaces, another form of public good, are crucial for enhancing social capital and income growth, essential for economic development (Su *et al.* 2024). However, providing public goods can create conflicts between equity and efficiency, potentially benefiting one group while disadvantaging another (Buchholz *et al.* 2018). Additionally, excessive public sector intervention can lead to market distortions, affecting competition and investment decisions (Baird, 2004). Another challenge in public goods provision is the misperceptions of public goods costs, which can result in voter error and resource misallocation (Lipi *et al.* 2024; Lang *et al.* 2022).

Taxation, a fiscal policy instrument, allows governments to collect revenue from individuals and businesses to fund public expenditures and services. Taxation serves as a crucial source of revenue for the government to finance public expenditures and services, and it can be used to influence economic behaviour, redistribute wealth, and address market failures like externalities (Hindriks and Myles, 2013). The implementation of taxation can affect the economy, e.g., economic growth, labour supply, productivity, and fiscal policy effects. Although there are different forms of taxation, a study identified that consumption taxes, personal income taxes, and property taxes have been more supportive of economic growth than other forms of taxation (Stoilova, 2017). However, excessive tax burdens can negatively impact businesses and economic strength (Buliková *et al.* 2021). Therefore, the optimal taxation theory seeks to determine the most efficient and equitable tax structures to maximize social welfare while considering behavioural responses to taxes (Kaplow, 2008). Empirical studies have shown varying results on the effect of taxation on economic growth, highlighting the complexity and inconclusiveness of theoretical predictions. A study highlights that high tax rates can discourage savings and investment, limiting capital formation and long-term economic development (Stiglitz and Rosengard, 2015). In China, the tax cuts and fee reduction policies have significantly impacted consumer income and expenditure, particularly benefiting younger consumers more than older ones (Wang, 2024). In South Africa, personal income tax has a growth-friendly effect in the short run. Still, in the long run, positive changes in personal income tax are detrimental to economic growth. This suggests that the current tax system, which heavily relies on personal income tax, may need restructuring to support long-term economic growth (Tala, 2024). Nigeria's economic development is influenced by various taxes, with personal income tax and value-added tax having a short-term negative impact on growth. In contrast, corporate income tax positively affects economic expansion. The study suggests that finding the optimal tax rate is crucial for maximizing revenue and economic incentives (Success *et al.* 2024). In Indonesia, income tax, value-added tax, and excise revenue positively influence both short-term and long-term economic growth, highlighting the importance of these taxes in supporting the country's GDP (Wibowo *et al.* 2024). Uganda faces high tax rates, which negatively affect unemployment and economic productivity. The study recommends reducing taxes to stimulate economic growth and widen the tax base (Mukoki *et al.* 2024). In Sierra Leone, indirect taxes negatively impact short-term economic growth, while interest rates have a positive effect. The study suggests enhancing international relations to attract foreign direct investment and promote exports (Davies and Heimoh, 2024).

Regarding the above discussion on public goods and tax, it could be stated that public goods can help improve several aspects of the economy. For instance, public good provision can support the efficient allocation of resources by providing goods and services that would be underprovided by the private sector, which leads to market failures. Also, public goods can enhance social welfare by ensuring that essential services like education, healthcare, and infrastructure are accessible to all members of society, irrespective of their ability to pay. In

addition, public goods can promote equity by reducing disparities in access to vital services, thereby fostering a more inclusive and fair society (Stiglitz and Rosengard, 2015). Furthermore, investments in public goods, such as infrastructure and education, can lead to long-term economic growth and development by creating a conducive environment for businesses and individuals to thrive (Hindriks and Myles, 2013). However, excessive public sector intervention in providing public goods can lead to market distortions and impact competition and investment decisions, implying a negative impact on the sustainable growth of the economy (Baird, 2004). Also, it can potentially reduce private consumption as individuals may rely more on public goods, diminishing their need for private alternatives (Stiglitz and Rosengard, 2015). Furthermore, the availability of high-quality public goods like public transportation may reduce the demand for private transportation services, impacting private consumption patterns (Paul and Robin, 2015). In addition, public goods can lead to a crowding-out effect where the increased provision of public goods displaces private consumption, affecting the overall economy. Therefore, it was suggested that the government has a crucial role in balancing the provision of public goods to ensure they complement rather than substitute private consumption choices (Langdana, 2016).

In the case of tax, at the optimal level, it can provide the necessary revenue to fund public services such as infrastructure development, healthcare, education, and national security. Taxation helps redistribute wealth by collecting funds from those who can afford to pay more and using them to support social welfare programs for the less privileged. It can also be crucial in maintaining economic stability by regulating demand, controlling inflation, and funding government initiatives that stimulate economic growth. However, taxes can lead to welfare losses due to distortionary effects, impacting consumer welfare and economic efficiency (Langdana, 2016). Also, an increase in taxes can reduce the purchasing power of individuals, affecting their ability to afford goods and services, leading to a decrease in consumption (Paul and Robin, 2015). Higher taxes can influence consumer spending patterns and business investments, affecting economic growth. Individuals and businesses may alter their financial behaviours in response to increased taxes, leading to adjustments in savings, investments, and consumption patterns. Another negative effect of tax on growth rates is that taxation can affect labour supply and productivity (Hindriks and Myles, 2013). However, many factors, particularly in economic modelling, can influence optimal tax, such as equilibrium conditions, private-sector equilibrium, government budget constraints, and assumptions about the utility function (Chugh, 2015).

The effect of public goods provision and taxation policies on the economy is multifaceted and complex. Public goods play a crucial role in influencing household consumption, private consumption patterns, and economic growth, while taxation policies serve as a mechanism to finance public expenditures. Understanding the dynamics between public goods provision, taxation policies, and economic outcomes is essential for policymakers to formulate effective strategies for promoting sustainable growth, reducing inequality, and addressing societal challenges.

2. Methodology

This section will propose the model that the government expenditure in terms of public goods is composed of social utility, and tax is imposed in the social constraint based on the optimal control framework. These public goods are non-excludable and non-rival in nature, meaning that individuals cannot be excluded from their benefits, and one person's consumption does not diminish the availability for others (Langdana, 2016). These goods normally are not provided by the market. In this study, the component of public goods in the utility is assumed to substitute for private goods, i.e., the higher the public good, the lower the private good consumption. The model also assumes a large number of infinitely lived households and firms, that population growth is zero and that there is no entry or exit of firms. The representative firm produces a single composite good using private capital, K, and labour, N, based on CobbDouglas technology:

$$Y_t = A_t K_t^{\alpha} N_t^{1-\alpha} \quad , \tag{1}$$

where A_t is the total productivity and the constant α denotes the proportion of K in the output.

Assuming that this economy uses the after-tax output for either reinvest in the firms to increase capital stock or use for consumption, depending on the social preferences. The capital accumulation of this economy can be expressed by:

$$\dot{K}_t = (1-\tau) Y_t - C_t - I_t \quad , \tag{2}$$

where τ denotes income tax. $I = \delta K$ and δ is capital depreciation rate.

The central planner maximizes lifetime utility U given by

$$U\left(C_t, G_t\right) = \ln\left(C_t\right) + \theta \ln\left(G_t\right), \tag{3}$$

where C and G represent private goods consumption and public goods consumption, respectively. The budget constraint of this economy is represented by:

$$\dot{B}_t = rB_t + \tau Y_t - G_t \tag{4}$$

where r is the interest rate and τ stand for tax rate.

The central planner considers (2) and (4) and solves the following problem:

$$MAX_{C_t, G_t} \int_0^{\infty} U(C_t, G_t) e^{-\rho t} dt \tag{5}$$

where the constant ρ is the rate of time preference.

The Hamiltonian function associated with problem (5) can be written by:

$$H = U\left(C_t, G_t\right) \mathrm{e}^{-\rho \cdot t} + \lambda_1\left(\dot{K}_t\right) + \lambda_2\left(\dot{B}_t\right), \tag{6}$$

which implies the following:

$$\dot{C}_t = \frac{C_t}{G_t}\left(\alpha A_t \left(\left(1-\tau\right)G_t + \tau\theta C_t\right) K_t^{\alpha-1} N_t^{1-\alpha} - \left(\rho+\delta\right)G_t\right), \tag{7}$$

$$\dot{G}_t = \left(r - \rho\right) G_t, \tag{8}$$

The stability of this economy can be evaluated

$$J = \begin{bmatrix} a_1 & a_2 & a_3 & 0 \\ 0 & r\text{-}rho & 0 & 0 \\ -1 & 0 & a_4 & 0 \\ 0 & -1 & a_5 & r \end{bmatrix}, \tag{9}$$

$$a_1 = \frac{A_t\left(\alpha\left(\left(1-\tau\right)G_t + \tau\theta C_t\right) + C_t\right) K_t^{\alpha-1} N_t^{1-\alpha} \alpha\tau\theta - \left(\rho+\delta\right)G_t}{G_t}$$

$$a_2 = \frac{C_t\left(\alpha A_t \left(1-\tau\right) K_t^{\alpha-1} N_t^{1-\alpha} - \rho - \delta\right)}{G_t} - \frac{C_t\left(\alpha A_t \left(\left(1-\tau\right)G_t + \tau\theta C_t\right) K_t^{\alpha-1} N_t^{1-\alpha} - \left(\rho+\delta\right)G_t\right)}{G_t^{\,2}}$$

$$a_3 = \frac{\alpha C_t A_t \left(\left(1-\tau\right)G_t + \tau\theta C_t\right) K_t^{\alpha-1} \left(\alpha-1\right) N_t^{1-\alpha}}{K_t G_t}$$

$$a_4 = \frac{\alpha\left(1-\tau\right) A K^{\alpha} N^{1-\alpha}}{K} - \delta$$

$$a_5 = \frac{\alpha A K^{\alpha} N^{1-\alpha} \tau}{K}$$

which provide

$$Det(J) = a_1 a_4 r^2 - a_1 a_4 r\rho + a_3 r^2 - a_3 r\rho, \tag{10}$$

$$Tr(J) = a_1 + a_4 - \rho + 2r. \tag{11}$$

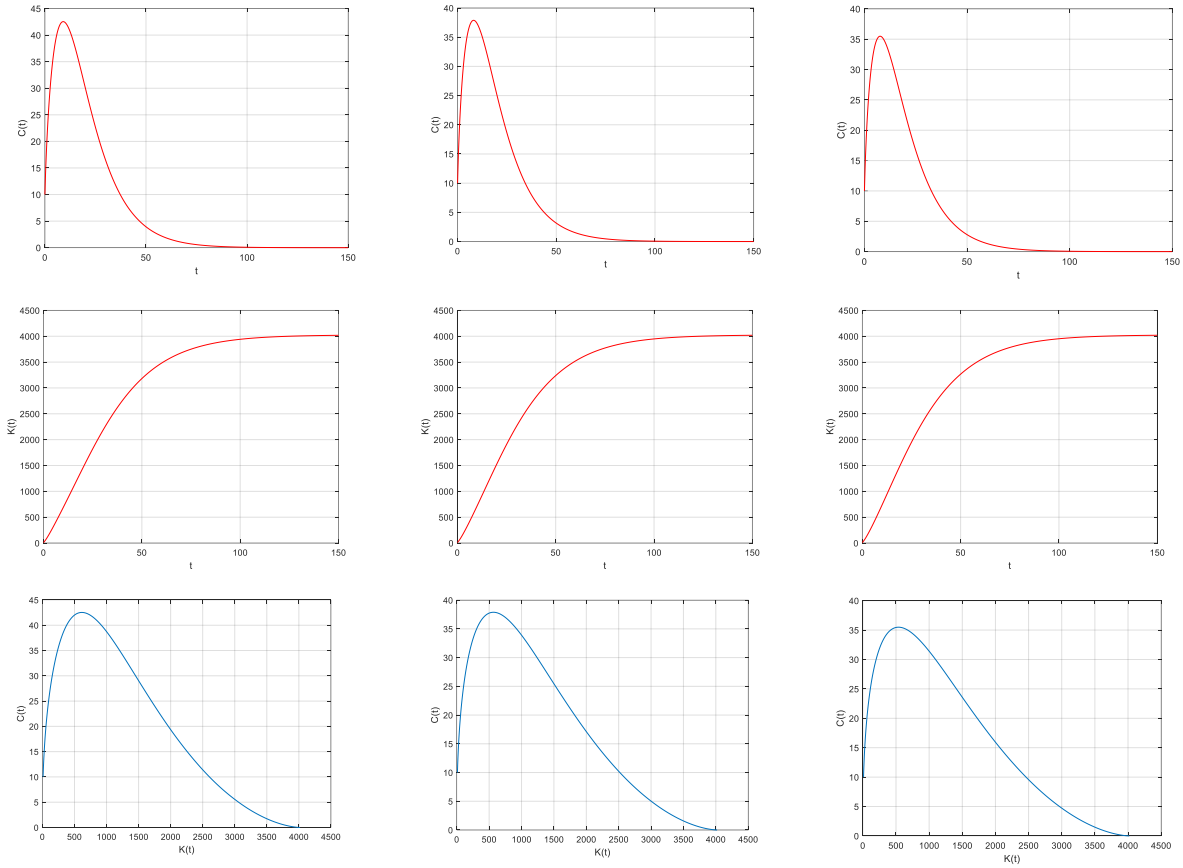
Therefore, in general, the stability of this economy is represented by $Det(J) > 0$, $Tr(J) < 0$, and $Det(J) < Tr^2/4$.

3. Results

This section will investigate the effect of the fiscal policy instruments, i.e., public goods and tax, on consumption, C, and the growth of the economy reflected by the level of capital, K. To visualize their effect, this study defines

$\rho = 0.03$, $\theta = 1$, $\tau = 0.07$, $\alpha = 0.3$, $\delta = 0.07$, and $r = 0.07$. The results from the numerical analysis are presented in Figure 1 and Figure 2.

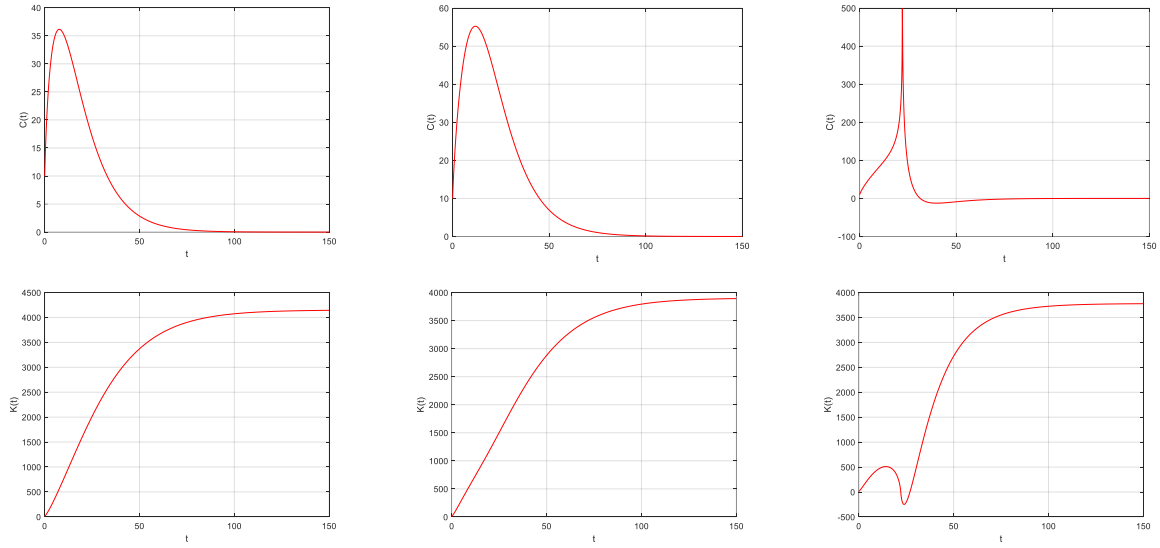
Figure 1. The effect of increased government spending on public goods on consumption and economic growth

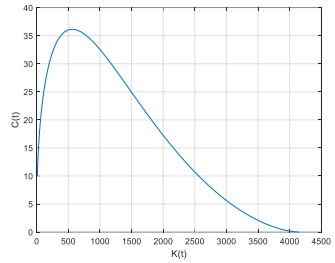


G = 8, τ = 0.07 G = 10, τ = 0.07 G = 12, τ = 0.07

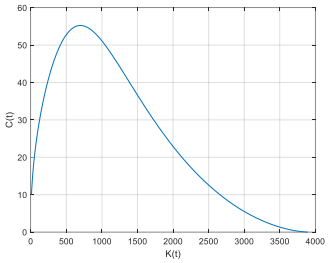
Source: Author's presentation

Figure 2. The effect of tax on consumption and economic growth.

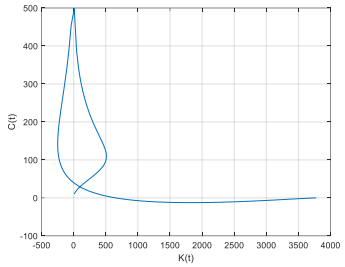




G = 8, τ = 0.05



G = 8, τ = 0.09



G = 8, τ = 0.11

Source: Author's presentation

The illustration in Figure 1 shows that increasing government spending on public goods will decrease private goods consumption while keeping capital unchanged. This implies that when the economy reaches the potential level, encouraging public goods only reduces private consumption without benefit for growth. Figure 2 expresses the scenario of tax increases, which eventually lead to the collapse of private goods consumption and the economy's growth reaching the maximum at a lower level. This implies that when the economy reaches the potential level, the high tax rate will make the economy's growth rely on government action and negatively affect economic growth.

4. Discussion

The results of this study are based on the assumption that public goods can substitute for private goods. Hence, when public goods are offered, they will choose to consume them, which leads to a reduction in private consumption. However, the results may be directed in the opposite direction if the public goods are assumed to be complementary goods.

Refer to the knowledge obtained from the literature section, which implies that public goods, such as infrastructure and education, generate positive externalities that enhance productivity, human capital, and economic well-being (Li *et al.* 2020; Reiss, 2021). These goods improve individual well-being by reducing household costs and increasing access to essential services, which, in turn, influence consumption patterns. However, the results of this simulation study indicate a more complex dynamic. According to the findings, increasing government spending on public goods does not necessarily translate into economic growth; instead, it can reduce private consumption. As shown in Figure 1, higher investment in public goods decreases private consumption without significantly benefiting growth when the economy reaches its potential level. This suggests that, beyond a certain threshold, the provision of public goods may crowd out private goods, reducing overall consumption and limiting its impact on growth. This aligns with existing literature highlighting the challenges associated with public goods provision. The "free-rider" problem and potential conflicts between equity and efficiency may arise, complicating efforts to optimize public goods provision (Holcombe, 1997; Buchholz *et al.* 2018). While public goods create economies of scale and promote societal well-being, their overprovision can distort market dynamics and lower private consumption, especially when poorly managed. Thus, a balanced approach is needed to ensure public goods support rather than hinder economic growth.

Taxation is another crucial fiscal policy component with significant economic performance implications. The literature suggests that the structure and level of taxation directly influence investment decisions, labour supply, and productivity (Stoilova, 2017; Buliková *et al.* 2021). Optimal taxation theory aims to identify tax structures that maximize social welfare while minimizing negative economic impacts (Kaplow, 2008). However, the results from the simulation in this study offer mixed results on the impact of taxation, with high tax rates potentially discouraging savings and investment, thereby limiting long-term economic growth (Stiglitz and Rosengard, 2015). The results of this study reinforce the notion that high tax rates can adversely affect economic growth. As depicted in Figure 2, increased taxation eventually leads to a collapse in private consumption, constraining the economy's growth potential. This finding resonates with previous research highlighting the detrimental effects of excessive taxation on business activity, investment, and overall economic strength (Buliková *et al.* 2021). In particular, as the economy reaches its potential, reliance on government action through high taxation can stifle growth, underscoring the importance of moderate and growth-friendly tax policies. Several studies have shown that different types of taxes have varying impacts on economic growth. For instance, corporate income taxes have positively influenced growth in some contexts, while personal income taxes may have a negative long-term effect (Tala, 2024; Success *et al.* 2024). This study adds to this debate by showing that high tax rates on private goods consumption reduce economic dynamism. The results highlight the need for

tax reforms that foster innovation, entrepreneurship, and investment, aligning with recommendations for more efficient taxation policies seen in both developed and developing economies (Wang, 2024; Mukoki *et al*. 2024).

5. Policy Implications

Based on the findings that increasing government spending on public goods can lead to a decrease in private goods consumption without significant benefits for economic growth and that high tax rates could potentially hinder economic growth by overly relying on government intervention, the following policy recommendations and implementations can be suggested. 1) Rather than solely focusing on increasing government spending on public goods, policymakers should aim for a balanced approach. This involves carefully evaluating the allocation of public funds to ensure optimal investment in public goods while minimizing negative impacts on private consumption. Prioritizing essential public goods with high social returns and efficiency can be beneficial. 2) Implement measures to enhance the efficiency and effectiveness of public spending. This includes regularly evaluating public projects to ensure they deliver value for money and contribute positively to economic growth. 3) Instead of high tax rates, focus on implementing tax reforms to foster economic growth. This could involve reducing tax burdens on individuals and businesses, especially those that hinder investment, innovation, and entrepreneurship.

6. Future Research

Based on the findings of this research, there are several potential avenues for future research in the domain of the effect of public goods and taxation on economic growth. Some suggestions for future research are as follows. Future research may explore dynamic economic models that capture the interplay between public goods provision, taxation policies, and economic growth over time. This could involve incorporating technological change, demographic shifts, and policy responses into the model better to understand the long-term implications of different policy interventions. In addition, they may try to investigate the behavioural aspects of how individuals and firms respond to changes in taxation and public goods provision. This could include examining factors such as consumer preferences, saving behaviour, investment decisions, and responses to government policies to enhance the realism of economic models.

Conclusion

This study examines the effect of fiscal policy, specifically government spending on public goods and taxation policies, on economic growth. Through an economic model constructed within the optimal control framework, the research aimed to estimate the potential impacts of these fiscal policy instruments on consumption and the economy's growth while also analyzing the stability conditions of the proposed model and conducting numerical experiments to elucidate its implications further. The methodology employed in this study integrated taxation policies into the social constraint and incorporated public goods into the social utility function within the optimal control framework. This framework allowed for the examination of how changes in government spending on public goods and tax policies influence private consumption and economic growth. The numerical analysis revealed significant insights into the dynamics between fiscal policy instruments and economic outcomes. The simulation results demonstrated that increasing government spending on public goods could decrease private goods consumption without significant benefits for economic growth. Conversely, high tax rates could potentially hinder economic growth by overly relying on government intervention, leading to a collapse in private goods consumption and limiting the growth of the economy. These findings highlight the importance of a balanced approach to fiscal policy, wherein policymakers carefully evaluate the allocation of public funds to ensure optimal investment in public goods while minimizing negative impacts on private consumption. Enhancing the efficiency and effectiveness of public spending, implementing tax reforms aimed at fostering economic growth, and encouraging private sector participation are recommended strategies.

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Credit Authorship Contribution Statement

Adirek Vajrapatkul: Contributions: Conceptualization, Methodology, Investigation, Formal analysis, Writing, original draft, editing, and Supervision.
Pinmanee Vajrapatkul: Contributions: Software, Data Curation, Visualization, Writing, Review, and Editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Declaration of Use of Generative AI and AI-Assisted Technologies

The authors declare that they have not used generative AI and AI-assisted technologies during the preparation of this work.

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Financial Factors and Beyond: A Survey of Credit Risk Assessment for VSBs by Moroccan Banks

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Abstract: This article analyzes the extent to which Moroccan banks adopt a holistic approach to credit risk assessment, incorporating criteria that go beyond simple balance sheets and financial ratios. To this end, Multiple Correspondence Analysis and advanced statistical techniques were employed using R software. A detailed questionnaire comprising 14 questions, was distributed to a sample of Moroccan bankers. The results of this analysis reliably confirm our initial hypotheses. They reveal a growing trend among Moroccan banks towards a more complex and nuanced assessment of credit risk. In addition to traditional financial aspects such as financial statement analysis, banks are increasingly considering non-financial criteria such as collateral requirements, quality of corporate governance, sustainability of business practices, and technological positioning. This diversified approach gives banks a more accurate and comprehensive view of a company's risk profile. It also enables them to make better-informed and more balanced lending decisions, considering the multitude of factors that can influence a company's ability to repay.

Keywords: credit risk management; very small businesses; statistical analysis.

JEL Classification: C52; G21; G32; C10.

Introduction

The heart of banking lies in its role as a financial intermediary, acting between those who have funds and those who need them. This function, according to the theory of financial intermediation, implies that banks play a specialized supervisory role, delegated by lenders to guarantee the proper management of the credits granted (Diamond 1984, 1991).

However, this function is not without risk. Banks are exposed to a wide range of risks, from financial to operational and business risks (Greuning and Bratanovic, 2004). Among these, credit risk, considered the main risk for a bank, arises when borrowers fail to meet their repayment obligations, leading to an increase in bad debts (Godlewski, 2005; Louzis *et al.* 2012).

According to the Bank for International Settlements (2011), credit risk lies in the fact that the counterparty may not fulfill its obligations in accordance with the agreed contractual terms. A financial asset is considered unpaid when a counterparty has failed to make the payment due on the contractual due date. In the same vein, Bank Al-Maghrib (2023) has defined credit risk as the risk incurred in the event of a counterparty default, *i.e.*, the borrower's inability to repay its debts and honor its commitments to the banking institution.

The banking sector is deeply regulated and often considered a barometer of the economy as a whole (Sumna, P. 2013). In order to prevent crises, regulatory authorities, such as the Basel Committee, have put in place arrangements to strengthen the financial stability of banks, notably by imposing capital requirements and prudential supervision standards (Pierandrei, L. 2015).

In the Moroccan context, non-performing-loans in Morocco have reached 88.8 billion of dirhams. Additionally, Business failures in Morocco have risen by 15% in 2023. Most of these failures are among Very Small Businesses (VSBs), which account for 98.7% of the total.

Faced with rising levels of non-performing loans and business failures, our article aims to answer the following question: How do Moroccan banks integrate non-financial factors, such as sustainability, governance, technology and market positioning, into their assessment processes to refine their credit risk management? In other words, can credit risk assessment based solely on financial data be considered sufficient to assess the solvency of Moroccan VSBs, or do Moroccan banks need to adopt a more complementary approach that includes non-financial data as well?

This questioning raises the hypothesis that, faced with the inadequacy of financial information alone for a complete risk assessment, banks need to extend their analysis to additional dimensions to improve their prediction of the future performance and repayment capacity of VSBs. The aim is to examine the extent to which Moroccan banks adopt a holistic approach to credit risk assessment, incorporating criteria beyond balance sheets and financial ratios, and to identify the main non-financial factors taken into account in their decision-making process.

To answer our research question, we adopt a methodology based on a questionnaire distributed to 44 corporate relationship managers in the Fez-Meknes region. To analyze the data collected, we use Multiple Correspondence Analysis (MCA) and advanced statistical tests, such as the G6 coefficient (SMC) and the RMSR.

The choice of the Fez-Meknes region is justified by its unique characteristics. According to the HCP (2018), among the twelve Moroccan regions, it ranks second with a contribution of 14.5% in the primary sector. This region is also characterized by a high concentration of VSBs operating in the construction sector (HCP, 2019). Construction and trade are the two sectors most affected by business failure in Morocco (Inforisk, 2024).

The novelty of this article is twofold. Firstly, to the best of our knowledge, this is the first study to take a holistic approach to credit risk in the Fez-Meknes region. Secondly, our scientific article highlights the importance of non-financial data in the assessment of VSBs credit risk by Moroccan banks.

To explore this issue further, our research is divided into two parts. The first is a literature review and methodology. The second part presents an in-depth case study. It aims to address our problem and gain a better understanding of credit risk assessment for VSBs by identifying the key factors that predict this specific risk.

1. Literature Review

Over the past few decades, numerous scientific studies have assessed the credit risk of banks. Commercial banks generate income by distributing credit to their customers. Nevertheless, this credit-granting activity involves credit risk when borrowers fail to meet their commitments to creditor banks (Accornero *et al.* 2018).

The inability of banks to accurately assess credit risk and predict financial distress can have detrimental effects on the financial system in particular and on economic activity in general. As a result, the assessment of credit risk and the prediction of financial distress before it occurs are considered major global challenges in the world of finance. Several articles have pointed out that excessive credit growth combined with poor risk management are the main causes of global financial crises (Chaplinska, 2012; Mileris, 2012).

To assess credit risk, operating and investment credit analysts consider the company's situation. Credit risk is generally assessed based on financial ratios. However, it is necessary to supplement this assessment with additional data such as the company's age, size, competition, and sector of activity (Alfaro *et al.* 2008; Ali *et al.* 2023). By using ordered probit analysis in cross-sectional and panel data, Gupta (2023) showed that size has the most significant influence on the credit ratings of Indian firms.

In the literature on predicting financial distress, financial ratios derived from the financial records of borrowing companies are most often used to predict credit risk using predictive models developed by researchers

(Altman, 1968; Beaver, 1966; Mehmood and De Luca, 2023; Khemakhem and Boujelbene, 2018; Zizi *et al.* 2020, 2021).

Siddique *et al.* (2021)used panel data from 19 commercial banks in India and Pakistan between 2009 and 2018 to assess the impact of credit risk management by including non-performing loans and the capital adequacy ratio, along with the bank-specific factors. The results of the study showed that the capital adequacy ratio (CAR) has a positive impact on the financial performance of South Asian commercial banks, while non-performing loans (NPLs) have negatively affect this performance.

Several studies have identified that high levels of non-performing loans indicate potential weaknesses in risk management and lending practices, thereby impacting financial indicators and overall financial stability (Cucinelli *et al.* 2018; Partovi and Matousek, 2019; Tarchouna *et al.* 2017). In addition, other studies have highlighted the importance of diversifying banking portfolios, as diversification spreads the risks incurred by banks over various assets (Naili and Lahrichi, 2022; Rossi *et al.* 2009; Zhou, 2014).

Ghanem (2016) employed a cross-national Basel II adoption database to examine the impact of capital ratios (the loan-to-assets ratio, banks' total assets, government securities holding, and equity) across five MENA countries (Morocco, Tunisia, Egypt, Jordan, and Lebanon) from 1997 to 2013. The results confirmed an increase in bank loans and assets following the introduction of capital regulations, particularly higher capital adequacy ratios.

On the other hand, the risk management literature has emphasized the usefulness of including non-financial variables, such as sector of activity and company age, in combination with financial ratios. Based on these variables, several business failure prediction models have been developed (Altman *et al.* 2008).

Altman *et al.* (2008) developed default prediction models for UK SMEs, including more than 5.8 million SMEs over the period of 2000-2007. The results reveal that firm-specific characteristics, company filing histories, and comprehensive audit report/opinion data significantly enhance the default prediction power of risk models developed for SMES. In Tunisia, Khemakhem and Boujelbene (2018) combined financial ratios with non-financial factors in a sample of 480 companies from 2011 to 2012. The findings demonstrated that guarantees, the duration of credit report, ownership structure, and corporate banking relationship duration are important in evaluating credit risk. Bhatt *et al.* (2023) revealed that market risk analysis significantly affects credit risk management in Nepal.

Du *et al.* (2021) aimed to determine the level of credit risk on the internet for early warning assessment using the BP neural network algorithm on a sample from 90 companies over a five-year period. The trained model consists of the input's variables, namely non-financial index, enterprise profitability index, enterprise operating capability index, and enterprise-scale potential index. The accuracy rate of the trained model can reach 97%.

Using Chinese commercial bank data from 2008 to 2017, Chen and Tsai (2020) explored how credit risk is affected by banking FinTech. The results indicated that banking FinTechs significantly reduce credit risk among commercial banks in China. However, further analysis showed that the negative impact of banking FinTechs on credit risk is moderately low among state-owned banks, large banks, and listed banks.

Finally, Donovan *et al.* (2021) analyzed qualitative information from disclosed in conference calls and the management's discussion and analysis (MDandA) section of the 10-K filings. The researchers gathered a sample of these fillings and transcripts spanning from 2002 to 2016. The machine learning methods employed identified significant key categories in predicting credit events and assessing credit risk, particularly industry-specific information, firm performance, and liquidity debt.

2. Methodology

To gain a rigorous understanding of banks' assessment of credit risk, our methodology is sructured and systematic. This section details the methods used to collect and analyze the data, illustrating the rigor and precision of our approach.

The survey was carried out using a designed questionnaire consisting of 14-targeted questions. These questions aim to explore banking practices in credit risk assessment. Each question was formulated to induce responses that reveal the nuances and complexities of the assessment strategies used in the banking sector.

Our study population consists of 44 corporate relations managers[15], each offering a unique and informed perspective on credit risk assessment practices. The sample was selected to reflect the diversity of strategies

[15] Our sample is made up of corporate relations managers in the Fez-Meknes region. Corporate relations managers are responsible for managing portfolios of SMEs, including VSBs.

within the banking community, and each participant was chosen for their knowledge and experience in the credit field.

Regarding the selected measurement variables, the items chosen for this study are mainly qualitative, with a variety of response modalities that capture the breadth of evaluative practices. These variables include, but are not limited to, balance sheet analysis, cash flow assessment, collateral review, and the incorporation of qualitative criteria such as entrepreneurial competence. The qualitative nature of the data enabled us to grasp the complexity of credit risk decision-making processes.

Table 1. Summary of selected variables

	Variables	Meanings
Evaluation based on traditional financial data	H3_UB	Use of balance sheets
	H3_AFT	Cash flow analysis
	H3_DH	Impact of historical financial data
	H3_IPP	The importance of past financial performance
	H3_IPF	The importance of financial planning and forecasting
	H3_IRF	The importance of financial ratios
Integration of non-financial factors	H3_CIM	Consideration of market information
	H3_IINF	The importance of non-financial information (sustainability, governance)
	H3_ISC	The importance of capital structure
	H3_ITI	Integration of information technologies
Complementary approaches and collateral requirements	H3_RCE	External credit reporting
	H3_TES	Application of solvency assessment techniques
	H3_EGR	Consideration of real collateral requirements even in the presence of positive financial performance
	H3_CEG	Comparison of guarantee policies applied to Very Small Businesses (VSB), Small and Medium Enterprises (SME) and Large Enterprises (LE)

Source: Compiled by the author

To analyze the data, we employ advanced statistical techniques using R software, recognized for its power and flexibility in statistical processing. We used Multiple Correspondence Analysis (MCA) to explore associations between qualitative variables. Additionally, advanced statistical tests such as Cronbach's alpha, the G6 coefficient (SMC), and the RMSR measure are used to assess the reliability and internal consistency of the data. The chi-square test is employed to determine the significance of observed relationships.

Together, these methods enabled us to identify precise outputs and confirm the research hypotheses with a high degree of reliability. The results obtained offer a significant contribution to the existing literature and can guide banks in optimizing their credit risk assessment strategies.

3. Results and Discussion

Based on our cleaned and structured[16] database, we then turned to the reliability analysis of the collected data. The importance of this step cannot be underestimated, as it aims to verify the internal consistency of our questionnaire items, which is essential to ensure the validity of our conclusions. To do this, we used Cronbach's alpha coefficient, a classic indicator of reliability introduced by Lee Cronbach in 1951. This index enables us to assess the extent to which a set of items measures the same concept or dimension, thus providing an estimate of the reliability of the scale used.

[16] Before delving into the heart of our reliability analysis, it is essential to acknowledge the rigorous statistical groundwork that was undertaken to prepare our database. This initial process included the meticulous cleaning of the collected base, ensuring the elimination of outliers and missing values, as well as the proper coding of quantitative data, in line with best practices in data management using R software. This preparatory work is fundamental, as it establishes the solidity of our analytical foundation, enabling reliable and accurate subsequent analyses.

Table 2. Summary of significant results

Statistic	Value
Alpha de Cronbach (Raw_Alpha)	0.25
Alpha de Cronbach standardisé	0.76
G6 (SMC)	0.84
Corrélation moyenne (Average_R)	0.19
Signal sur bruit (S/N)	3.2
Erreur standard (ASE)	0.067
Écart-type (SD)	1
Médiane de la corrélation (Median_R)	0.21

Source: Compiled by the author

Our statistical investigation of the reliability of the data collected to study banks' assessment of credit risk highlights internal consistency, which, upon closer examination, reveals promising aspects of instrumental precision. Initially, Cronbach's alpha for our raw scale stands at a modest 0.25, suggesting moderate initial consistency within the sample. However, a more favorable picture emerges when we consider the standardized Cronbach's alpha, which rises to 0.76. This value, well above the threshold of 0.7[17], reflects reliable internal consistency after standardization, attesting to the robustness of the survey items when assessed on a common ground[18].

The G6 coefficient (SMC) of 0.84 confirms the reliability of our instruments, revealing significant convergence in the answers provided by respondents. This convergence is crucial, as it indicates that our items do indeed capture a shared essence of the concept under study. Despite this, the average correlation between items is 0.19, a value that warrants further analysis. Although this correlation may seem modest, it nevertheless reflects significant overall consistency, suggesting that the items are significantly interconnected, even though they may measure slightly divergent facets of our central concept.

The real strength of our assessment lies in the signal-to-noise ratio of 3.2, which underlines that the observed variance is mainly due to real differences rather than random variations, thus reinforcing the quality of our collected data. The accuracy of the reliability estimate is corroborated by a low alpha standard error (0.067), guaranteeing the stability of our results across the sample examined.

Having examined the reliability of the data, the next step is to explore the relationships between selected variables to confirm the hypotheses of our research on banks' assessment of credit risk among VSBs in Morocco. Validating reliability strengthens our confidence in future analyses, which will use advanced statistical methods to investigate banks' assessment practices and the effectiveness of these methods for VSBs. We aim to understand the impact of non-financial factors on credit decisions and offer recommendations for optimizing credit risk assessment in a complex economic context, emphasizing the importance of a more holistic approach.

3.1. Valuation Based on Traditional Financial Data

Here, we focus on a confirmatory factor analysis of responses[19] related to the use of traditional financial assessment methods by banks. Our aim is to determine whether the assessment of credit risk by these institutions is based primarily on financial information. Specific variables examined include the use of balance sheets (H3_UB), cash flow analysis (H3_AFT), the impact of historical financial data (H3_DH), the importance of

[17] Interpretation:
- Alpha > 0.9: Excellent reliability.
- Alpha > 0.8: Good reliability.
- Alpha > 0.7: Acceptable reliability in most situations.
- Alpha < 0.7: Questionable item consistency.

[18] This value is considered acceptable and even good for studies in the social sciences, testifying to a reliable measure (Kuh, G. D., & Whitt, E. J. 1988). Furthermore, the difference between raw and standardized alpha suggests that standardizing items (e.g., bringing them all to the same scale) considerably improves the internal consistency of the scale, which could be due to variations in response scales or in the dispersion of responses between items.

[19] Confirmatory analysis, an advanced statistical method used to test whether a set of variables adheres to a certain hypothetical structure, is particularly well-suited to examining the complex relationships between these financial variables and their contributions to credit risk assessment. This technique enables us to confirm the validity of our research hypotheses and provide a solid basis for accurate and reliable conclusions (Jöreskog, K. G. 1969).

past financial performance (H3_IPP), the importance of financial planning and forecasting (H3_IPF), and the importance of financial ratios (H3_IRF).

Table 3. Results summary table

Tranche	Chargement sur Facteur 1 (MR1)	Chargement sur Facteur 2 (MR2)	Communauté (h2)	Unicité (u2)	Complexité
H3_UB	0.42	0.23	0.23	0.77	1.5
H3_AFT	0.64	-0.28	0.49	0.51	1.4
H3_DH	0.35	-0.24	0.18	0.82	1.8
H3_IPP	0.72	-0.27	0.59	0.41	1.3
H3_IPF	0.58	0.09	0.35	0.65	1.0
H3_IRF	0.51	0.61	0.63	0.37	1.9

Source: Compiled by the author, R

Turning to factor loadings, it is clear that the variables H3_IPP (Importance of past financial performance) and H3_IPF (Importance of financial planning and forecasting) show the strongest loadings on Factor 1 (MR1), indicating a strong association with what could be interpreted as key aspects of traditional financial assessment. Factor 2 (MR2) is strongly associated with H3_IRF (Importance of financial ratios), suggesting a distinct dimension in credit risk assessment.

As for communality and uniqueness, communality scores (h2) vary, indicating that some variables are better explained by the extracted factors than others. For example, H3_IRF has a high communality score (0.63), suggesting that this variable is well represented by the factors. The high uniqueness (u2) of some variables, such as H3_DH (0.82), suggests that these variables have features not captured by the two factors[20].

Factor analysis has highlighted two main dimensions in the credit risk assessment methods used by banks for Very Small Enterprises (VSBs). On the one hand, the emphasis on past financial performance and financial planning reveals a traditional component of financial assessment. This observation corroborates the work of Berger and Udell (2006), who discussed the importance of historical financial information in access to credit for small businesses.

On the other hand, the significant valuation of financial ratios underlines an analytical approach that goes beyond the simple consideration of raw financial data. This finding is in line with the studies of Altman (1968), notably his model for predicting business failures, which illustrates the usefulness of financial ratios in assessing credit risk.

The duality of these dimensions reflects the complexity and sophistication of credit risk assessment processes, a thesis supported by the research of Frame, Srinivasan, and Woosley (2001), who examined the impact of information technology on credit risk assessment methods for small businesses. These authors highlighted the emergence of innovative assessment techniques, complementing traditional methods.

Our results encourage banks to adopt an integrated approach to credit risk assessment for VSBs, recognizing the value of traditional financial data while exploring the benefits of complementary indicators, such as financial ratios. This conclusion is in line with the recommendations of DeYoung, Glennon, and Nigro (2008), who stressed the importance of accurate risk assessment for the financial stability and access to finance of small businesses.

3.2. Integration of Non-Financial Factors

Confirmatory Factor Analysis (CFA) explored the importance and integration of non-financial factors in banks' assessment of credit risk. This process highlighted how banks consider aspects beyond simple financial data, such as the consideration of market information (H3_CIM), the importance of non-financial information (sustainability, governance) (H3_IINF), the importance of capital structure (H3_ISC), and the integration of information technology (H3_ITI). The results obtained align and enrich our understanding of these dynamics, offering valuable insights into current practices in the banking sector.

[20] In addition, reliability indices such as the Tucker Lewis Index (1.239) and RMSEA (0 with a 90% confidence interval of 0 to 0.184) indicate a good model fit. The Fit based upon off-diagonal values of 0.98 reinforces this interpretation.

Table 4. Summary of AFC results

Indicator	Quality of fit Value	Interpretation
Test statistique (Chi-square)	0.170	Indicates a very good fit of the model to the data.
P-value (Chi-square)	0.919	A value greater than 0.05 suggests a good model fit.
Comparative Fit Index (CFI)	1.000	Perfect fit; values close to 1 indicate a good fit.
Tucker-Lewis Index (TLI)	1.608	Unusually high value: in general, values > 0.95 indicate a good fit.
RMSEA	0.000	The mean square error of the approximation is very low, indicating a good fit. Confidence intervals support this conclusion.
SRMR	0.017	The standardized mean square deviation of the residuals is very low, indicating a good fit.
Variable	**Factor loadings** **Factorial loading**	**P-value** **Interpretation**
H3_CIM	0.205	0.016 Statistically significant, but low contribution to factor.
H3_IINF	0.719	0.002 Strong contribution to the factor and statistically significant.
H3_ISC	0.391	0.008 Moderate contribution and statistically significant.
H3_ITI	-0.017	0.945 Not significant and negligible/negative contribution to the factor.
Variable	**Variance factor loadings** **Estimate**	**P-value** **Interpretation**
H3_CIM	0.151	0.000 Significant variance explained by the model.
H3_IINF	0.338	0.244 Not significant, suggesting less well explained variance.
H3_ISC	0.362	0.002 Significant variance explained by the model.
H3_ITI	1.800	0.000 Significant variance, but negative/non-significant load raises questions.

Source: Compiled by the author, R

Statistically, indicators of model fit, such as the Chi-square statistical test (0.170) with a P-value of 0.919, the Comparative Fit Index (CFI) of 1,000, and the unusually high Tucker-Lewis Index (TLI) of 1,608, reveal an exceptional fit of the model to the data. These outputs suggest that the proposed model faithfully captures the relationships between observed variables. In addition, measures such as RMSEA (0.000) and SRMR (0.017) confirm the goodness of fit, indicating that the model is well specified.

Furthermore, the factor loadings of each variable on the latent factor "Non-Financial Factors" reveal varying degrees of contribution. In particular, H3_IINF shows a strong contribution and statistical significance, underlining the importance of non-financial information in credit risk assessment. H3_ISC also offers a moderate and significant contribution, highlighting the role of capital structure. On the other hand, H3_CIM shows a weaker, albeit statistically significant, contribution, and H3_ITI appears to have a negligible and insignificant contribution.

The results confirm the sub-hypothesis that banks consider a range of non-financial information when assessing credit risk. The strong association of H3_IINF with the latent factor underlines the emergence of a sophisticated approach to risk assessment, aligned with the findings of researchers such as Levine (2005), who noted the growing importance of non-financial factors in financial decision-making. Similarly, H3_ISC's significant contribution recalls the work of Modigliani and Miller (1958) on capital structure, reaffirming the importance of companies' internal financial structures in risk assessment.

In the same vein, the less pronounced impact of H3_CIM and the negative/non-significant contribution of H3_ITI invite further reflection. This might suggest that, despite recognition of their potential, the way in which market information and information technologies are integrated into risk assessment processes requires more

detailed exploration. These observations are in line with Bharadwaj *et al.* (2007) recommendations on the strategic role of IT in risk management.

The analysis confirms the growing importance of non-financial factors in banks' assessment of credit risk. It underlines an evolution towards more nuanced assessment practices, integrating a diversity of information beyond financial data alone. The results invite financial institutions to continue exploring and integrating these non-financial dimensions to refine their credit risk assessment methods, in line with modern trends in sustainable and responsible finance.

3.3. Complementary Approaches and Warranty Requirements

In the third sub-hypothesis that orchestrates our exploration, we look at the nuances of banking approaches to collateral requirements and the use of specific methods for assessing creditworthiness. This exploration aims to unveil a richer and more diversified perspective on how banks apprehend and manage credit risk. Specifically, we examine the influence of external credit reports (H3_RCE), the application of creditworthiness assessment techniques (H3_TES), the consideration of real collateral requirements even in the presence of positive financial performance (H3_EGR), and finally, the comparison of collateral policies applied to Very Small Enterprises (VSBs), Small and Medium Enterprises (SMEs) and Large Enterprises (GEs) (H3_CEG). In doing so, we hope to offer an insight into the concise and nuanced approach adopted by banks in their risk assessment, revealing the importance attached to factors that go beyond simple financial measures.

Table 5. Quality of results adjustment

Indicator	Value	Interpretation
Test statistique (Chi-square)	1.669	Indicates a good fit of the model to the data, suggesting that the specified model is appropriate.
P-value (Chi-square)	0.434	A value greater than 0.05 confirms adequate model fit.
Comparative Fit Index (CFI)	1.000	A perfect fit, indicating a very good model fit.
Tucker-Lewis Index (TLI)	2.357	An unusually high value: generally, values above 0.95 indicate a good fit. This high value requires re-evaluation to understand its significance in this context.
RMSEA	0.000 (90% CI: 0.000 - 0.286)	The mean square error of the approximation is very low, indicating a good fit. However, the wide confidence interval suggests that this estimate should be treated with caution.
SRMR	0.059	The standardized mean square deviation of the residuals is low, indicating a good model fit.

Source: Compiled by the author, R

Factor loadings for observed variables on the latent factor "Approches_Complementaires" are relatively low and insignificant for H3_RCE, H3_TES, H3_EGR, and H3_CEG, suggesting that these variables make a limited contribution to the construction of the latent factor based on current data. The variable H3_CEG (Comparison of collateral requirements between VSBs, SMEs, and GEs) shows the highest loading, although it is not statistically significant.

Table 6. Combined summary table of factor[21] loadings and variances

Variable	Factorial loading	P-value	Estimate of Variance	P-value of Variance
H3_RCE	0.088	0.335	0.112	< 0.001
H3_TES	0.295	0.760	25.705	< 0.001
H3_EGR	0.292	0.300	0.715	0.001
H3_CEG	0.556	0.247	0.168	0.750

Source: Compiled by the author, R

The integration of non-financial factors and collateral requirements in the assessment of credit risk illustrates a complex and nuanced approach by banks. The results of the Confirmatory Factor Analysis (CFA) suggest a varied interaction between the variables considered, reflecting distinct degrees of association with the

[21] It is important to note that the lack of statistical significance for some loadings may reflect limitations in sample size, variability in responses, or nuances in how these variables are measured or perceived by respondents.

latent factor "Approches_Complementaires". Although the factor loadings indicate a limited association between these variables and the latent factor, the significant variance for some variables underlines the importance of considering the diversity of responses. These observations offer an important perspective on banks' multifaceted approach to credit risk assessment, in line with existing studies in the field.

The moderate factor loading of H3_EGR (Requirement of real collateral despite positive financial performance) with significant variance suggests a recognition of the importance of collateral in risk assessment, in line with the findings of Berger and Frame (2006), who found that collateral plays a determinant role in lending decisions, especially for new businesses or those with less established credit histories.

The significance of the variance for H3_TES (Techniques for assessing creditworthiness), although the factor loading is low, could reflect the complexity and diversity of the techniques used by banks, echoing Altman's (1968) analysis of bankruptcy prediction models and recognition of the usefulness of financial ratios in assessing credit risk.

The comparison of collateral requirements between VSBs, SMEs, and GEs (H3_CEG) with the highest factor loading suggests a differentiation in risk management strategies according to company size, aligned with the observations of DeYoung, Glennon, and Nigro (2008), who highlighted how banks adjust their lending criteria according to company size and perceived risk.

As for the high variance observed for H3_TES (Solvency assessment techniques), this suggests an inherent complexity and considerable diversification in the approaches adopted by banks to assess solvency. This complexity is reflected in the range of answers given by respondents, which include not only assessments of financial statements, such as balance sheets and income statements, but also a forward-looking appraisal of future cash flows. In addition, the responses highlight the inclusion of procedures such as field surveys - company visits and interviews - which provide essential qualitative insights into a company's management and operational potential.

Credit scoring based on statistical models, also cited by respondents, aligns with the foundations laid by Altman, who argued for the integration of multiple financial and non-financial variables into predictive models. The emphasis on qualitative criteria, such as company size, loan purpose, industry and entrepreneurial competence, reflects a contemporary tendency to recognize factors that go beyond traditional financial measures in risk assessment.

This nuance and depth in assessment techniques, as reported by respondents, points to an evolving risk assessment landscape. This is in line with the observations of researchers such as Berger and Udell (2006), who found that the combination of qualitative and quantitative methods leads to a more accurate and comprehensive assessment of credit risk and suggests a growing recognition of the need to adapt assessment methods to meet the complex realities of the modern financial landscape.

The statistical significance of the variance for H3_TES, despite its relatively low factor loading, therefore testifies to the wide range and relevance of the different valuation techniques used. It underlines the importance of a multidimensional assessment that integrates both robust financial data and qualitative evaluations for a comprehensive assessment of credit risk.

In summary, although the CFA indicates a good overall fit of the model, the analysis reveals that the specific contributions of the variables considered in the complementary approach to credit risk assessment require more careful consideration. These various assessment techniques reflect a recognition by banks of the complexity of credit risk assessment and the need to adopt a multifactorial approach. Research by Altman (1968) highlighted the importance of financial information in predicting bankruptcy, while Berger and Udell (2006) highlighted the value of qualitative information and relationships in risk assessment. Modern assessment methods, such as credit scoring, are based on work such as that of Poon (2009), who examined scoring methods and their application in different lending contexts.

3.4. Integrated Banking Strategies: A Multidimensional Analysis of Credit Risk

The growing complexity of the financial landscape has led banking institutions to seek credit risk assessment methods that transcend traditional approaches. The current trend is towards an integrated strategy that encompasses not only financial indicators but also a multitude of non-financial factors. These diversified strategies, considering variables such as financial statement analysis, the impact of historical data, and even collateral requirements, offer a more sophisticated view of a company's risk profile.

To examine the effectiveness of these integrated strategies, Principal Component Analysis (PCA) can be used to reveal hidden patterns in the data, making it easier to understand the complex relationships between various risk indicators. This dimension reduction technique is particularly well-suited to identifying and interpreting

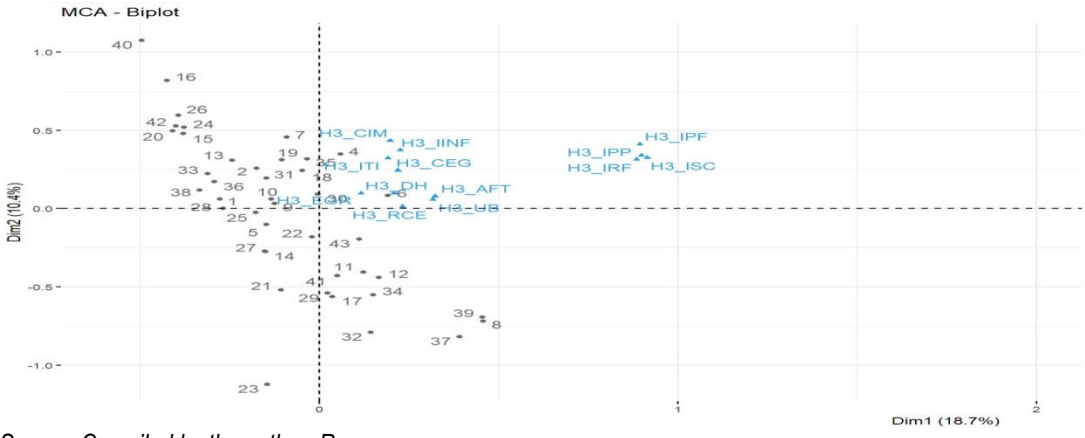
the underlying factors that influence lending decisions (Jolliffe, 2002). It allows us to determine whether a banking strategy that combines a multitude of variables can actually produce different and potentially more insightful results than those obtained by separate analyses (Abdi and Williams, 2010).

By analyzing a set of variables representative of credit risk assessment practices - ranging from market and non-financial information to collateral requirements - we can unveil whether banking strategies are truly multifaceted and whether they can be optimized for better risk prediction and management. The aim is to answer the question: can banks refine their risk assessment methods by integrating various measures into a unified approach, and how effective is this integration?

The Multiple Correspondence Analysis (MCA) we have carried out reveals some fascinating insights into bank strategy in credit risk assessment. The biplot obtained from our Multiple Correspondence Analysis (MCA) illustrates the relationships between the different variables used to assess credit risk by bankers. On the horizontal axis (Dim1, representing 18.7% of the variance), and on the vertical axis (Dim2, representing 14.6% of the variance), we observe how the variables and individuals (bankers) position themselves in relation to each other:

- The variables H3_IPF, H3_IPP, H3_IRF and H3_ISC are grouped together in the upper right quadrant, indicating that they are positively correlated with each other on these two dimensions.
- H3_UB, H3_AFT, H3_DH and H3_RCE appear to be located in the center, suggesting that they are less distinctive in relation to the two main dimensions of variance captured by the ACM…
- H3_CEG, H3_IINF, and H3_ITI are further apart on the horizontal axis but close to the center on the vertical axis, which might indicate that they are viewed differently along the first dimension but do not have a strong unique distinction along the second dimension.
- H3_CIM is a little more isolated on the left-hand side, suggesting that it represents a different facet of credit risk assessment from the other variables.

Figure 1. Biplot diagram. Multidimensional visualization of credit risk assessment strategies



Source: Compiled by the author, R

The centrality of variables such as balance sheet analysis and assessment of future cash flows indicates adherence to proven risk management methods, in line with the findings of Berger and Udell (2006), who identified solvency and liquidity as pillars of credit risk assessment. The variables at the center of the biplot suggest that these criteria are an integral part of standard risk assessment practices and are widely adopted by banks.

On the other hand, the move away from variables such as the integration of market information (H3_CIM) and the importance given to non-financial information (H3_IINF) on the horizontal axis suggests a growing recognition of the impact of external factors on risk assessments. This is consistent with the work of researchers such as Boot and Thakor (1994), who have highlighted the importance of contextual and environmental information in understanding financial risk.

The most striking strategy highlighted by our analysis is the emphasis placed on a detailed analysis of internal financial performance, while taking into account market information and governance. This observation is in line with the perspective of Boot, A. W. A., and Thakor, A. V. (2000), who suggest that effective credit risk assessment requires a combination of internal measures and external insights.

In practice, this analysis recommends that bankers adopt a balanced approach that integrates both robust financial data and qualitative assessments for comprehensive credit risk management. By doing so, financial

institutions can improve their competitiveness and efficiency, in line with Rajan and Zingales (1995) recommendations on the importance of innovation in financial management.

Overall, the ACM highlights the diversity of credit risk assessment practices and indicates areas where strategies could be refined for more accurate risk prediction. Banks are advised to continue integrating multidimensional approaches to remain competitive and efficient in credit risk management.

Conclusions and Further Research

In conclusion, credit risk models have evolved substantially since their introduction in the 1950s, becoming essential tools in the financial sector. Despite these advancements, challenges persist on both global and national scales, as evidenced by non-performing loans reaching 88.8 billion dirhams and a 15% increase in business failures in 2023, mainly affecting very small businesses (VSBs).

The lack of specific research in the Fez-Meknes region motivated us to undertake this study. It explored the challenges of credit risk assessment by identifying additional factors, particularly for VSBs, often perceived as high-risk due to asymmetric information and lack of sufficient collateral. Using a detailed questionnaire addressed to corporate relations managers in the Fez-Meknes region, this research delved deeper into credit risk assessment practices, revealing the diversity of strategies employed by the Moroccan banking sector.

The results obtained, using statistical techniques such as Multiple Correspondence Analysis, Cronbach's alpha, G6 coefficient (SMC), RMSR measure and chi-square test, reliably validated our initial hypotheses. They indicate a growing trend towards a more sophisticated and nuanced assessment of credit risk by Moroccan banks, incorporating non-financial criteria such as corporate governance, sustainability, business practices and technological position, as well as collateral requirement based on company size.

The practical implications of our study are significant for the banking sector, VSBs, and state institutions. To minimize counterparty risk and defaults by VSBs, it is essential that banks accurately assess the financial health of corporate borrowers, taking into account the specific non-financial factors identified in our research. For VSBs, variables identified will help strengthen their financial solidity, thereby facilitating access to the financing they need for sustainable growth. For state institutions, our results suggest the adoption of preventive measures aimed at anticipating bank financial crises, such as the creation of specific guarantees and the implementation of policies that support the VSB ecosystem, including tailored support programs and tax incentives.

The main limitation of this research is the limited sample, due to the limited number of corporate relations managers in the Fez-Meknes region. To improve the robustness of our findings, it would be advisable to include more qualitative and macroeconomic variables.

Credit Authorship Contribution Statement

Youssef Khanchaoui: Conceptualization; Software; Data curation; Investigation; Formal analysis; Methodology; Writing - original draft; Visualization.
Youssef Zizi: Conceptualization; Funding acquisition; Formal analysis; Validation; Writing - original draft; Writing - review and editing; Visualization; Project administration.
El Mouddem Abdeslam: Funding acquisition; Investigation; Validation; Project administration; Supervision.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Declaration of Use of Generative AI and AI-assisted Technologies

The authors declare that they have not used generative AI and AI-assisted technologies during the preparation of this work.

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Kyrgyz Republic Tax Legislation Influence on the Local Automotive Industry Efficiency

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Abstract: The issue of tax regulation of the automotive industry is relevant, as in the context of a dynamically developing global economy and rapid changes in the automotive industry, the issues of tax regulation become key to the effective functioning of the industry in any country, including the Kyrgyz Republic. The study aims to identify the relationship between tax legislation and the efficiency of the automotive industry in Kyrgyzstan, considering the current challenges and trends in the industry. The study employed various methods, including analytical, statistical, functional, system analysis, deduction, synthesis and comparison. The study analysed the impact of tax legislation on the efficiency of the automotive industry in the Kyrgyz Republic. The focus was on identifying the key aspects of tax regulation that have a direct impact on various areas of industry, including the investment climate, innovation activity and overall competitiveness of enterprises. A systematic analysis of existing tax mechanisms was conducted, the current state of the automotive industry in the country was analysed, and the impact of external factors such as dependence on imports, economic stability and changes in global trends, especially in the context of the development of electric vehicles, was identified. Tax mechanisms in the automotive industry, including customs duties, excise duties, and value-added taxes (VAT) are studied. Particular attention is devoted to the changes in tax legislation introduced in 2023 aimed at exempting parts supplies from VAT. The results of the study indicate the positive impact of such measures on the efficiency of car production.

Keywords: investment climate; economic sustainability; fiscal reforms; innovation; vehicle production.

JEL Classification: D20; D22; E22; E62; O32.

Introduction

The automobile industry is an essential factor driving economic development and innovation progress for many countries in the world today. It carries not only the function of producing vehicles but also provides the impetus for the creation of new technologies, stimulating the economy and shaping the innovation landscape. In this context, for the Kyrgyz Republic, where the automotive industry occupies a strategic position in the formation of the national economy, the issue of the impact of tax legislation on this industry becomes particularly important (Jomartova *et al.* 2021). Kyrgyz Republic, with its unique geopolitical position and potential for the development of the automotive sector, faces the challenges of global change and strives for sustainable, innovative growth. In this context, analysing the impact of tax regulation on the automotive industry goes beyond the usual financial aspect, becoming a strategic tool for shaping a competitive environment. It should be noted that tax regulation is a powerful means of influencing various aspects of the automotive industry, including attracting investment and supporting innovation (Akkucuk 2023). In the context of modern challenges, such as climate change and the transition to electric vehicles, the role of tax regulation in stimulating the sustainable development of the automotive industry becomes more relevant and important (Yaroshenko *et al.* 2018; Chochia *et al.* 2018; Spytska 2023). The analysis and impact of tax mechanisms in this context become particularly important for ensuring sustainable and innovative development of the automotive industry in Kyrgyzstan.

Dzhailova *et al.* (2023) argue that high tax rates discourage investment in the automotive industry in Kyrgyzstan. The study provides data on how limited access to finance under conditions of high tax burden hinders the development of new technologies and modernisation of enterprises in the industry. Akanov and

Zhakypov (2022) emphasises that climate change and requirements for the environmental friendliness of cars are becoming determining factors in the modern automotive industry. They suggest reducing tax pressure for companies that actively implement technologies aimed at reducing the harmful impact on the environment. Das *et al.* (2023) conducted a study of the impact of tax incentives on the stimulation of innovation in industry. The results indicate the need to create favourable tax mechanisms for companies actively investing in research and development in various areas, including the automotive industry. Kondev *et al.* (2023) emphasise the sustainability of the domestic car market in Kyrgyzstan despite tax barriers. Their analysis suggests a revision of the tax incentive system to support domestic producers and improve their competitiveness. Generalov and Generalova-Kutuzova (2021) emphasise the social impact of tax policy on the country's industry. Their analysis shows that tax measures should be aimed at creating new jobs, improving working conditions and supporting the social responsibility of enterprises in various areas.

Based on previous studies of the impact of tax legislation on the automotive industry in Kyrgyzstan, problems associated with high tax rates that limit investment and innovation are identified. The importance of sustainability of the domestic market and social aspects of tax policy is also highlighted, emphasising the need for comprehensive analysis and reforms in this area. The impact of taxes on vehicle production, including automobiles, remains under-researched. The study aims to identify the relationship between changes in tax legislation and the automotive industry in Kyrgyzstan to formulate optimal tax mechanisms.

1. Literature Review

Taxes are a fundamental element in the economic system and fulfil several important functions. They provide the state budget with the funds necessary for the implementation of national programs and the provision of infrastructure. This means that taxes are a key source of revenue for the state. However, the role of taxes is not limited to the financial aspect. Gashi (2018) emphasizes that taxes fulfil the function of income distribution in society, as different categories of citizens and businesses bear different tax burdens depending on their income and asset structure. This function contributes to a more equitable social structure. In the industrial context, taxes play a crucial role in shaping the economic environment for enterprises. Tax policy determines the extent to which enterprises are incentivized to invest in new technologies, develop RandD projects, and renew production capacity.

The variety of tax types in the economic system has many impacts on industry, shaping its financial, competitive, and responsible aspects. Hakim (2020) argues that profit tax, being one of the main financial obligations of enterprises, directly affects their financial stability. High rates of this tax can significantly limit the ability of enterprises to invest in innovation and technological development, which can slow down the process of modernization of the industry. Another important tax affecting the industry is the value-added tax (VAT). Jensen (2022) points out that high rates of this tax can have a noticeable impact on the competitiveness of products, as they change the price structure in the production chain. This, in turn, can affect the demand for goods and services, determining the success of enterprises in a competitive market. Excises and special taxes play the role of an instrument influencing industries, considering social and environmental aspects. Adandohoin (2021) and Gunash *et al.* (2024) illustrate that the introduction of excise taxes on products harmful to health or taxes on emissions of harmful substances stimulates the formation of a more responsible approach to production. This not only contributes to the improvement of public health but also creates additional motivators for companies to introduce eco-friendlier technologies and processes.

Tax incentives are a significant element contributing to the formation of a favourable investment climate in the economy. This instrument is particularly important in the context of industry, where innovation, capital attraction, and social development play key roles. Cnossen (2023) highlights that benefits directed at RandD activities have a significant impact on the innovation potential of the industry. Providing tax advantages for research projects incentivizes enterprises to adopt new technologies, conduct research, and develop innovative products. This, in turn, contributes to enriching the technological base and increasing the competitiveness of the entire industry. Investment incentives are an integral part of the strategy to stimulate industrial development. The provision of tax incentives to attract capital supports the growth of production, renewal of production facilities, and increase in the efficiency of enterprises. Geczy (2021) emphasizes that this, in turn, contributes to strengthening the competitiveness of the industry in the global market and promotes the creation of new jobs. Social benefits in the form of incentives for job creation and staff training also play an important role in tax policy. Jakubik *et al.* (2017) suggest that they promote sustainable social development, support employment, and, through staff training, improve the skills of the labour force. This comprehensive approach to social benefits creates favourable conditions for the formation of a healthy and diversified industrial sphere. As a result, incentive-oriented tax policy

plays an integral role in ensuring the efficiency and sustainability of industry. Creating conditions for investment, encouraging innovation, and improving the social aspects of labour relations form the basis for the sustainable development of the industrial sector.

The state of the automotive industry in Kyrgyzstan is a complex mix of factors that determine the dynamics of this industry. Musiralieva (2016) and Kerimkulov *et al.* (2015) observe that over the past few years, Kyrgyzstan has remained heavily dependent on imported cars, both new and used. The lack of domestic large-scale production defines the country as a car consumer, highlighting the importance of analysing external factors. Trends in car sales in the country are affected by economic factors such as income levels and stability in the economy. Fluctuations in economic activity and the availability of finance can have a significant impact on purchasing power and therefore on car sales. In the context of global trends, Kydykov (2021) notes that the focus on electric vehicles is becoming an important aspect of automotive industry development. Kyrgyzstan is also changing to promote electrification of the transport sector, which can influence infrastructure and stimulate the development of electric vehicles.

While previous studies have provided valuable insights into various aspects of taxation and its effects on different sectors, the specific impact of tax regulations on the efficiency and sustainability of Kyrgyzstan's automotive sector remains underexplored. This gap highlights the importance of the current study, which aims to provide a comprehensive analysis of how recent tax legislation changes, particularly the VAT exemption for domestically produced vehicle components, influence the production, innovation, and competitiveness of the local automotive industry. By addressing this gap, the study contributes to a deeper understanding of the strategic role of tax policies in fostering industrial development in Kyrgyzstan, offering actionable insights that could guide future legislative reforms and industrial strategies.

2. Materials and Methods

An extensive analysis of a variety of sources covering the impact of tax legislation on the automotive industry in Kyrgyzstan has been carried out. To obtain an objective estimation, official statistical reports on the website of the National Statistical Committee of the Kyrgyz Republic (2023) were used, which include information on the volume of production of vehicles, including cars, as well as parts and automotive accessories. These data served as a basis for quantitative analyses and identification of the main trends in the development of the automotive industry. The study also scrutinised tax laws, regulations and other official documents governing taxation in the automotive industry. Special attention was paid to the use of subparagraph 111 of Law of the Kyrgyz Republic No. 78 “On amendments to certain legislative acts of the Kyrgyz Republic in the field of taxation” (2023), according to which Article 296 of the Tax Code of the Kyrgyz Republic No. 3 (2022) was supplemented with paragraphs providing new opportunities for tax regulation in this area. These materials played a key role in understanding the current taxation system and highlighting the main aspects that affect the efficiency of enterprises in this sector. The analytical method was used to systematise the complex issue of the impact of tax legislation on the automotive industry in Kyrgyzstan and its components. This included analysing tax rates, examining their changes over time, identifying key laws and regulations, and highlighting the main factors affecting tax efficiency in this industry. The statistical method was used to examine quantitative data such as the volume of production of vehicles, parts and automotive accessories. This identified patterns and trends and provided an understanding of the relationship between tax parameters and production. The functional method was used to study the role of tax instruments in the industry. The study of the functions of tax incentives that stimulate innovation, attract investment, and support social and environmental initiatives identified their role in achieving the strategic development goals of the automotive industry.

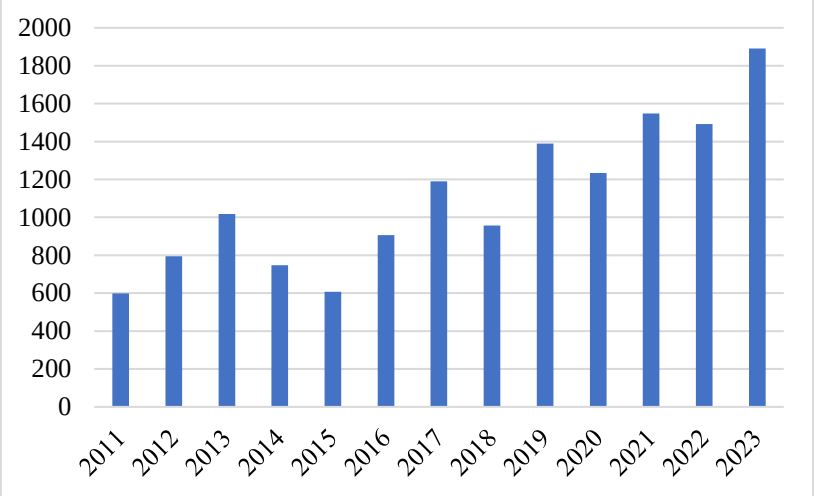
The method of system analysis was used to study the interrelationships and impact of various components of the system, in this case, the tax system on the automotive industry. This identified key factors and influences, as well as consequences of changes in the tax policy of the Kyrgyz Republic. The application of the deduction method allowed the study of general principles of taxation and their impact on the industry, going from general provisions to specific cases. This helped to identify the laws and trends underlying the tax impact. The synthesis method was used to bring together the various aspects of tax impact and form a comprehensive perception of the topic, thus creating a generalised picture of the impact of taxes on the automotive industry, considering multiple factors and variables. The comparison method was used to identify successful approaches that could be adapted or applied to optimise the tax impact in the context of the automotive industry in Kyrgyzstan. As a result, these actions were applied to consider the feasibility of improving tax legislation for the successful development of the automotive industry in the Kyrgyz Republic.

3. Results

3.1 Production Trends in the Automotive Industry

With the increasing focus on environmental issues and social responsibility, automotive companies may face increased demands on the environmental performance of production and working conditions. Infrastructure such as road networks also has an impact on the automotive industry. The condition and development of infrastructure affect logistics, transport needs and therefore the efficiency of industry. Figure 1 shows the volume of vehicle production in Kyrgyzstan.

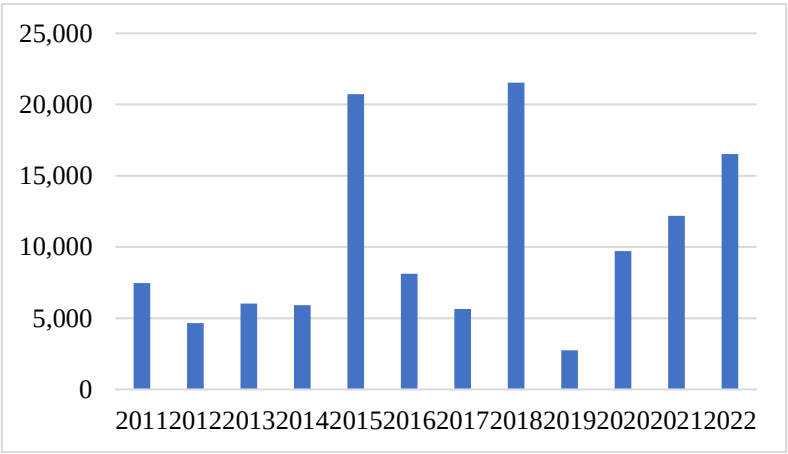
Figure 1. Vehicle production volume in Kyrgyzstan, million KGS



Source: compiled by the author based on (National Statistical Committee, 2023).

Between 2011 and 2013, a significant increase in production volume took place, showing a significant increase of more than 60%. However, in 2014, there was a sharp decline in production volume, which can be attributed to various factors such as economic difficulties, changes in tax policy or other external influences. After declining in 2014 and 2015, vehicle production started to stabilise and show steady growth from 2016 onwards. Subsequent years (2016-2023) are marked by a gradual increase in production volume, peaking in 2023. In 2022 and 2023, vehicle production consisted of motor vehicles (1324 and 1728.4 million KGS) and other vehicles (145.1 and 162.5 million KGS, respectively). The growth of vehicle production can be attributed to the increase in market demand, the introduction of new technologies, and support from government and commercial structures. Figure 2 shows the dynamics of the volume of parts and motor vehicle accessories.

Figure 2. Production volume of parts and automotive accessories in Kyrgyzstan, thousand KGS



Source: compiled by the author based on (National Statistical Committee, 2023).

There are dynamic fluctuations in the volume of production of parts and accessories representing the automotive industry in Kyrgyzstan. The growth in recent years may indicate positive changes in the economy and the development of the automotive industry in the country.

3.2 Taxation Mechanisms and Their Impact on Production Efficiency

Taxation mechanisms in the automotive industry usually include various aspects. Customs duties and excise taxes are key instruments for government control and regulation of imports of automobiles into Kyrgyzstan. Customs duties are levied on imported cars and are a form of tax that is collected at border crossings. Excise duties may also be used to regulate the level of consumption of automotive goods, especially given their environmental impact. VAT (12%) applies to sales of motor vehicles and related services in Kyrgyzstan. This tax is levied at every stage of production and distribution of goods, including import, manufacturing, wholesale and retail sales. VAT creates an additional source of revenue for the government at each stage of the vehicle life cycle. The introduction of excise taxes on fuel (diesel fuel – 400 KGS per tonne, petrol – 5 thousand KGS per tonne) is a measure aimed at regulating fuel consumption and affecting the level of pollutant emissions. These excises can increase the cost of fuel, which in turn affects the costs of car owners and incentivises more efficient use of fuel resources.

Car companies, including dealers and service centres, are liable to pay income tax (10%). This tax is imposed on companies' profits after deducting various expenses. Payment of income tax is part of corporate responsibility and contributes to funding government programmes and services. The government can provide tax breaks and incentives to support the automotive industry. This may include lower tax rates for companies involved in car manufacturing, investment in innovation or clean technology. Such measures are aimed at stimulating the development and competitiveness of the industry. Companies that own production facilities and infrastructure in the automotive industry are subject to property tax. This tax is levied on their property, including buildings, equipment and other assets, and contributes to the financing of public needs. Given the growing attention to environmental issues, the state may introduce environmental tax mechanisms. These may include taxes on emissions, penalties for the use of harmful fuels, or incentives for those who use environmentally friendly technologies in cars.

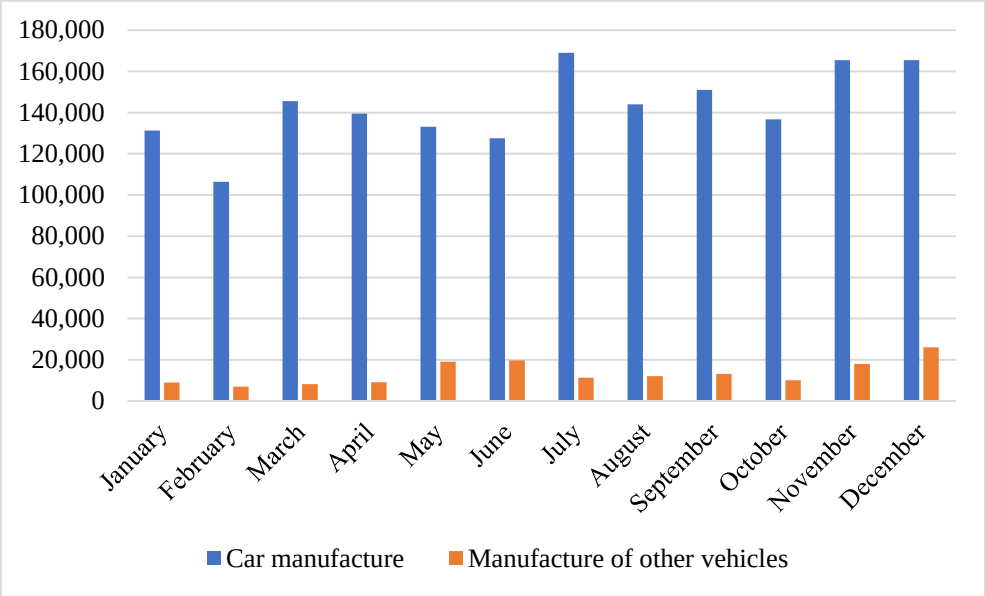
3.3 The Role of VAT Exemptions in Stimulating Local Production

The introduction of amendments to the Tax Code of the Kyrgyz Republic, exempting from VAT the supply of components and spare parts for vehicles, could have a significant positive impact on the efficiency of vehicle production in the country. VAT exemption for components produced domestically favours the development of local production. This can support car manufacturers in the country by reducing the cost of component procurement and increasing the competitiveness of domestic products. VAT exemption reduces the overall costs of car production, as components and spare parts imported from Kyrgyzstan become more affordable for manufacturers. This can lead to improved financial sustainability of enterprises and increase their efficiency. Reduced cost of components may increase the availability of inventories for vehicle production. Increased flexibility in inventory management can reduce time delays in production processes and improve production efficiency. Reducing the tax burden on the supply of components can also be an incentive for innovation in transport production. Increased investment in research and development of new technologies can lead to more modern and competitive vehicles. Improved conditions for local production can attract more investments and orders for vehicle production in the country. This also favours the growth of economic activity in the automotive industry.

Within the framework of the changes introduced by subparagraph 111 Law of the Kyrgyz Republic No. 78 "On amendments to certain legislative acts of the Kyrgyz Republic in the field of taxation" (2023), an article 296 Tax Code of the Kyrgyz Republic No. 3 (2022) was amended with paragraphs dealing with various aspects of taxation in the field of supply and maintenance. The amendments consist of 5 items. Supply of vehicles and components: VAT exemption for vehicles and components produced domestically. Such a measure aims to support local manufacturers and stimulate the domestic automotive industry. Supply and maintenance of cash register machines (CCMs): VAT exemption on supply and maintenance of cash registers entered in the Register of Cash Registers, as well as components for their repair. Such a measure may contribute to updating and maintaining the performance of cash register equipment. Supply of POS terminals: VAT exemption for the supply of POS terminals with the function of working with cash registers included in the Register of Cash registers. This may facilitate the introduction of modern technology in the retail sector and trade efficiency. Provision of excise duty stamps and identity documents: the item provides for VAT exemption on the supply of stamps subject to

excise duty, blank passports and identity cards of a citizen of the Kyrgyz Republic of the established standard. This may have an impact on administrative processes and state identification. Supply of electronic devices for software KKMs, suggesting that the supply of electronic devices with a built-in receipt printer and operating system intended for installation of a software KKM is exempt from VAT. This may stimulate the introduction of modern technologies in the field of fiscal control. Figure 3 shows the volume of production of cars and other vehicles in the Kyrgyz Republic by month during 2023.

Figure 3. Production of cars and other vehicles in Kyrgyzstan for 2023, thousand KGS



Source: compiled by the authors based on (National Statistical Committee, 2023)

The VAT exemption for domestically produced components and spare parts reduces the overall cost of car production. This, in turn, leads to an increase in vehicle production volumes, as can be seen in the data for the period. The increase in production volumes starts in summer and continues until the end of the year. A similar trend is evident in the other vehicle production segment. There is an increase in volume from April to the end of the year. The impact of VAT exemption on the supply of components is evident in the growth of the production of various vehicles. Thus, the changes in the tax legislation have a positive impact on the automotive industry, contributing to an increase in production volumes and stimulating local entrepreneurship in this area.

4. Discussion

This study highlights key aspects of the relationship between tax mechanisms and the automotive industry in Kyrgyzstan. The introduction of amendments to the tax code, exempting from VAT the supply of components and spare parts for vehicles manufactured in the country, provides significant incentives for the development of local production. This reduces financial barriers, improves the financial sustainability of enterprises and, consequently, increases their competitiveness. Changes in tax policy oriented to support domestic production have a positive response in the form of sustainable growth of vehicle production in the country. VAT exemption on locally produced components stimulates innovation and technological development, which in turn contributes to the creation of more modern and competitive vehicles.

A study of the dynamics of motor vehicle production in Kyrgyzstan reveals the impact of various factors, including economic stability, income levels and government support measures. A positive trend in the increase of production volumes is noticeable, especially after changes in legislation. In the context of global trends towards the electrification of transport, it is important to note that the electric vehicle sector in Kyrgyzstan may also receive a new impetus for development. Strengthening environmental requirements and social responsibility of enterprises is becoming an increasingly important factor that can influence the future of the automotive industry in the country. In addition, the results emphasise the practical significance of the changes made to the tax legislation. The exemption from VAT on components and spare parts produced in the country not only supports local production but also creates conditions for increasing the efficiency of vehicle production, reducing overall costs and improving competitiveness. These measures promote innovation, investment attraction and sustainable social development in the Kyrgyz automotive industry.

This aligns with conclusions drawn by Llopis-Albert *et al.* (2021), who found that well-structured tax incentives foster innovation and attract investment within the automotive sector. Similarly, this study corroborates the notion that tax benefits not only stimulate technological advancements but also enhance the overall competitiveness of the industry. An earlier study conducted by Górecki and Letki (2021) highlighted the wider societal consequences of tax policy, specifically underscoring the significance of social advantages in advancing sustainable development. The results support this view, as the exemption of VAT on domestically manufactured components seems to have a beneficial impact on the social dimensions of the Kyrgyz automotive sector, such as the generation of employment opportunities and the enhancement of working conditions. Such a comprehensive tax policy strategy not only promotes industry expansion but also serves wider societal goals.

When analysing the influence of tax rates on the automobile industry, Trencher (2020) found a significant association between tax policies and the patterns of car manufacturing and sales. This paper expands upon the initial research by illustrating the direct impact of the decrease in VAT on components on the production volumes in Kyrgyzstan. This is supported by the observed rise in car production subsequent to the legislative reforms. This discovery emphasises the crucial significance of tax policy in influencing the economic architecture of the car industry. Furthermore, Fedeli and Giuriato (2023) conducted a comprehensive analysis of tax policies designed to encourage component supply, emphasising their efficacy in improving manufacturing efficiency. The present analysis supports their findings by demonstrating that the exemption of VAT has decreased manufacturing expenses, thereby enhancing the financial viability of automotive operations in Kyrgyzstan. The aforementioned result highlights the significance of implementing focused tax policies to promote a competitive and robust automobile sector.

The importance of environmental factors in the formulation of tax policies has been highlighted by Böckin and Tillman (2019), who emphasised the necessity of implementing tax systems that are environmentally appropriate. The results indicate that the tax incentives granted in Kyrgyzstan not only facilitate the expansion of the industrial sector but also promote the use of environmentally friendly technologies, so making a positive contribution to the sustainability of the automobile industry. These studies emphasise the key impact of tax mechanisms on the automotive industry. Tax incentives are an effective incentive for innovation, increasing the competitiveness of enterprises. Changes in tax legislation, such as VAT exemptions for component supplies, have a significant impact on the efficiency of domestic production. The role of tax solutions becomes important in the context of environmental responsibility and support for innovation in small enterprises. The competent use of tax mechanisms contributes to the financial sustainability, social development and overall competitiveness of the automotive industry, highlighting their central importance in the development of the sector.

Conclusions

The present study offers a thorough examination of the influence of tax legislation on the operational effectiveness and long-term viability of the automobile sector in the Kyrgyz Republic. The primary results suggest that the recent exemption of VAT on components and spare parts manufactured within the country has greatly boosted local production, mitigated financial obstacles, and enhanced the competitiveness of domestic automotive firms. Furthermore, these tax incentives have played a role in fostering innovation and technological advancement in the sector, in line with worldwide movements towards sustainability and environmental accountability.

The implications of these findings go beyond the obvious advantages to the automotive industry. The implementation of tax measures has the capacity to attract additional investment, stimulate economic growth, and enhance the social conditions linked to the industry, including job creation and improved working conditions, by lowering production costs and promoting a favourable environment for local manufacturers. The aforementioned results indicate that tax policy has the potential to exert significant influence on both the economic and social and environmental aspects of the automobile sector in Kyrgyzstan.

Utilising these results, a number of suggestions for future investigation are put forward. First, additional research should investigate the enduring effects of tax incentives on the long-term viability of the automotive sector, notably with regard to environmental goals. Furthermore, studies should explore the possibility of extending comparable tax policies to other sectors of the economy in order to evaluate their wider relevance and efficacy. Ultimately, it is imperative to conduct thorough examination of consumer behaviour and market dynamics in reaction to these tax modifications. This analysis has the potential to offer significant insights for policymakers and industry participants. These recommendations emphasise the need of ongoing research and policy formulation to enhance tax policies that promote industrial innovation, competitiveness, and sustainability in the Kyrgyz Republic.

Credit Authorship Contribution Statement

Kanash Abilpeissov: Conceptualization, Investigation, Project administration, Methodology, Formal analysis, Software, Writing – original draft, Supervision, Data curation, Validation, Writing – review and editing, Visualization.

Declaration of Competing Interest

The author declares that he has no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Declaration of Use of Generative AI and AI-assisted Technologies

The author declares that he has not used generative AI and AI-assisted technologies during the preparation of this work.

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An Analysis to the Link between Foreign Trade and Sectorial Economic Growth in Iraq

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Abstract: This research aims to analyse the link between oil export, commodity imports and other major sectors such as agricultural, manufacturing and service sectors over the period spanning from 2004 to 2020. So, it aims to extrapolating and analyse the role of Iraqi economic policy toward the diversification. Therefore, it tries to assess the governmental economic performance in utilizing oil revenues for reinforcement the manufacturing and agriculture sectors. For this purpose, the Granger causal relationship is used to find out the magnitude of the variables examined. The expected results will depict an assessment of the public economic policy. Thus, this paper tries to extrapolate to what extent the oil revenues can be circulated to activate the local economic sectors and enhance level of economic diversification in Iraq as an announced policy during the period studied.

Keywords: oil export; commodity import; economic growth; Granger causality.

JEL Classification: F10; F14; F43; L38; O11.

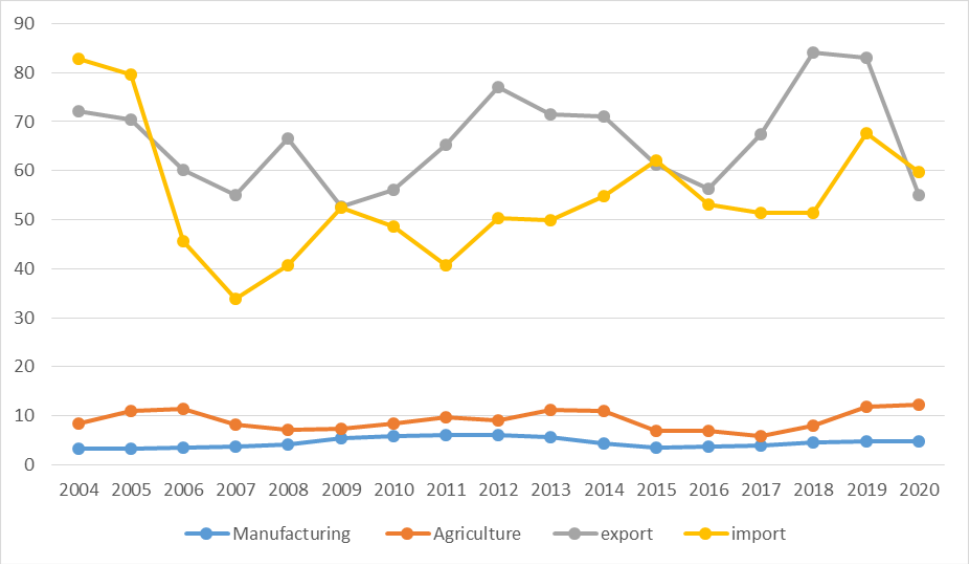
Introduction

Although the rise of level of crude oil export revenues and the availability of economic resources, the Iraqi economy still suffering from the economic structural disruption. Iraq as oil producing country has become the fastest growing consumer. Its demand for imported goods is estimated by almost USD 54.41 billion on average over the period from 2004 to 2020 (SESRIC 2023). The GDP growth level, as well-known is largely based on extractive sectors. In 2003, and then after the economic policy in Iraq has shifted toward the economic openness and diversification but these policies are not achieved in practice. However, the average of value added of agriculture and manufacturing sectors amounted by 6.8 and 13.6 percent of oil export for the said period consequentially (SESRIC 2023). Hence, these modest levels of non-oil contribution do not reflect sound economic policies that can diversify the economy and expand level of non-oil sectors, particularly agriculture and manufacturing sectors. Meaning that, there is an absence strategy toward diversification, in which the high reliance on oil sector is dominant as a major source of income. Therefore, the consumption in Iraq that represented by the high level of import will remain as a dependant variable to all fluctuations of oil market prices and world economic growth.

From the above, the non-oil sectors growth ought to be more than the share indicated above, and more than 90 percent reliance on oil sector will be not fulfilled the requirements of diversification. This means a significant increase of manufacturing and agriculture sectors is highly important to enhancing the economic structure. Furthermore, the oil revenues are not used for adopting processes to maintain non-oil economy via improving production capacity which is considered another key reason of failure of economic policies in Iraq. However, manufacturing and agriculture sectors does not witness a remarkable increase over the period of study. Whereas imports featured by a parallel link with the export. This implies that export revenues have been devoted to meet import payments. In other words, the oil revenues cannot lead to improved value added due to a high

level of reliance on import. Thus, we can state that all efforts devoted to improving level of economic structure have not resulted a positive impact on the non-oil sector in Iraq.

Figure 1. Value added of Manufacturing and Agriculture sector and Revenues of trade in Iraq in constant prices, 2004 -2020. (Billion USD)



Source: By the author based on database of SESRIC, Database of Statistical, Economic and Social Research and Training Centre for Islamic Countries. http://www.sesric.org/baseind-step5.php

In addition, the Iraqi demand for imports has increased due to the big economic disruption and failure of economic policy in producing goods that can lead to reduce level of consuming goods' import gradually and achieve surpluses that can be utilized in other projects and then expand size of economy. Therefore, this situation is majorly related to the disability of the governmental policy in subsidizing the economic activities in general through state-imposed tariffs and tax-free regulations.

However, the economic policy in Iraq ought to be altered and catalyse local and foreign investors alike. This could be achieved via mitigation the investment cost to maintain relatively low prices of goods and services supplied in the local market. Hence, this policy can be driven by oil-based industries and engaging the surpluses of oil in activating industries such as refineries and petrochemical, where it could lead to raise value added and create links with other relevant industries and then enhancing level of diversification gradually. Consequently, the sectorial economic growth in Iraq does alter to be improved due to the availability of economic potentials, particularly relatively low prices of energy in general. This feature could be engaged ideally if the economic policy is able to avail all pillars requested; namely reforming the institutional structure and easing roles and procedures related to investments and infrastructure.

From the above, it is obvious that the Iraqi foreign trade; mainly oil export has a mutual role as a main source of revenues for activating the economy and as a source that meet various kinds of capital goods that can be a spark for non-oil growth. But this role, however, is conditioned by the strategic national policies that maintain a positive relationship between oil exports and the progress of other economic sectors. We therefore in this study attempt to empirically find out how much these variables are linked to state the most important factors that lead to activate the Iraqi economy. Finally, the significance of this study embodied in its empirical implication and in analysing the role of economic policy in Iraq over the period studied as an important period after the political regime change. It is a new investigation that tries to assess to what extent Iraqi foreign trade revenues are utilized in improving level of non-oil sectors. In other words, it tries to measure the level of economic growth that could be derived from foreign trade, particularly crude oil export revenues, in which enhancing level of other sectors implies an indirect increase in the level of value-added of crude oil export via its role in financing and supporting the agriculture and manufacturing sectors as the major financial allocations of the public budget in Iraq are linked with the oil export revenues.

1. Literature Review

Various studies have paid big concern on trade and its influence in enhancing level of growth in many countries via using different empirical methodologies. Most of these studies have adopted the causality approach focusing

on foreign trade and economic sectors. This trend also pertains to state policies needed for sustaining the economic activities which have investigated the linkage between foreign trade and other economic activities. Therefore, a special attention to countries in which oil export revenues have a dominant role in both sides; meeting the economy needs, as well as its impact as a major economic activity for a country such as Iraq. However, the oil exports almost play a significant role where the growth level is a major limitation of oil export prices in the advanced countries. In this context (Lal, *et al.* 1987) found that export, FDI and foreign exchange rate have a positive impact on the real GDP, whereas imports, inflation, and economic openness have led to a negative impact on real GDP. The study revealed that growth of international trade helps to cause a dynamic benefit to the local economy. Also, it asserts that both size of international trade and trade structure supported by high technology of export result a positive effect on Nigeria economy. Also, (Al-Salamah, *et al.* 2006) suggested a large-scale optimization model for production in the GCC for improving economic progress. This regional model determined the least cost for meeting the increased domestic demand for natural gas. Its importance, however, derived from its role as a main input of electricity generation, as well as, in re-injection process of oil wells. Therefore, a new policy actions are required for securing the main energy resources of GCC countries.

In this respect, (Sari, Ewing *et al.* 2008) is also found a positive linkage between energy consumption and the US manufacturing industries. They asserted that the real production and employment are key factors for economic growth in the long run, where they constitute for nearly all measures of disaggregate energy consumption. And (Chen, 2009) confirms the presence of a parallel link between growth of export and aggregate economic growth for seventeen country. However, in this regard (Kombargi, Waterlander *et al.* 2010) tackled the GCC gas shortage and declared that these countries have an opportunity to meet their high increase of natural gas use in the short-run. This opportunity summarized in importing natural gas from north America which witnesses a large increase in the level of gas production. For the long-run, this study explained that attracting gas-foreign companies is a good substitution to bridge the gap of gas supply-demand imbalance in GCC countries.

(Costantini and Martini 2010) analysed the impact of energy sector on the economy via adopting VECM approach. The results revealed the presence of a causal relationship between energy and real GDP. While (Erkan, Mucuk *et al.* 2010) stated a long term significant role between energy use and exports, and also the Granger-causality test showed a unidirectional association running form energy consumption to exports. (Loganathan and Subramaniam 2010) found a bidirectional effect running between energy consumption and economic performance in Malaysia. However, these studies ensure that the industrial sector, and then export manufactured goods could be considered as a main engine of the sectorial economic growth. Furthermore, the quantitative results showed that the local energy consumption in industries have a positive influence on export, which means the importance of energy use in Turkey. Moreover, (Squalli, *et al.* 2011) found a long-run causal relationship existed between economic growth and electricity consumption in GCC states. Accordingly, we note that economic growth is a result of various activities that has almost been positive, where these empirical studies show this relation via using different methods and various variables which representing growth level. However, (Kwakwa 2012) has recommended that the economic policies ought to be geared to achieving an increase in level of high supply of energy to the industrial sector, particularly manufacturing industries as an important strategy for maintaining a stable economic growth. Based on that, the government policies should focus on sustaining a steady energy supply which could be consistent with the dynamic progress of energy use. (Bibi, *et al.* 2014) conducted an empirical investigation and reveal that export, exchange rate and foreign direct investment have a positive association with real GDP while import, openness and inflation rate affect negatively on economic growth. Also, (Mkubwa, *et al.* 2014) revealed that trade openness in Tanzania has a positive effect on the economy. It was higher when the economy was closed in comparison to the open economy period. Also, the study has stated that a continuous trade deficit during 1980s was due to weak level of its export value added which is highly needed to compensate for a high value level of its import.

(Kılıc, *et al.* 2017) investigated the link between trade and economic growth for the Eurasia Economic Union countries, the study revealed a bi-directional causal relationship running from growth to export and unidirectional from growth to import. Moreover, (Necoechea-Porrasm *et al.* 2021) asserted that economic liberalization is evidence for the increase of level of growth, competitiveness of industrial sector, and then developing human capital. It found also that activities linked with foreign trade determine the size of manufactured goods; GDP and received export revenues. In addition, (Kausar, *et al.* 2022) found cointegrated association between energy use and economic progress. This confirms a long-run link of energy as an engine of the economy and its growth level, particularly in oil countries like Iraq. Also, (Aga, *et al.* 2023) revealed that trade openness has an important influence on the Iraqi economy in the short and long term. This study recommended

that the economic policy should pay high attention to the economic diversification and enhancing level of non-oil export. Furthermore, (Abdalltef 2023) found an absent relationship between the growth of gross domestic product and gross fixed capital formation in the agricultural sector due to volatility of the economic policy in Iraq. And regarding the impact of foreign trade in economic growth (Srdelić *et al.* 2024) examined the determinants of elasticities of revenues generated from foreign trade, the most important conclusion focused on the role of foreign trade during twenty years in addition to the policies adopted and human capital accumulation as a driving force of economic growth. Similarly, (Susanto *et al.* 2024) proved that export-oriented industries importantly contribute to enhancing level of economic growth, this study has focused on the role of both export and import in international trade and activating related economic activated that lead to sustain growth of gross domestic product.

From the above, we can say that major studies addressed that foreign trade and other variables that represented the economic sectors have almost a positive relationship, but also there has been an exception to this statement. This could be related with the actual economic policies and institutional system that empower the economic activities in economy. Therefore, the role of foreign trade is crucially related to the circumstances of economy and policies adopted, as well as level of economic stability which is directly linked with the political system. However, our study deals with the Iraqi economy which is highly linked to global oil markets and the fluctuations of its prices. This study seeks to analyse the relationship of Iraqis foreign trade sectors and other economic sectors. It will be differentiated by addressing the impact of export on the growth of other sectors. So, the contribution of this study will be represented by analysing the linkage amongst the said variables. This study, therefore, is an attempt to analyse the economic policies and the Iraqi governmental efforts toward diversifications apart from the high reliance of the whole economy on oil export and its linked fluctuations with partner economies.

2. Methodology

The methodology of this study employs the VAR model to analyse the causal association between the variables adopted. The study investigates annual data spanned from 2004 to 2020. Four variables are included in the analysis which are agriculture (*Ag*), manufacturing (*Mnf*), export (*Ex*), and import sectors (*Im*). The model adopted is represented in the following equation:

$$Ex=f\ (Im,\ Mnf,\ Ag) \tag{1}$$

Where,
Ex: Export of goods and services (US Dollar)
Im: Import of goods and services (US Dollar)
Ag: Value added of agriculture sector in the economy (US Dollar)
Mnf: Value added of manufacturing sector in the economy (US Dollar)
Equation (1) above could be formulated in the logarithmic model, as follows:

$$log\ Ex = \alpha 0 + \beta 1\ log\ Im + \beta 2\ log\ Mnf + \beta 3\ log\ Ag + Ut \tag{2}$$

Where,
α_0: is the intercept term,
β_1, β_2, and β_3: coefficients, which are more than zero.
U: Error term.
t: time subscripts of variables in the time series. The method used is based on the Vector Autoregressive (VAR) model, which could be written as follows:

$$\log Ex = \alpha_0 + \beta_1\ log\ Im + \beta_2\ log\ Mnf + \beta_3 logAg + Ut_1 \tag{3}$$
$$\text{Log } Im = \alpha_1 + \beta_4\ log\ Ex + \beta_5\ log\ Mnf + \beta_6\ log\ Ag + Ut_2 \tag{4}$$
$$\text{Log } Mnf = \alpha_2 + \beta 7\ log\ Ex + \beta 8\ log\ Im + \beta 9\ log\ Ag + Ut_3 \tag{5}$$
$$\text{Log } Ag = \alpha_3 + \beta 10\ log\ Mnf + \beta 11\ log\ Ex + \beta 12\ log\ Im + Ut_4 \tag{6}$$

However, to ensure the stationrity of data adopted, a unit root test is used for the study variables. This implies the absence of unit root, and the model is statistically valid. Therefore, we can run the model and where the results obtained will not be spurious, it could be used for a meaningful economic analysis.

Table 1. VAR Granger causality results of the model estimated

VAR Granger Causality/Block Exogeneity Wald Tests
Sample: 2004 2020
Included observations: 15

Dependent variable: MANUFACTURING

Excluded	Chi-sq	df	Prob.
IMPORT	3.896619	2	0.1425
EXPORT	7.443074	2	0.0242
AGRICULTURE01	1.562328	2	0.4579
All	13.19717	6	0.0400

Dependent variable: IMPORT

Excluded	Chi-sq	df	Prob.
MANUFACTURING	8.999903	2	0.0111
EXPORT	6.605728	2	0.0368
AGRICULTURE01	9.905001	2	0.0071
All	25.60461	6	0.0003

Dependent variable: EXPORT

Excluded	Chi-sq	df	Prob.
MANUFACTURING	4.382663	2	0.1118
IMPORT	5.877975	2	0.0529
AGRICULTURE01	5.594658	2	0.0610
All	7.567370	6	0.2715

Dependent variable: AGRICULTURE01

Excluded	Chi-sq	df	Prob.
MANUFACTURING	7.005173	2	0.0301
IMPORT	2.855822	2	0.2398
EXPORT	8.442353	2	0.0147
All	13.75761	6	0.0325

Source: By the author via using Eviews Software.

2.1 Model Estimation and Result Analysis

The VAR ganger causality approach is conducted for the variables tested. The model examined showed the following results, as shown in table (1) above. It shows that there is a unidirectional causal relationship run from export to manufacturing sector. This asserts that the Iraqi exports – which majorly oil exports - have an important role in the industrial sector and other public activities in Iraq as well, whereas the manufacturing sector has no positive impact on exports.

However, this implies the absence of value-added achieved over the period studied resulting from the low level of contribution as a share to oil export revenues. This case depicts the inverse impact of structural disruption, and the domination of oil revenues compared to other sources of income.

In addition, we found that the causal relationship from agriculture sector to manufacturing is absent, where this indicates the weak share of agriculture sector to GDP and in its link with the industrial sector in general.

Furthermore, it was found a bidirectional causality between import and export, where this proves the high reliance on the oil revenues in meeting the payments of imported goods from abroad.

However, there is approximately a parallel relationship between the two variables resulting from the modest level of local production. Accordingly, this case explains that the value-added of oil imports is not completely circulated inside the local economy to enhance level of economic capacity as much as it is in turn devoted for importing various kinds of consuming and capital goods.

Table 2. Cointegration test results

Sample (adjusted): 2006 2020
Included observations: 15 after adjustments
Trend assumption: Linear deterministic trend
Series: MANUFACTURING IMPORT EXPORT AGRICULTURE
Lags interval (in first differences): 1 to 1
Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.953685	99.37418	47.85613	0.0000
At most 1 *	0.839147	53.29000	29.79707	0.0000
At most 2 *	0.672205	25.88101	15.49471	0.0010
At most 3 *	0.456668	9.150509	3.841466	0.0025

Trace test indicates 4 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.953685	46.08418	27.58434	0.0001
At most 1 *	0.839147	27.40899	21.13162	0.0057
At most 2 *	0.672205	16.73050	14.26460	0.0200
At most 3 *	0.456668	9.150509	3.841466	0.0025

Source: By the author via using Eviews Software.
Max-eigenvalue test indicates 4 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

Furthermore, the result illustrates that there is a bidirectional effect running from export to agricultural sector. This implies that this sector still highly reliant on the revenues gained from oil exports, where any decline

in the level of oil prices will be translated to a negative impact on the non-oil sectors, particularly manufacturing and agriculture sector. Therefore, we can say that most efforts which concentrating to reinforcement level of economic diversification were not feasible, in which the financial allocations of public budgets spanned from 2004 to 2020 are not influenced positively on other sectors.

In other words, the duration from 2004 to 2020 witnessed an inefficient use of economic resources, where this could be related to the administrative corruption that hinder any effort for using the investment allocations efficiently

Finally, the variables examined are correlated – except for export as a dependant variable on the long run, this means that these variables can drifted together due to the possible interdependence between agriculture, manufacturing and import and this is compatible with the real economic situation in Iraq. However, this fact has been proved by the co-integration test, where the test probability depicts a significant relationship between all variables regressed, as shown in the table above.

The test above identifies that the time series used in this study has no deviation in the long run and are integrated together. This explains the degree of sensitivity of all variables examined to the same average over the period of study. Furthermore, the data of study illustrates the value added of manufacturing and agriculture sectors, and revenues of export and imports as well. It was noted that a parallel relationship between export and import over the period spanned from 2011 to 2020. This explains the high reliance on the global market in which the oil revenues majorly return to meeting the Iraqi local market of various kinds of goods imported from abroad. In other words, it implies that the structural disruption has mitigated the economic efforts towards increasing level of investment allocations in the public budget due to devoting the main revenues for consuming goods rather than capital goods. Therefore, policies of encouraging local and foreign investments are highly needed to enhance level of private sectors and improving of non-oil sectors as an important policy to mitigate share of export oil revenues to GDP and reducing fluctuations resulted from fluctuations of global oil markets.

From the above, it is evident that a modest contribution of manufacturing and agriculture sectors associated with the absence of their growth over the period studied from 2004 to 2020. This indicates that the relevant policies have not succeeded in reinforcement the two sectors, agriculture and manufacturing sectors. However, enhancing level of sectorial economic growth ought to be linked with the sound economic policies that could be able to utilize the revenues of foreign trade in improving level of non-oil sectors, which can lead to avail local made goods and then reduce level of imports. Meaning that, economic stability cannot be achieved without activating a real role of private sectors in the agriculture and industrial manufacturing sectors using policies that catalyse local investors and elevate all restrictions that imped foreign investors as well.

Conclusion and Policy Recommendations

The financing of manufacturing and agriculture sectors will continuously facing periodical fluctuations that can impede the governmental efforts for diversifications due to the high reliance on the oil export revenues as a major source of income. This implies that the non-oil economic growth is highly conditioned with the efficiency of public policies in activating the role of private sector that can finance the economy away from the public revenues and create the competition between investors as well. Therefore, the results proved that the manufacturing sector has no positive impact on exports, and this means that this sector is still not active in diversifying the foreign trade due to the weakness of value-added achieved over the period studied. The non-oil sectors still highly reliant on the revenues gained from oil exports, where any decline in the level of oil prices will be translated to a negative impact on the non-oil sectors, particularly manufacturing and agriculture sector.

Moreover, the value-added achieved of oil imports is not completely circulated inside the local economy to enhancing level of economic capacity as much as it is in turn devoted for importing various kinds of consuming and capital goods, where this explains that the economic policy must be taking into account all surpluses of oil revenues to be geared for reinforcement of non-oil sectors and raise level of economic growth. This policy should be supported by real governmental actions in practice, most importantly easing and accelerating all procedures that can create competition between investors and attract foreign companies, particularly in sectors that are not preferred by local investors.

Declaration of Competing Interest

The author declares that he has no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Declaration of Use of Generative AI and AI-assisted Technologies

The author declares that he has not used generative AI and AI-assisted technologies during the preparation of this work.

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Appendix

Table 1. Value added of Manufacturing and agriculture sector, and import and export values, 2004 – 2020, USD

year	Manufacturing	Agriculture	export	import
2004	3296374777	8403719246	72809874948	82762890222
2005	3260225830	11038686106	70406211011	79535150609
2006	3602617748	11515017045	60236988593	45584522906
2007	3826339987	8326038008	55104992310	33847086262
2008	4082704714	7168524787	66679858871	40710444600
2009	5552019271	7423697682	52676179880	52525315598
2010	5904042614	8426989211	56173635645	48568950791
2011	6041790860	9798183285	65282225028	40790886826
2012	6168668460	9122162261	77069792406	50389328425
2013	5584995340	11303773573	71415159217	49958213358
2014	4346292264	11076227235	71130387488	54872013205
2015	3627684380	6990950628	61142814964	62141028595
2016	3762212708	6969370899	56309038163	53046702949
2017	4054718067	5854404452	67465178287	51449858035
2018	4564045327	8059369443	84071305596	51509192869
2019	4868548873	11779564003	83113688270	67575581588
2020	4898101068	12309677989	55104077855	59753307589

Table 2. Augmented Dickey-Fuller Test of Manufacturing variable

Null Hypothesis: MANUFACTURING has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=3)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.881190	0.0498
Test critical values:	1% level	-3.959148	
	5% level	-3.081002	
	10% level	-2.681330	

*MacKinnon (1996) one-sided p-values.
Warning: Probabilities and critical values calculated for 20 observations
and may not be accurate for a sample size of 15

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(MANUFACTURING)
Method: Least Squares
Date: 12/15/22 Time: 12:13
Sample (adjusted): 2006 2020
Included observations: 15 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
MANUFACTURING(-1)	-0.344255	0.119483	-2.881190	0.0138
D(MANUFACTURING(-1))	0.639010	0.194357	3.287809	0.0065
C	1.63E+09	5.59E+08	2.919315	0.0129

R-squared	0.567137	Mean dependent var	1.09E+08
Adjusted R-squared	0.494994	S.D. dependent var	6.11E+08
S.E. of regression	4.34E+08	Akaike info criterion	42.79155
Sum squared resid	2.26E+18	Schwarz criterion	42.93316
Log likelihood	-317.9366	Hannan-Quinn criter.	42.79004
F-statistic	7.861212	Durbin-Watson stat	2.300286
Prob(F-statistic)	0.006578		

Table 3. Augmented Dickey-Fuller Test of Import variable

Null Hypothesis: D(IMPORT) has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=3)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.848046	0.0027
Test critical values:	1% level	-4.057910	
	5% level	-3.119910	
	10% level	-2.701103	

*MacKinnon (1996) one-sided p-values.
Warning: Probabilities and critical values calculated for 20 observations
and may not be accurate for a sample size of 13
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(IMPORT,2)
Method: Least Squares
Date: 12/15/22 Time: 22:28
Sample (adjusted): 2008 2020
Included observations: 13 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(IMPORT(-1))	-1.862765	0.384230	-4.848046	0.0009
D(IMPORT(-1),2)	0.445995	0.228761	1.949611	0.0830
D(IMPORT(-2),2)	0.289133	0.201410	1.435544	0.1850
C	1.66E+09	2.14E+09	0.775890	0.4577

R-squared	0.781953	Mean dependent var	3.01E+08
Adjusted R-squared	0.709271	S.D. dependent var	1.36E+10
S.E. of regression	7.34E+09	Akaike info criterion	48.51838
Sum squared resid	4.85E+20	Schwarz criterion	48.69221
Log likelihood	-311.3694	Hannan-Quinn criter.	48.48265
F-statistic	10.75852	Durbin-Watson stat	2.380861
Prob(F-statistic)	0.002475		

Table 4. Augmented Dickey-Fuller Test of Export variable

Null Hypothesis: D(EXPORT) has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=3)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.529778	0.0249
Test critical values:	1% level	-4.057910	
	5% level	-3.119910	
	10% level	-2.701103	

*MacKinnon (1996) one-sided p-values.
Warning: Probabilities and critical values calculated for 20 observations
and may not be accurate for a sample size of 13

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(EXPORT,2)
Method: Least Squares
Date: 12/15/22 Time: 22:30
Sample (adjusted): 2008 2020
Included observations: 13 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EXPORT(-1))	-2.285527	0.647499	-3.529778	0.0064
D(EXPORT(-1),2)	1.144884	0.479426	2.388029	0.0407
D(EXPORT(-2),2)	0.563620	0.375746	1.500002	0.1679
C	6.27E+08	3.21E+09	0.194951	0.8498

R-squared	0.617690	Mean dependent var	-1.76E+09
Adjusted R-squared	0.490253	S.D. dependent var	1.59E+10
S.E. of regression	1.13E+10	Akaike info criterion	49.38551
Sum squared resid	1.15E+21	Schwarz criterion	49.55934
Log likelihood	-317.0058	Hannan-Quinn criter.	49.34978
F-statistic	4.847026	Durbin-Watson stat	1.955226
Prob(F-statistic)	0.028302		

Table 5. Augmented Dickey-Fuller Test of Agriculture variable

Null Hypothesis: D(AGRICULTURE) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=3)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.215796	0.0393
Test critical values:	1% level	-3.959148	
	5% level	-3.081002	
	10% level	-2.681330	

*MacKinnon (1996) one-sided p-values.
Warning: Probabilities and critical values calculated for 20 observations
and may not be accurate for a sample size of 15
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(AGRICULTURE01,2)
Method: Least Squares
Date: 12/15/22 Time: 22:29
Sample (adjusted): 2006 2020
Included observations: 15 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(AGRICULTURE01(-1))	-0.835317	0.259754	-3.215796	0.0068
C	47669878	5.35E+08	0.089171	0.9303

R-squared	0.443048	Mean dependent var	-1.40E+08
Adjusted R-squared	0.400206	S.D. dependent var	2.66E+09
S.E. of regression	2.06E+09	Akaike info criterion	45.85149
Sum squared resid	5.51E+19	Schwarz criterion	45.94589
Log likelihood	-341.8861	Hannan-Quinn criter.	45.85048
F-statistic	10.34134	Durbin-Watson stat	1.898105
Prob(F-statistic)	0.006759		

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The Impact of Competitive Relations on the Issuers' Dividend Policy

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Abstract: Purpose: The aim of the research is to analyse the impact of indicators of market position and financial stability of companies as determinants of competitiveness on dividend policy.

Methodology: The research employed the methods of correlation analysis, multivariate regression, and statistical analysis.

Findings: As a result of the study, two indicators characterizing dividend policy and eleven indicators were identified as determinants of companies' competitiveness. It was established which determinants of competitiveness have a close connection and significant impact on the dividend policy. It was found that for Lenovo, P/B ratio (–0.69) has the greatest impact, Dividend Yield, variables not included in the model (0.62), Annual revenue (1.18), Net assets by year (0.93) — on Annual dividend payments. For ASUS, Total debt by year (0.88) has the greatest impact on Dividend Yield, Total liabilities (0.36) and Total debt (0.63) - on Annual dividend payments.

Originality: The results indicate that ASUS actively uses debt policies in the competition for investors, while Lenovo follows a more conservative approach. The results may be useful for investors when choosing companies to invest in. Research prospects may be aimed at investigating the relationship between dividend policy and global macroeconomic phenomena.

Keywords: competitive relations; competitiveness; dividend policy; market position; market estimates; financial condition; financial indicators.

JEL Classification: G10; C01; G23; G32.

Introduction

A company's dividend policy describes its propensity to pay appropriate dividends to investors. Dividend policy has a positive relationship with shareholder welfare (Nambukara-Gamage and Peries 2020). A company's payment of high or low dividends is the main characteristic of dividend policy (Dang *et al.* 2021). Factors affecting dividend policy are the subject of active academic discussions (Pinto *et al.* 2020).

Yan and Zhu (2020) noted that most studies consider dividend policy as if companies make decisions in isolation and solely on their own discretion. However, it was confirmed in a number of works that the company's dividend policy is determined both taking into account internal characteristics and external influences (Lotto 2020). Internal features may include:

- corporate governance (Yilmaz *et al.* 2022) and corporate social responsibility (Sheikh *et al.* 2022; Ben Salah and Ben Amar 2022);
- a conflict of interests (principal-agent conflict or principal-principal conflict) (Kilincarslan 2021; Khan 2022);
- stage of development (Trihermanto and Nainggolan 2022; Cadenovic *et al.* 2024);
- financial status (Wahjudi 2020; Sari *et al.* 2022);
- environmental, social, and governance (ESG) scores (Zahid *et al.* 2023);
- selected management and decision-making approaches (Tomchuk *et al.* 2021; Bykova *et al.* 2024), etc.

External influences can refer to various macroeconomic fluctuations (Ali 2022; Kukaj and Ademi 2024) and are generated by the global competitive environment (Ellili 2022; Sheikh *et al.* 2022). Competitive relations can potentially influence the dividend policy, which is the main hypothesis of the study.

Competitive relations between companies refer to the struggle between them for leadership in certain market sectors, winning consumer loyalty, innovative and technological capabilities, and the ability to adapt to changes (Sheth *et al.* 2020; Assarzadegan and Hejazi 2021). Achieving success in the noted areas is directly influenced by the company's financial condition and attractiveness for investors, in particular, expressed through market valuations. Therefore, it is important to reveal whether the financial condition and market valuations are able to influence the company's dividend policy, which, in turn, determines the advantages of companies in the competition for investors. Therefore, the aim of the study is to analyse the impact of indicators of market position and financial stability of companies as determinants of competitiveness on dividend policy.

The aim was achieved by fulfilling the following research objectives:

- determine the key indicators that characterize the dividend policy, as well as indicators that are determinants of competitiveness;
- conduct a correlation analysis between defined groups of indicators for Lenovo and ASUS as international competing companies in the technology sector;
- conduct a regression analysis between defined groups of indicators for Lenovo and ASUS, where the indicators characterizing the dividend policy are dependent variables;
- draw analytical conclusions regarding the influence of competitiveness and competitive relations on the companies' dividend policy.

1. Literature Review

Many studies focus on the factors influencing the companies' dividend policy. Iqbal *et al.* (2020) identify competition as an important determinant of dividend policy. Pahi and Yadav (2022) studied the effect of competition on dividend policy. The researchers identified competition as a proxy for external corporate governance and applied five indicators of competition and three indicators of dividends. Kang *et al.* (2021) studied the effect of competition on the companies' dividend policy by dividing firms into two groups. The first group includes companies with high dividends, the second — with low dividends. These enabled researchers to analyse the impact of increased competition on the market depending on the chosen dividend policy. Danila *et al.* (2020) explained the impact of growth opportunities on dividend policy. The researchers characterized the relationship between investment opportunities and the companies' tendency to pay high or low dividends.

A number of studies explored the impact of the dividend policy on the company's financial results or, conversely, the financial condition on the dividend policy. This can be explained by the fact that the financial condition is one of the primary determinants of the company's competitiveness. In particular, Hermansyah (2023) revealed the influence of dividend policy on the company's financial results. However, the researcher noted that such influence can be characterized both as positive and as negative. It depends on the factors influencing the dividend policy. The researcher noted the influence of the dividend policy on competitiveness, because the appropriate dividend policy is able to increase the confidence of investors, and therefore the share price. Akhmadi and Januarsi (2021) studied the relationship between profitability and company value mediated by dividend policy. Kadim *et al.* (2020) examined the value of a model company based on dividend policy, financial performance, and intellectual capital. These enabled researchers to describe the influence of financial ratios on dividend policy. Pattiruhu and Paais (2020) also aimed to identify the relationship between a number of financial indicators of companies and their dividend policy. The studied financial ratios were the rate of return on equity, the rate of return on assets, the debt-to-equity ratio, etc., and their influence on the dividend policy varied significantly. Setyabudi (2021) identified the influence of institutional ownership, leverage and profitability on company value and dividend policy as an intermediate indicator. Munandar *et al.* (2023) confirmed the influence of the company's financial condition and managerial ownership on the dividend policy through the literature review.

The review results give grounds to note that researchers give priority to the connection between dividend policy and competitiveness, as well as with the financial condition of companies. More often, studies are either theoretical or cover a large sample of dividend-paying companies. However, it is also important to study the impact of the financial condition and competitiveness of companies on the dividend policy on specific examples of companies. This will more deeply justify the approaches to the dividend policy chosen by the companies.

2. Methods

2.1. Research Design

The research design provided for such main stages as the preparatory stage, correlation analysis, regression analysis, analysing the obtained results, drawing conclusions. The preparatory stage involved sampling. After forming a sample of indicators, they were added to specially created tables for each company, the columns of which were variables and contained all the studied indicators. The rows of the tables contained the corresponding values of indicators by year, that is, observations. The created tables were used to implement the following stages of the research, in particular, correlation and regression analysis. The conclusions were drawn based on the results of the conducted analyses.

2.2. Sample

The sample included Dividend Yield and Annual dividend payments as indicators that directly characterize the company's dividend policy. The indicators related to competitive relations were included in the sample and were determined for the purpose of the study as determinants of competitiveness. These are indicators related to the company's financial condition, as well as its market valuations. These include End of year Market Cap, Annual revenue, Annual EPS, PE ratio, P/B ratio, PS ratio, Total liabilities, Total debt, Net assets, Cash on Hand by year, Shares Outstanding. All indicators were taken for 2000 to 2024 for two companies: Lenovo and ASUS (CompaniesMarketCap.com 2024). In turn, the choice of companies can be explained by their belonging to the technological sector, which is currently actively developing and provides a wide landscape for research. The companies' belonging to the same sector made it possible to draw more consistent and comparable conclusions. Furthermore, the studied companies are global market players, so the study of their dividend policies provided a unique insight into how global competition affects the performance indicators of such policies. The preparatory stage included, among other things, a graphical representation of the structure and dynamics of the studied indicators of the companies to form an understanding of their competitive capabilities.

2.3. Methods

The indicators were further standardized, and a correlation analysis was carried out using special software (STATISTA). As a result of the correlation analysis, rectangular tables were obtained with correlations between the indicators of the company's dividend policy - on the one hand, and the indicators acting as determinants of competitiveness - on the other hand. The correlation analysis made it possible to reveal which indicators from the selected groups of indicators have a statistically significant correlation. The presence of a correlation allows us to assume that with the growth of one indicator, the other also grows (or vice versa). In the case when an inverse statistical relationship was found with the growth of one indicator, the other decreases. The correlation analysis also made it possible to filter out indicators that did not have a statistically significant relationship with the indicators of the dividend policy. Their removal made the model clearer and prevented the inclusion of irrelevant variables.

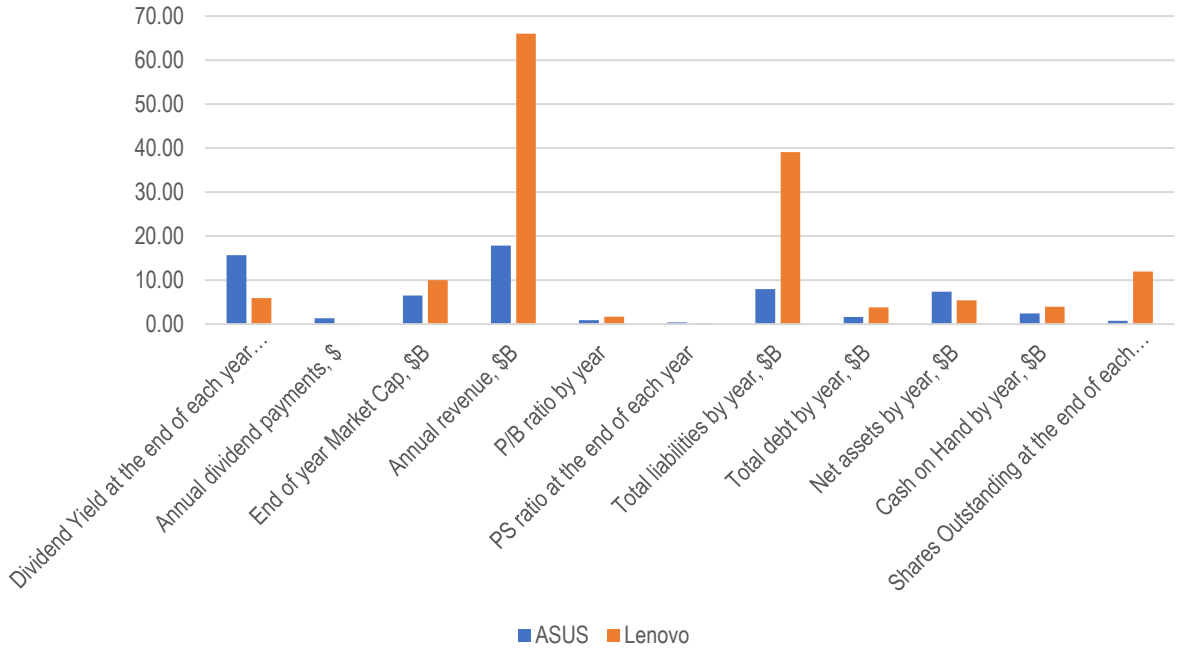
The next stage was a regression analysis, where each of the Dividend Yield and Annual dividend payments indicators for both companies were dependent variables. The indicators found as a result of correlation analysis, which had a statistically significant relationship with Dividend Yield and Annual dividend payments, were used as independent variables. The regression analysis clarified the conclusions drawn from the results of the correlation analysis due to the simultaneous consideration of the influence of several independent variables on the dependent one. Regression equations were constructed based on the results of the regression analysis that allow predicting the dependent variables and demonstrate the influence of each of the independent variables on them.

3. Results

3.1. General Condition

A number of indicators can testify to the general financial condition of the studied companies and their market valuations. Figure 1 presents the values of the indicators included in the research sample for Lenovo and ASUS. For clarity, the diagram also contains indicators characterizing the dividend policy.

Figure 1. Indicators of the Studied Companies for 2022

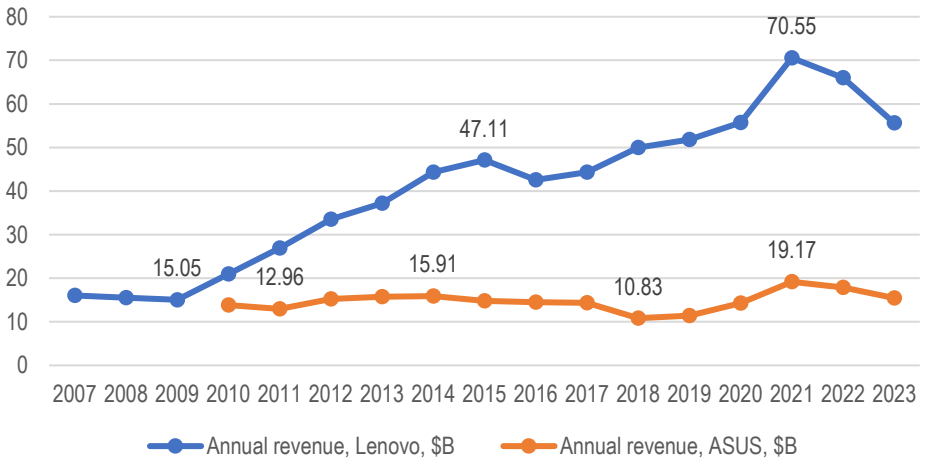


Source: graphed by the author based on CompaniesMarketCap.com (2024)

Figure 1 shows that Lenovo has significantly higher values for End of year Market Cap, Annual revenue, Total liabilities and Shares Outstanding indicators. This may indicate a larger scale of activity, as well as better financial opportunities. In addition, Lenovo is characterized by higher market valuations in terms of P/B ratio. At the same time, ASUS has higher values in terms of Net assets and PS ratio, which also indicates that the company is worthy of investors' attention according to market expectations. At the same time, Dividend Yield and Annual dividend payments of ASUS are significantly higher than those of Lenovo. Given the differences in competitive position, it is important to investigate what influences companies' approaches to dividend policy development.

Analysis of individual indicators of companies in the dynamics identifies other features related to competitiveness. Figures 2 and 3 show a comparison of the trends of such growth indicators of companies as Annual revenue and Annual EPS.

Figure 2. Annual Revenue for Lenovo and ASUS from 2007 to 2023



Source: graphed by the author based on CompaniesMarketCap.com (2024)

According to Figure 2, it can be noted that Lenovo demonstrates a much larger volume and a more stable growth of Annual revenue during the studied period. After 2021, the revenues of both companies are characterized by a certain decline, which could be related to external fluctuations affecting the market.

3.2. Correlation Analysis

The influence of competitive relations on the issuers' dividend policy was studied through a correlation analysis conducted for two groups of the selected indicators at the first stage of the study. Based on the results of the correlation analysis, rectangular matrices were built for the two studied companies - Lenovo and ASUS (Tables 1 and 2).

Table 1. Results of Correlation Analysis between Determinants of Competitiveness and Indicators of Dividend Policy for Lenovo

	End of year Market Cap	Annual revenue, $B	Annual EPS, $	PE ratio at the end of each year	P/B ratio by year	PS ratio at the end of each year	Total liabilities by year, $B	Total debt by year, $B	Net assets by year, $B	Cash on Hand by year, $B	Shares Outstanding at the end of each year, B
Dividend Yield at the end of each year, %	-0.327	0.331	-0.015	-0.079	-0.907	-0.888	0.427	0.505	0.502	-0.028	0.395
Annual dividend payments, $	0.492	0.917	0.449	-0.078	-0.557	-0.759	0.917	0.781	0.902	0.426	0.888

Source: calculated by the author based on CompaniesMarketCap.com (2024)

Table 1 shows that for Lenovo, both indicators characterizing the dividend policy have a very strong inverse correlation with the P/B ratio by year. The indicators have a strong inverse correlation with the PS ratio at the end of each year.

The P/B ratio is defined as the ratio of the share price to its book value. PS ratio is defined as the ratio of price to earnings per share. High values often indicate that the stock is overvalued or that investors expect future growth.

High values of P/B ratio and PS ratio may indicate greater opportunities for companies to reinvest profits for further growth. At the same time, it reduces the share of profits that goes to the payment of dividends. Low values may indicate a lack of growth opportunities, so such companies agree to pay higher dividends. Investors looking for stable income are more likely to invest in companies with lower market valuations, as this can provide higher dividend yields. Lower income is accepted by investors targeting companies where growth is expected — this can bring higher incomes in the future. This explains an inverse correlation between indicators of dividend policy and P/B ratio and PS ratio.

The results obtained in Table 1 give grounds to assume that Lenovo's market valuations significantly affect its dividend policy. In addition to the noted connection with market estimates, the Annual dividend payments indicator for Lenovo is characterized by a direct correlation with the indicators of the capital structure - Total liabilities, Total debt and Net assets. A close relationship between Annual dividend payments and Total liabilities may indicate that dividend payments are financed with the involvement of a larger amount of liabilities. This is acceptable for large companies that operate relatively stably, because they are able to both pay dividends and service debts. A close relationship between Annual dividend payments and Net assets may indicate a company's broader ability to pay dividends as its assets grow.

The relationship between Annual dividend payments and Shares Outstanding indicates that the company size expressed through the number of shares, can affect dividend payments. Annual revenue is also closely related to Annual dividend payments, because the ability to pay dividends directly depends on the volume of annual income.

Table 2 contains the results of the correlation analysis for ASUS. The same set of indicators as in the case of Lenovo was used for the analysis.

Table 2. Results of Correlation Analysis between Determinants of Competitiveness and Indicators of Dividend Policy for ASUS

	End of year Market Cap	Annual revenue, $B	Annual EPS, $	PE ratio at the end of each year	P/B ratio by year	PS ratio at the end of each year	Total liabilities by year, $B	Total debt by year, $B	Net assets by year, $B	Cash on Hand by year, $B	Shares Outstanding at the end of each year, B
Dividend Yield at the end of each year, %	-0.126	0.372	-0.151	0.155	-0.458	-0.595	0.523	0.964	0.397	0.041	-0.324
Annual dividend payments, $	0.270	0.688	0.180	-0.078	-0.268	-0.349	0.726	0.932	0.543	0.126	-0.335

Source: calculated by the author based on CompaniesMarketCap.com (2024)

The results of the correlation analysis show that the Dividend Yield of ASUS is inversely correlated with the PS ratio and Total debt. Annual dividend payments correlate with Annual revenue, Total liabilities, and Total debt.

So, the results of the correlation analysis for the two companies have a lot in common. However, for ASUS there is a more pronounced relationship between dividend policy indicators and liabilities, for Lenovo - with market valuations, income, and net assets.

3.3. Regression Analysis

The previously conducted correlation analysis was supplemented with a regression analysis of dividend policy indicators and determinants of competitiveness. Dividend Yield and Annual dividend payments were the dependent variables. Indicators that had a weak correlation with the dependent variables according to the results of the correlation analysis were removed from further calculations. The results of the regression analysis for Lenovo are presented in Table 3.

Table 3. Results of Regression Analysis for Lenovo

	BETA	Standard error BETA	B	Standard error B	t(16)	p-value
Regression results for the dependent variable: Dividend Yield at the end of each year. %. R=.84774839. R2=.71867733. Adjusted R2 = .68351200. F(2.16)=20.437 p<.00004. Stand. estimation error: .60504						
Free term			0.162516	0.138805	1.17082	0.258814
P/B ratio by year	-0.692715	0.171587	-0.745006	0.184540	-4.03710	0.000955
PS ratio at the end of each year	-0.217706	0.171587	-0.234139	0.184540	-1.26878	0.222670
Regression results for the dependent variable: Annual dividend payments. $. R = 97927140. R2 = 95897247. Adjusted R2 = .92706217. F(7.9)=30.052 p<.00002. Stand. estimation error: .24851						
Free term			0.622020	0.255391	2.43556	0.037638
Annual revenue. $B	1.179962	0.466140	1.085776	0.428932	2.53135	0.032164
P/B ratio by year	-0.117273	0.172561	-0.104386	0.153599	-0.67960	0.513856
PS ratio at the end of each year	-0.097084	0.180749	-0.131465	0.244759	-0.53712	0.604207
Total liabilities by year. $B	-0.545626	0.502056	-0.570048	0.524527	-1.08678	0.305380
Total debt by year. $B	0.065276	0.161697	0.059659	0.147783	0.40369	0.695862
Net assets by year. $B	0.932280	0.279393	1.003453	0.300723	3.33680	0.008704
Shares Outstanding at the end of each year. B	-0.743663	0.335048	-0.998731	0.449966	-2.21957	0.053602

Source: calculated by the author based on CompaniesMarketCap.com (2024)

Based on the results of the regression analysis conducted for Lenovo's dividend policy indicators, it can be concluded that 71.87% of the Dividend Yield can be explained by the independent variables included in the model. Annual dividend payments can be explained by relevant variables for 95.9%. The P/B ratio has a statistically significant influence on the indicator. The free term of the model has a statistically significant influence

on Annual dividend payments, which may indicate a significant influence of variables not included in the model, as well as Annual revenue and Net assets. The results of the regression analysis for ASUS are shown in Table 4.

Table 4. Results of Regression Analysis for ASUS

	BETA	Standard error BETA	B	Standard error B	t(16)	p-value
Regression results for the dependent variable: Dividend Yield at the end of each year. %. R = 97668461. R2 = 95391282. Adjusted R2 = .94367122. F(2.9)=93.141 p<.00000. Stand. estimation error: .08132						
Free term			-0.014832	0.026909	-0.55119	0.594917
PS ratio at the end of each year	-0.175780	0.081382	-0.105672	0.048924	-2.15993	0.059074
Total debt by year. $B	0.880659	0.081382	0.267305	0.024702	10.82127	0.000002
Regression results for the dependent variable: Annual dividend payments. $. R = 96253018. R2 = 92646435. Adjusted R2 = .90195246. F(3.9)=37.797 p<.00002. Stand. estimation error: .13352						
Free term			-0.051631	0.040137	-1.28635	0.230423
Annual revenue. $B	0.149117	0.121527	0.061378	0.050022	1.22703	0.250940
Total liabilities by year. $B	0.359525	0.123987	0.163735	0.056466	2.89970	0.017604
Total debt by year. $B	0.625585	0.107268	0.246624	0.042288	5.83199	0.000249

Source: calculated by the author based on CompaniesMarketCap.com (2024)

ASUS's Dividend Yield can be explained by 95.39% by the independent variables included in the model, and Annual revenue — by 92.64%. Total debt has a statistically significant influence on Dividend Yield, Total liabilities and Total debt on Annual dividend payments.

A regression equation was constructed based on the results of the regression analysis. They included all the variables that were included in the regression analysis. Regression equation for Lenovo:

Dividend Yield = 0.162516 – 0.692715 * P/B ratio – 0.217706 * PS ratio

Annual dividend payments = 0.622020 + 1.179962 * Annual revenue + (−0.117273) * P/B ratio + (−0.097084) * PS ratio + (−0.545626) * Total liabilities + 0.065276 * Total debt + 0.932280 * Net assets + (−0.743663) * Shares Outstanding

Regression equation for ASUS:

Dividend Yield = −0.014832 – 0.175780 * PS ratio + 0.880659 * Total debt

Annual dividend payments = −0.051631 + 0.149117 * Annual revenue + 0.359525 * Total liabilities + 0.625585 × Total debt

The presented regression equations can be used to predict Dividend Yield and Annual dividend payments through the values of other indicators that represent independent variables. In addition, these equations help to understand the impact of each of these indicators on Dividend Yield and Annual dividend payments. The obtained results can be useful for investors when making investment decisions taking into account competitive relations.

4. Discussion

Summarizing the results of the analysis, the following conclusions can be drawn for the two companies regarding approaches to maintaining competitiveness and developing competitive relations. For Lenovo, it is more typical to fund dividends through income and net assets. ASUS is more actively using a debt policy to finance dividends, which can be explained by the competitive struggle to attract investors. Lenovo's tendency to pay smaller dividends can be explained by the desire to invest in development, which will provide the company with a higher competitive position. So, the hypothesis regarding the influence of competitive relations on the dividend policy was confirmed.

The results of the study are consistent with the conclusions of other researchers. Danila *et al.* (2020) found that growth opportunities are characterized by a significant negative correlation with dividend yield and debt ratios. From this purpose, the researchers concluded that companies with significant opportunities for growth should not increase debt to solve problems of lack of investment. Companies with broad investment opportunities are more likely to pay low dividends, which can be explained by directing funds to investments. The study also revealed a positive effect of profitability on the dividend policy, in particular, the tendency to pay higher dividends. Pahi and Yadav (2022) concluded that companies with lower competitiveness are more likely to pay high dividends. These results correspond to the author's conclusions, which confirms their reliability.

Some authors compared the dividend policy with the level of general competition in the market. Iqbal *et al.* (2020) found the effect of intense competition on increasing the probability of paying dividends. Kang *et al.* (2021) found that when the market is more competitive, companies with high dividends pay more dividends and companies with low dividends pay less. Besides, the researchers identified a positive impact of dividend

reputation on the growth of dividend payments. This area was not part of the author's research, but it directly concerns the influence of competitive relations on dividend policy, and therefore can become a research prospect.

In a number of studies, the relationship between the dividend policy and the company's financial condition is also examined through the analysis of individual indicators. Hermansyah (2023) stated that an appropriate dividend policy can have a positive effect on the company's financial results. The researcher found that companies that tend to pay high dividends have higher growth rates, profits, and financial indicators. At the same time, companies with low profits and high dividends are characterized by worse financial performance. Akhmadi and Januarsi (2021) found that with a higher dividend policy ratio, the relationship between indicators such as profitability and firm value increases. The study also established that the dividend policy is more pronounced in companies with a lower level of financial capital. Munandar *et al.* (2023) proved that the influence of financial indicators on the company's dividend policy is significant. However, the study is theoretical and does not reveal specific influence that the indicators have and which ones.

The observed views are reflected in the author's conclusions, but these conclusions are not confirmed in some studies. Kadim *et al.* (2020) determined that indicators of liquidity, solvency and profitability did not significantly affect the dividend policy of the studied sample of companies. This may be due to differences in the samples of the studied companies. Moreover, some studies use a different set of indicators for evaluation. Pattiruhu and Paais (2020) found that indicators of current ratio (CR), return on equity (ROE) and company size do not have a significant impact on dividend policy. At the same time, debt-to-equity ratio (DER) and return on assets (ROA) have a significant positive impact on dividend policy. Setyabudi (2021) revealed that dividend policy is significantly influenced by institutional ownership, profitability and leverage. The differences found in the studies may be related to the individual characteristics and approaches affecting the dividend policy in different companies. Therefore, the appropriateness of the author's approach can be noted, which studies the specifics of the influence on the dividend policy using the example of specific companies.

Conclusions

The aim of the research was achieved, the impact of indicators of market position and financial stability of companies as determinants of competitiveness on dividend policy was determined. For this purpose, two indicators of dividend policy were determined, as well as eleven determinant indicators of competitiveness. Correlation and regression analyses were carried out between dividend policy indicators and competitiveness determinants using the example of Lenovo and ASUS. The correlation analysis of Lenovo found that a significant correlation is characteristic between Dividend Yield, PE ratio and PS ratio, as well as between Annual dividend payments, Annual revenue, PE ratio, PS ratio, Total liabilities, Total debt, Net assets and Shares Outstanding. An additional regression analysis proved that the P/B ratio has a significant influence on Dividend Yield, and Annual revenue, Net assets and variables not included in the model — on Annual dividend payments. Correlation analysis for ASUS revealed a significant relationship between Dividend Yield, PS ratio and Total debt, as well as between Annual dividend payments, Annual revenue, Total liabilities and Total debt. Regression analysis for ASUS confirmed the significant impact of Total debt on Dividend Yield, as well as Total liabilities and Total debt on Annual dividend payments. In general, the results of the study indicate a more active use of debt policy by ASUS in the competition for investors, while Lenovo takes a more conservative approach. Further directions of research may relate to identifying the connection between dividend policy and global macroeconomic phenomena.

The models obtained as a result of the research integrate the indicators characterizing the dividend policy and the indicators of the financial condition. This allows for new insights for investors, which helps to better understand the factors influencing dividend policy. The findings are important for investors and other stakeholders in the context of providing a better basis for decision-making.

Credit Authorship Contribution Statement

The authors equally contributed to the present research, at all stages from the formulation of the problem to the final findings and solution.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Declaration of Use of Generative AI and AI-assisted Technologies

The authors declare that they have used/not used generative AI and AI-assisted technologies during the preparation of this work.

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Nexus between Monetary Indicators and Bitcoin in Selected Sub-Saharan Africa: A Panel ARDL

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Abstract: The rapid adoption and growing prominence of Bitcoin and other cryptocurrencies have sparked significant interest and debate among economists, policymakers, and financial analysts. In Sub-Saharan Africa, where traditional financial systems often face challenges such as limited access to banking services, high transaction costs, and volatile currencies, Bitcoin presents both opportunities and risks. Understanding the interplay between Bitcoin and key monetary indicators such as monetary aggregates, exchange rates, and interest rates can provide valuable insights for policymakers and stakeholders in these economies. This study therefore seeks to investigate the nexus between monetary indicators and Bitcoin in selected Sub-Saharan African countries using a Panel ARDL (Autoregressive Distributed Lag) approach. The analysis focuses on understanding the dynamic relationship between key monetary variables, such as monetary aggregates, exchange rates, interest rates, and Bitcoin prices, from 2010 quarter three to 2022 quarter four. The findings reveal several significant relationships between monetary indicators and Bitcoin across the selected Sub-Saharan African countries. In the short run of the Panel Ardl monetary aggregates exhibit a positive relationship with Bitcoin prices, indicating that changes in the money supply may influence the demand for cryptocurrencies. Conversely, both exchange rates and interest rates show a negative relationship with Bitcoin prices in the short run, suggesting that currency depreciation and higher borrowing costs may reduce demand for Bitcoin. In the long run, the relationship between monetary aggregates and Bitcoin remains positive, emphasizing the potential influence of money supply on cryptocurrency markets over time. However, the significance of exchange rates diminishes, indicating a less pronounced impact in the longer term. Interestingly, interest rates continue to exhibit a significant negative relationship with Bitcoin prices in the long run, highlighting the persistent effect of borrowing costs on cryptocurrency demand. These results have important implications for policymakers, investors, and researchers interested in the intersection of monetary policy and cryptocurrency markets in Sub-Saharan Africa. Policymakers may

consider the impact of monetary policy decisions on cryptocurrency adoption and market dynamics, while investors can use these insights to inform their investment strategies.

Keywords: monetary indicators; interest rate; bitcoin; exchange rate; sub-Saharan Africa.

JEL Classification: E42; G15; C23; R11.

Introduction

Residents of Sub-Saharan Africa are using digital gold as a substitute form of currency. Since growing inflation and debt have plagued many of the region's nations, cryptocurrencies have become an alluring way to save savings, store value, and achieve more financial freedom. One of the most popular coins in cryptocurrency is the bitcoin. Vranken (2017) Since its launch in 2008, the electronic currency known as Bitcoin has grown in popularity. The blockchain a public transaction ledger is a decentralized, peer-to-peer network where transactions in the Bitcoin system are kept. Bitcoin offers decentralized transaction clearing and money issuance. A computationally demanding method for bitcoin mining, which forbids double spending of bitcoins and tampering with confirmed transactions, is essential to the blockchain's integrity. Velde (2013) is of the view that Bitcoins are worthless in and of themselves; their value comes on the belief that they might be accepted by someone else or from government fiat. Though numerous research studies have been done on bitcoin, none used monetary indicators, to see the effect on bitcoin; using panel Ardl. Research such as Vo *et al.* (2021), is of the view that Following its introduction by Nakamoto in 2008 as a substitute online payment method, Bitcoin gained popularity as a research topic and as an attractive investment vehicle. While much research has been done on the price of Bitcoin, relatively little, at least in Information System (IS) research, has been done on how Bitcoin relates to recognized economic metrics. Bitcoin, the pioneering cryptocurrency, represents a paradigm shift in the realm of finance. Its decentralized nature, limited supply, and blockchain technology have disrupted traditional financial systems, offering new avenues for transactions and investments. The growing adoption of Bitcoin globally has prompted a closer examination of its relationship with conventional monetary metrics.

During COVID-19 of 2020, the usage of Bitcoin increased drastically. Koraus *et al.* (2021) stated that in 2020, the association between bitcoin, gold, and the stock market increased due to causes like the worldwide pandemic, financial uncertainty, and the US election. The relentless push for fiat money by governments and central banks to keep their economies afloat in the wake of the coronavirus outbreak caused both bitcoins and gold to rise dramatically in 2020. The cashless Internet economy is drawn to Bitcoin (BTC) as digital gold mostly because of its attributes, which include constant pricing transparency and an absence of limitations, interruptions, or third-party control. Studies have tried to investigate how bitcoin volume is affected. Studies such as Keller and Scholz (2019) analyzed Bitcoin exchange trading and looked at the variables that affect the actions of various kinds of cryptocurrency investors. Market bids are taken into account as investors' offers and orders as a stand-in for their trading behavior to respond to this query. Vaddepalli and Antoney,(2017) also tried to investigate if economic factors are driving bitcoin transactions in selected economies, they made use of key economic factors such as trade openness, inflation, and internet penetration. Bitcoin is indeed increasing worldwide but in less developing countries such as Africa, which depend highly on the developed countries and are still slow in modern facilities. It would be necessary to know how their financial indicators fluctuates with the growing level of cryptocurrency. Levi-Oguike, Sandoval, and Ntagwirumugara, (2019) are of the view that while the developed world makes technological advancements and closes the gaps in current economic, financial, and environmentally "green" systems, improving the socio-economic indices of their respective nations and citizens in the process, it would be wise to reflect on the difficulties facing their third-world counterpart, Africa. The majority of people in the continent do not currently have access to modern, reasonably priced, and dependable energy services, suggesting that the continent continues to face challenges related to energy poverty and access in general.

Monetary indicators form the cornerstone of economic policymaking, influencing factors such as inflation, interest rates, and overall economic stability. In the context of Sub-Saharan Africa, where monetary policies are critical for fostering economic development and stability, understanding the interactions between these traditional indicators and digital assets like Bitcoin is imperative. The rapid adoption of Bitcoin in Sub-Saharan Africa, driven by factors such as limited access to banking services, high remittance costs, and currency volatility, highlights the need for a deeper exploration of its impact on and interaction with local monetary conditions. This study delves into the dynamic relationship between monetary indicators and Bitcoin, a prominent cryptocurrency, across a selection of Sub-Saharan African countries. The utilization of a Panel Autoregressive Distributed Lag (ARDL) framework allows for a comprehensive analysis that incorporates both cross-country variations and time-series

dynamics. The primary objective of this study is to investigate the nexus between monetary indicators and Bitcoin in selected Sub-Saharan African countries. Specifically, we aim to analyze how changes in monetary policies and economic conditions impact the adoption, usage, and valuation of Bitcoin within this region. Selected sub-Saharan African countries were done based on the availability of data. These countries are Nigeria, Kenya, South Africa, cabo verde, Ghana, and Mauritius.

The novelty of this paper lies in its exploration of the dynamic interaction between traditional monetary indicators and Bitcoin in Sub-Saharan African countries, an area that remains relatively underexplored in the existing literature. While many studies focus on Bitcoin's price, trading behavior, or its global impact, this research uniquely examines how monetary policy changes in specific African nations, characterized by inflation, currency volatility, and financial exclusion, affect Bitcoin adoption and usage. By utilizing a Panel ARDL approach across multiple countries, including Nigeria, Kenya, South Africa, Cabo Verde, Ghana, and Mauritius, this study provides valuable insights into the interplay between digital assets and economic conditions in emerging markets.

1. Literature Review

Monetary Indicators

Monetary indicators refer to a set of metrics that reflect the overall health and performance of a country's monetary system. These indicators are closely monitored by policymakers, economists, and financial analysts to assess the effectiveness of monetary policies and to understand the broader economic conditions. This paper will adopt the definition of Curtis and Irvine (2017) for our analysis. Curtis and Irvine (2017) defined monetary indicators to constitute, interest rates, exchange rates, and monetary aggregates. They are of the view that the money supply or the rate at which it is growing is viewed as a policy indicator by the Bank and many economists in addition to interest rates and exchange rates, which are significant indicators of monetary policy. Some propose a money supply monetary policy rule that employs the money supply as a tool for central bank policy. Nominal income determines the demand for nominal money balances.

Bitcoin

Bitcoin is a digital currency that was introduced in 2009 by an anonymous entity or group known as Satoshi Nakamoto. It is often referred to as a cryptocurrency because it relies on cryptographic techniques to secure transactions and control the creation of new units. Unlike traditional currencies issued by governments, Bitcoin operates on a decentralized network called blockchain, which is a public ledger that records all transactions. According to Böhme, *et al.* (2015). Bitcoin is a virtual money that can be used for electronic payments and other internet communication protocols. Engineers created the regulations governing Bitcoin without any apparent input from attorneys or government authorities. The foundation of Bitcoin is a transaction log that is shared by all of the computers in the network. It has safeguards against power concentrations, early adopter adoption via bootstrapping, and incentives for sincere engagement. The architecture of Bitcoin permits public transaction history, a predetermined course for money generation over time, and irreversible transactions.

2. Theoretical Framework

This paper will adopt the quantity theory of money, which was propounded by Friedman (1957). This is because the Quantity Theory of Money posits that changes in the money supply can affect currency values. In the context of Bitcoin, its limited supply and demand dynamics play a significant role in determining its valuation against fiat currencies and other assets. Understanding these valuation mechanisms is crucial for investors and market participants.

Market participants often incorporate Quantity Theory principles into their expectations and investment decisions. Changes in Bitcoin's supply dynamics, such as halving events that reduce block rewards for miners, can influence investor expectations about future scarcity and price movements. the Quantity Theory of Money provides a theoretical lens through which to analyze Bitcoin's monetary characteristics, its impact on economic dynamics, and its potential implications for the broader financial landscape. Incorporating Quantity Theory principles into discussions about Bitcoin enriches our understanding of its role as a digital asset and its interaction with traditional monetary systems. The quantity theory of money is mathematically described as:

$$MV = PT \tag{2.1}$$

Where M is the money supply, V is the velocity of circulation (the number of times money changes hands), P is the average Price level and T is the volume of transactions of goods and services. This theory posits that there is a direct relationship between the supply of money and the price level in an economy. In the context of

Bitcoin, understanding how changes in traditional money supplies (M1, M2, etc.) impact Bitcoin adoption and valuation is crucial. Therefore, equation (2.1) could be modified into:

$$MV = BV \tag{2.2}$$

Where BV is the volume of Bitcoin purchases in the economy. If MV is the money supply used as a monetary indicator in controlling the price level. Then adopting the theory of Curtis and Irvine (2017), interest rate and exchange rate would be added to the monetary aggregate. Therefore, the model would be further modified into:

$$MV + IR + EXR = BV \tag{2.3}$$

Where MV is monetary aggregates, IR is interest rates, EXR is exchange rate and BV is the price of bitcoin.

3. Empirical Review

The fast adoption of Bitcoin in Sub-Saharan Africa, driven by unique economic challenges and opportunities, necessitates a deeper knowledge of its interaction with the traditional monetary policy. This study will investigate the nexus between key monetary variables such as monetary aggregates, exchange rates, and interest rate and Bitcoins in selected Sub-Saharan African countries, employing the Panel Autoregressive Distributed Lag (ARDL) approach. By exploring these interactions, we aim to provide valuable insight for policymakers and stakeholders in the navigating the complexities of integrating digital currencies within these emerging economies. According to Bouri *et al.* 2017, they examine whether Bitcoin can act as a hedge against global uncertainty. Although the study was not specific to the Sub-Saharan context, but it does provide a framework for understanding the relationship between Bitcoins and some vital economic indicators. They employ Quantile regression, and their findings reveal that Bitcoin does act as a hedge against macroeconomic uncertainty as Bitcoin react positively to both higher quantiles and shorter frequency movement of Bitcoin returns.

Hayes (2017) seeks to determine the most likely factors that contribute to the construction of cryptocurrency values, including Bitcoin's worth. The degree of competition in the network of producers, the rate of unit production, and the complexity of the algorithm used to "mine" for the cryptocurrency are the three main factors that influence the value of cryptocurrencies, according to a regression model estimated using cross-sectional empirical data analyzing 66 of the most popular cryptocurrencies. Following a series of stationarity and cointegration tests, Chen (2021) selected the VEC model as the foundation for an empirical price estimate of Bitcoin. He also includes rival approaches on his data set that have been applied in another research. VAR and ADRL models are these approaches. Using daily data from 2009 to 2019, the baseline model demonstrates that, in the near term, the medium of exchange and financial anticipation pressures have the greatest impact on the price of bitcoin, with blockchain technological considerations having the least effect. A thorough empirical analysis of Bitcoin's payment and investing features, as well as how they affect e-commerce, is given by Polasik *et al.* (2015). They look into both adoption and pricing formation since network externality theory contends that a network's worth and uptake are related. They found that the popularity of Bitcoin, the opinions expressed in media articles about cryptocurrencies, and the overall volume of transactions are the main factors influencing its returns. The objective of Havidz, Karman, and Mambea's (2021) analysis is to use liquidity and macrofinancial components as potential influences on the price of Bitcoin. The stock market index, foreign exchange, interest rates, and gold were the macro-financial elements examined in this study; the liquidity ratio was the internal factor. With a total of 2,826 observations collected weekly from 1 January 2017 to 29 December 2019 from 18 nations, this study used a fixed-effect model (FEM) and the Generalized Method of Moments (GMM).

According to the analysis, the US dollar increases the trading of Bitcoin; an increase in interest rates will reduce investors' desire to buy Bitcoin as a speculative asset; and gold may eventually supplant Bitcoin as a preferred asset. Ciaian, Rajčániová, and Kancs (2015) discovered, using daily data spanning five years (2009–2015) and time-series analytical techniques, that the price of BitCoin is significantly influenced by market forces as well as its allure for investors and users, albeit with fluctuations over time. Neves (2020) aims to make a valuable contribution to the analysis of Bitcoin pricing by examining the relationship between the attractiveness and the value of the digital currency. The association between the price of the virtual currency, Bitcoin, and the quantity of Google searches that included the terms bitcoin, bitcoin crash, and bitcoin crisis between December 2012 and February 2018 is examined using the error correction model. The same approach was also used in the study to examine Bitcoin values that were traded during the same period but denominated in various sovereign currencies. The Johansen test shows cointegration between the first two terms' Google search volume and price. Guizani and Nafti (2019) sought to understand the causes of bitcoin fluctuation. Try to determine, examine, and quantify the primary factors that affect the price of bitcoin. They utilize time series analysis on daily data spanning

from December 19, 2011, to February 6, 2018. They employed several strategies, such as the Granger causality test, the cointegration test, and the Auto Regressive Distributed Lag (ARDL) model. According to their predicted results, the price of Bitcoin is significantly influenced by the attractiveness indicator, the number of addresses, and the mining difficulty, with variations over time. Wang, Xue, and Liu (2016) investigate whether digital currencies like bitcoin have the potential to be profitable investments and examine the price variations of bitcoin. Cointegration analysis and the Vector Error Correction (VEC) Model have been used to show how the price of bitcoin relates to several variables, such as the price of oil, the stock market index, and the volume of bitcoin traded daily. The empirical study shows that there is a short-term dynamic relationship and a long-term equilibrium between the four elements. According to the short-term analysis, the stock price index has a comparatively greater impact on the price of bitcoin than the oil price and the volume of bitcoin trades. Kjaerland *et al.* (2018) look for the causes behind the price swings of Bitcoin. The value of the virtual currency Bitcoin has fluctuated, rising from $0 in 2009 to over USD 19,500 in December 2017. Using Ordinary Least Squares regression, they have developed two Autoregressive Distributed Lag models to explain the price changes. 279 weekly measurements from 18.09.2011 to 05.02.2017 are included in the data.

Nine independent factors have been evaluated in this analysis, with the price of Bitcoin serving as the dependent variable. Our primary discovery and contribution is the identification of political events and remarks as major influences on the price of Bitcoin.Kolodin and Fantazzini (2020). examines the connection between hash rate and the price of bitcoin by separating the impact of structural breaks, the halving of the price of bitcoin, and energy efficiency of mining equipment on price trends. To account for any nonlinearity, they either consider the hash rate directly or use the Bitcoin cost-of-production model (CPM) as a proxy for the hash rate. The hash rate and CPMs were never significant in the first subsample under examination (01/08/2016–04/12/2017), however, a significant cointegration relationship was discovered in the second subsample (11/12/2017–24/02/2020). Bouri, Azzi, and Dyhrberg (2017) used a daily database denominated in US dollars to investigate the relationship between price returns and volatility variations in the Bitcoin market. There is no indication of an asymmetric return-volatility link in the Bitcoin market based on the results over the full timeframe. The authors examine whether the return-volatility relationship changed before or after the 2013 price fall. They find that there was a substantial negative relationship between volatility and previous shocks prior to the disaster, but not after. This result demonstrates that, prior to the December 2013 price drop, positive shocks were more likely than negative shocks to raise conditional volatility. Sami and Abdallah's (2022) goal was to evaluate how the cryptocurrency market affected the market value of African enterprises, particularly at the sectoral level. The authors used Panel-Corrected Standard Errors (PCSEs) and Panel Double-Clustered Standard Errors (PDCSEs) to achieve the primary objective of the study. The outcome demonstrates how the bitcoin market lowers a company's worth in Africa. Bouraoui (2020) examined the volume of local Bitcoin transactions in 21 developing nations. Specifically, he aims to identify the factors that influenced the amount of Bitcoin trading in these nations between August 1, 2015, and June 2, 2018. He discovered evidence of a strong correlation, particularly in the near term, between the local Bitcoin trade volume in each nation and the corresponding banking system access based on VECM and ARDL models. Ozili (2022) demonstrated the merits and benefits of decentralized financing (DEFI) using literature reviews and external data sources. The results indicate that DeFi is not well-liked in Africa. Ma *et al.* (2022). Investigated monetary policy shocks and bitcoin prices, they investigated this using FOMC meetings announcements in the USA, concerning monetary policy. They had three strands of results based on the announcement effect. Though using an empirical quantile regression analysis, they found that the effect of bitcoin prices from monetary policy is more pronounced in the higher quantile, which shows that monetary policy greatly impacts bitcoin prices in the bull market. Zhang, Hou, and Ba (2021) used a special database from the Decentralized Finance platform to examine the factors influencing interest rates in the cryptocurrency loan market. Using a moderated mediation model, they verify the presence of both moderation and mediation effects in the bitcoin loan market. First, the empirical findings demonstrate a strong correlation between the interest rate and the loan-to-value ratio, which serves as the lending industry's mediation variable. Secondly, there is an obvious correlation between the interest rate and changes in the price of Bitcoin. Feng and Zhang (2023) employed the Autoregressive Distributive Lag (ARDL) and Error Correction Specification in analyzing the currency exchange rate predictability, emphasizing the new power of bitcoin prices. They found out that exchange rate serves as a fundamental for bitcoin prices. Troian (2024) investigates the complex relationship between oil futures and cryptocurrencies from 2018 to 2024, identifying weak short-term correlations but significant long-term cointegration, especially involving major cryptocurrencies like Bitcoin and Ethereum. The study highlights heterogeneous relationships across cryptocurrency-oil pairs and shows limited predictive power of oil prices on cryptocurrency movements. These findings offer important insights for portfolio diversification, risk management,

and market regulation, contributing to the growing literature on the integration of digital assets with traditional financial markets. Setyawan *et al.* (2024) explore cryptocurrency's role in emerging markets, highlighting its benefits lower transaction costs, faster settlements, and increased transparency while addressing challenges like regulatory hurdles, security concerns, and limited awareness. The study examines cryptocurrency's disruption of traditional financial systems and its potential in international trade, offering insights for policymakers, businesses, and investors.

This paper seeks to address the significant gap in the literature by focusing on the interaction between monetary indicators and Bitcoins in Sub-Saharan Africa. The Sub-Saharan region encompasses diverse economies with varying levels of development, regulatory environments and financial infrastructures. By investigating how these factors influence the relationship between monetary indicators and Bitcoins. This study provides valuable insights for policymakers. Exploring the policy implications such as how central banks view and interact the Bitcoin-related activities and the risk management strategies adopted by the financial institutions and governments in response to the growing presence of Bitcoins adds substantial value to the body of knowledge on the Bitcoin relationship to monetary policy in the selected countries

4. Materials and Methods

The study used the Panel Autoregressive distributive lag model approach to quantify the link between monetary indicators and bitcoin in selected sub-Saharan African countries. Bloomberg and International Financial Statistics provided the data for this study. Quarterly data from 2010 quarter three to 2022 quarter four was included in the study. The study period chosen for this purpose is based on the availability of data, and it covered the early period of Bitcoin and its boom era. Table 1 displays the lists of variables for which study data were collected. It explains the several variables and resources utilized to estimate the monetary indicator and bitcoin in sub-Saharan Africa.

Table 1. Data and Variable Description.

Variables	Description	Source
BV	Bitcoin is viewed as a digital alternative investment in Sub-Saharan Africa, allowing individuals and institutions to diversify their investment portfolios beyond traditional assets like stocks, bonds, and real estate.	Bloomberg
MV	Monetary aggregates of selected sub-Saharan African countries. In the context of this paper, it is the highest monetary aggregate in each sub-Saharan Africa used.	International Financial Statistics
Ir	The interest rate of selected sub-Saharan African countries. In the context of this paper, interest. Interest rates in Sub-Saharan Africa, as in other regions, are a critical tool of monetary policy used by central banks to influence economic activity. They represent the cost of borrowing money or the reward for saving.	International Financial Statistics
exr	Exchange rate of selected sub-Saharan African countries. The exchange rate is a critical economic variable that denotes the value of one country's currency in terms of another currency. In Sub-Saharan Africa, exchange rates hold significant importance due to the region's economic characteristics and the role of international trade, investment, and aid in these economies.	International Financial Statistics

Source: Authors computation, 2024

5. Model Specification

This study employs quarterly series data of the selected monetary indicators of 6 sub-Saharan countries from 2010 quarter three to 2022 quarter four. The series was procured from Bloomberg and international financial statistics. The variable of interest includes bitcoin (BV), monetary aggregate [MV], interest rate [Ir], and exchange rate (exr).

Mean Group

To address the bias resulting from heterogeneous slopes in dynamic panels, Pesaran, Shin, and Smith (1995) proposed the Mean Group (MG) model. The MG estimator, on the other hand, calculates the panel's long-run parameters by averaging the long-run parameters from ARDL models for each country. If the ARDL model, for example,

$$y_t = a_i + \gamma_i y_{i,t-1} + \beta_i x_{it} + \varepsilon_{it} \quad (5.1)$$

Here, i stands the country where i=1,2,3…N. Then the long run parameter is θ_i

$$\theta_i = \frac{\beta_i}{1-\gamma_i} \quad (5.2)$$

The MG estimator for the whole panel is given by

$$\theta = \frac{1}{N}\sum_{i=1}^{N}\theta_i \quad (5.3)$$

$$\sigma = \frac{1}{N}\sum_{i=1}^{N}\sigma_i \quad (5.4)$$

Equations (5.2) to (5.4) illustrate how the model estimates distinct regressions for every nation and computes the coefficients as an unweighted average of the predicted coefficients for each nation. There are no limitations as a result. It permits heterogeneity and variation in all coefficients over both the short run and long run. However, having a sizable enough time-series dimension in the data is a prerequisite for this method to work consistently and be valid. Conversely, the Pool Mean Group was utilized to identify both the short- and long-term relationships between bitcoin and monetary indicators, as well as to look into potential country-specific heterogeneous dynamics. The best method for analyzing dynamic panels is ARDL (p,q) model with autoregressive distributed lag in error correction form then after that, compute the model using the mean group (MG) that Pesaran and Smith(1995) provided and the estimators for the Pooled Mean Group (PMG) created by Pesaran *et al.* (1999). The ARDL according to Loayza and Ranciere (2006), the specification is written as follows:

$$Y_{it} = \sum_{j=1}^{p-1}\gamma_y^i\,(y_i)_{t-j} + \sum_{j=0}^{q-1}\partial_y^i\,(x_i)_{t-j} + \varphi^i(y_i)_{t-j} + \mu_i + \varepsilon_{it} \quad (5.5)$$

where $(x_i)_{t-j}$the (k x 1) is a vector of explanatory variables for group i and μ_i represents the fixed effect. The panel may not be balanced in theory, and p and q may differ between nations. One way to reparametrize this model is as a VECM system:

$$\Delta Y_{it} = \theta_i\left(Y_{i,t-1} - \beta_i x_{i,t-1}\right) + \sum_{j=1}^{p-1}\gamma_y^i\,\Delta Y_{i,t-1} + \sum_{j=0}^{q-1}\delta_y^i\Delta(x_i)_{t-j} + \mu_i + \varepsilon_{it} \quad (5.6)$$

In this case, the equilibrium (or error)-correction parameters are denoted by the θ_i; and the long-run parameters by the β_i. The elements β are shared by all countries, which is the pooled mean group restriction.

$$\Delta y_{it} = \theta_i\left(y_{i,t-1} - \beta_i x_{i,t-1}\right) + \sum_{j=1}^{p-1}\gamma_y^i\,\Delta(y_i)_{t-j} + \sum_{j=0}^{q-1}\delta_y^i\Delta(x_i)_{t-j} + \mu_i + \varepsilon_{it} \quad (5.7)$$

where y is Bitcoin, x is a set of independent variables, γ, and δ represent the short-run coefficients of dependent and independent variables respectively, β is the long-run coefficients, θ is the coefficient of speed of adjustment to the long-run status. In contrast, i and t represent the country and time respectively. According to Demetriades and Law (2006), the three models that can be used to estimate the above specification are PMG, MG, and even DFE estimators. All three models take into account the heterogeneity of the dynamic adjustment process and the long-run equilibrium.

Hausman Test

The Hausman test is a statistical test used in econometrics to determine whether the Pooled mean group or Dynamic fixed effect is more appropriate in panel data analysis. In the context of panel ARDL (Auto Regressive Distributed Lag) models, which are used to analyze the long-run relationships among variables in panel data, the Hausman test helps in choosing between dynamic fixed effects and pooled mean group.

6. Results and Discussions

Descriptive Statistics

Table 2. Summary Statistics of the Variables used in this Study

Variables	BV	MV	Ir	exr
Mean	8430.69	5688769	8.64	120.56
Maximum	58960.2	5.22e+07	26	612.19
Minimum	0.06	11155.98	0.25	2.23
Standard dev.	14137	1.07e+07	5.72	136.07
Observation	300	300	300	300
Time series	50	50	50	50
Country	6	6	6	6

Source: Authors computation, 2024

The descriptive statistics presented in Table 2, show that MV has the highest mean value among the variables, followed by BV. The variable with the highest maximum value is BV with a value of 58960.2, followed by exr, and the variable with the least maximum value is MV with a value of 5.22e+07. The variables with the minimum value is BV, with a value of 0.06. The standard deviation of BV, MV and Ir are less than their mean except exr which their standard deviation is greater than their mean. This means that the variables in the panel not dispersed from their mean, except exr which is volatile.

Unit Root Test

The panel unit root aspect of the Harris tzavalis test is used when dealing with panel data, which involves observations on multiple individuals or entities over time. It extends the unit root test to account for potential cross-sectional dependence among the individuals in the panel. This is important because it allows for a more accurate analysis of the data by considering both the time series and cross –sectional dimensions.

Table 3. The Unit Root Test

Variables	level		first difference	
	Statistics	z	statistics	z
BV	0.83***	-3.46		
lnMV	0.99	1.89	-0.24***	-45.78
Ir	0.91*	-1.42		
exr	1.00	2.51	0.06***	-34.23

*** p<0.01, ** p<0.05, * p<0.1

Source: Authors Computation (2024).

The table shows that BV and ir are stationary at level, BV at 1percent and Ir at 10 percent level of significance. MV and exr were stationary at first difference, both at 1 percent level of significance

Panel ARDL Model

The Panel Autoregressive Distributed Lag (Panel ARDL) approach is a statistical method that analyzes relationships between variables in panel data settings. It combines the Autoregressive Distributed Lag (ARDL) model with panel data techniques to account for the analysis's time series and cross-sectional dimensions.

The result of the short-run from Table 4, shows that dynamic fixed effect (DFE) is preferable to the pooled mean group. Based on the result of the Hausman test it shows that the Dynamic Fixed Effect should be chosen over the Pool Mean Group model. The reason for this choice is that the Hausman test indicates a statically significant difference between PMG and DFE estimates suggesting that the DFE model which is consistent under both the null and alternative hypothesis provides a more reliable estimate, Also the DFE model can handle the problem of potential endogeneity of omitted variable biases more effectively than the PGM model. The result of the DFE, shows that 21% of deviation are corrected each quarter. This indicates a high speed of adjustment towards the equilibrium of in the Bitcoin market, suggesting that Bitcoin prices are responsive to shifts in economic fundamentals. A change in MV in selected African countries would bring about a 14943 positive unit change in BV. A change in Ir in sub-Saharan Africa would bring about a 920.13 unit reduction in BV, which showed to be significant at 5% level of significance. On the other hand, a change in exr in sub-Saharan Africa brings about a 15.82 reduction on BV.

The long-run of DFE shows that a change in MV, would bring about a 0.0027 positive unit change on BV, which showed to be significant at 10 %. A change in Ir, would bring about a 2376.95-unit decrease in BV, which showed to be significant at 1% level of significance. The result of the exr, showed that a 1perccent change in exr would bring about a 113.63-unit reduction in BV which is not significant. The constant showed that BV would have a unit decrease of 5737.39, which is also significant at 5%.

Table 4. Panel ARDL Model

	Pool Mean Group Model (PGM)		Dynamic Fixed Effect Model (DFE)	
VARIABLES	Long Run	Short Run	Long Run	Short Run
Error Correction		0.25***		0.21***
		(0.0818)		(0.0369)
D.lnMV		17,150		14,943
		(18,730)		(14,045)
D.ir		-1,715		-920.1**
		(1,059)		(445)
D.exr		-56.42		-15.82
		(259.7)		(45.46)
M3	-0.0048		0.0027*	
	(0.0041)		(0.0015)	
Ir	-1,381*		-2,377***	
	(720.3)		(887.6)	
exr	2,137***		-113.6	
	(367.6)		(127.7)	
Constant		29,361*		-5,737**
		(15,310)		(2,438)
Observations	294	294	.	.
HausmanTest[Chi-Square]				41.85***

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Source: Authors Computation (2024).

Discussion of findings

The findings highlight the intricate relationship between monetary indicators and Bitcoin valuation in Sub-Saharan Africa. The significant positive impact of money velocity suggests that economic activity can have a favorable effect on Bitcoin demand. Conversely, the significant negative impact of interest rates reinforces the sensitivity of Bitcoin to traditional monetary policy tools, where higher rates discourage investment in non-yielding assets. The non-significant impact of exchange rates indicates a complex and less clear-cut relationship, warranting further investigation.

The significant positive impact of money velocity on Bitcoin valuation suggests that as economic activity increases, the demand for Bitcoin also rises. This conforms to Ma *et al.* (2022), and it could be due to several factors, including increased disposable income leading to more investment in cryptocurrencies, or a greater propensity for people to seek alternative investments during times of economic dynamism. The significant negative impact of interest rates on Bitcoin valuation indicates that higher interest rates discourage investment in Bitcoin. This does not conform to Zhang, Hou, and Ba (2021) who concluded that there is a correlation between interest rate and bitcoin. This could be that Bitcoin, like other non-yielding assets, does not provide interest or dividends. When traditional financial instruments offer higher returns due to increased interest rates and are less volatile in sub-Saharan Africa, investors may prefer these over Bitcoin, leading to a decrease in Bitcoin demand in Sub-Saharan Africa. The non-significant impact of exchange rates on Bitcoin valuation suggests that the relationship between exchange rates and Bitcoin demand is complex and not straightforward. This contradicts the works of Feng and Zhang (2023), it could be due to the decentralized nature of Bitcoin, making it less sensitive to currency fluctuations, or because other factors, such as regulatory environments and investor sentiment, play a more dominant role in influencing Bitcoin demand in Sub-Saharan Africa. Further investigation is needed to understand the underlying dynamics.

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Conclusion and Recommendations

The study made use of monetary indicators comprising monetary aggregates, interest rates, and exchange rates of selected sub-Saharan countries. The dependent variable in the analysis is bitcoin volume. The descriptive statistics and unit root were the pre-estimation tests carried out. The panel Ardl was then estimated using the pooled mean group and dynamic fixed effect based on Stata 17. The unit root test result showed that the series were of mixed stationarity. The Hausman test showed that the dynamic fixed effect is preferable to the pooled mean group. The result of the dynamic fixed effect of the panel ardl showed that in the short run monetary aggregates have a positive relationship with Bitcoin while the exchange rate and the interest rate have a negative relationship. The same result was found in the long run, though in the short run, interest rate and monetary aggregates was significant but in the long run, only the exchange rate was insignificant. Interest rate and monetary aggregate showed to be significant both in the short run and long run. Based on this findings, there is a relationship between monetary indicators and Bitcoin in sub-Saharan Africa.

1. Africa should strive to provide clear and comprehensive regulations regarding cryptocurrencies like Bitcoin. This includes defining legal status, taxation policies, and regulatory oversight to ensure investor protection and financial stability. Policymakers (monetary- fiscal consolidation) may consider the impact of monetary policy decisions on cryptocurrency adoption and market dynamics, while investors can use these insights to inform their investment strategies. Furthermore, researchers can build upon these findings to explore additional factors shaping the relationship between monetary indicators and Bitcoin in the region.
2. Given the positive relationship between monetary aggregates and Bitcoin in the short and long run, central banks could consider adjusting their monetary policy to manage the impact on Bitcoin prices. This might involve monitoring and possibly adjusting money supply growth rates to moderate fluctuations in Bitcoin prices.
3. While the exchange rate was not significant in the long run, it had a negative relationship with Bitcoin in the short run. Central banks should continue to monitor exchange rate movements and their impact on Bitcoin prices, as sudden changes in exchange rates could influence investor behavior towards Bitcoin.

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Credit Authorship Contribution Statement

Authors have contributed equally to this research.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Declaration of Use of Generative AI and AI-Assisted Technologies

The authors declare that they have used/not used generative AI and AI-assisted technologies during the preparation of this work.

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Empowering a Knowledge-Based Economy: An Assessment of the Influence on Economic Development

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Abstract: Scientific research is one of the most important variables affecting the economic growth and development of a country, being the engine of innovation. In this regard, the relevance of various assessments of scientific interaction with economic development is determined by modern requirements. The study aims to investigate the impact of scientific research on economic development in Albania. The assessment was based on the analysis of secondary data from organisations such as Eurostat and INSTAT, which were further considered within the framework of an econometric model in EViews. The study highlighted the role of stimulating economic development in Albania in various sectors. The study demonstrated that scientific research is highly significant for the economic growth of a country. Based on the statistical data during the period from 1996 to 2022, a regression model was employed to simulate the relationship between independent variables (scientific labour force, public research and development (R&D) expenditures, and patents) and the dependent variable (gross domestic product (GDP) growth). The study shows that these factors have a positive impact on the gross domestic product per capita in Albania. The empirical research results revealed that the scientific labour force, public R&D expenditures and patents have a positive and significant impact on GDP growth in Albania. Based on the information received, recommendations were made to improve the quality of scientific research in the country. The result of this study could provide valuable information to policymakers and serve as scientific evidence for future studies

Keywords: policy reforms; global competition; productivity; academic publishing; education.

JEL Classification: I23; C32; H52.

Introduction

The development of science and technology is essential for economic prosperity. Thus, studies and publications are the primary means of disseminating new knowledge and research results. This allows scientists, entrepreneurs and government agencies to get acquainted with the latest discoveries in various fields, which stimulates innovation and the development of new technologies. In addition, studies describing new methods, technologies, research and discoveries contribute to scientific and technological progress. This is important for improving production processes, improving the quality of goods and services, and developing new products and services. The publication of scientific research can attract the attention of investors and financiers who are interested in supporting promising projects and ideas, and motivate scientists, students and researchers to be active in research and develop their professional skills. In addition, publications in scientific journals and conferences facilitate international communication and cooperation between scientists, research institutes, universities and companies. Thus, the role of the development of scientific articles for economic well-being is extremely important and is relevant for further research.

Many scholars studied the impact of scientific articles and research papers on economic development. Thus, as part of a study, Lis *et al.* (2021) addressed the peculiarities of economic research on Albania in the modern literature. The study identified seven thematic research clusters, including the transition of Albania's economy to a market economy, the specifics of the education sector, the challenges of developing innovations, and the country's European integration. Domi *et al.* (2019), in turn, analysed opportunities to develop innovations in the country and noted that this can be achieved primarily by promoting such ideas among small and medium-

sized enterprises. Nevertheless, other approaches to the development of science and innovation in the country were also addressed.

In turn, the role of science, technology and innovation in achieving the Sustainable Development Goals was discussed by Walsh *et al.* (2020). Scientists described in detail the need for modern innovation development in countries required to achieve the goals of sustainable development more effectively and to better implement domestic policies in this area. It is worth noting that this is also true for Albania, where the use of such approaches can also help to achieve sustainable development goals more effectively. The role of scientific expertise in the development of COVID -19 policy was discussed by Hodges *et al.* (2022). They noted that scientific expertise initially played a crucial role in shaping public policy to address the pandemic, but that this role declined over time, due to the need for the government to reduce economic and social restrictions. Scientists also note the enormous role of the recommendations made by the expert community in countering the effects of the crisis. This is one of the reasons for ensuring more active development of this area in the country. Cameron *et al.* (2020), in turn, considered the role of scientific communication in predicting scientific identity and research career intentions. They noted the role of scientific communication skills among scientists in ensuring more effective development of innovations in the country, which indicates that public authorities should prioritise their development.

Thus, the study aims to assess the impact of scientific works on the economic development of Albania. Research Questions are as mentioned:

1. What effect has the scientific labour force, public R&D expenditures and patents on GDP per capita?
2. What is the impact of the scientific labour force, public R&D expenditures and patents on GDP per capita?

The hypothesis of this study is H_0: Public expenditure in R&D, patents and scientific labour force affect positively economic development. The objectives of this study are to determine the relationship between GDPs per capita and the scientific labour force, public R&D expenditures, and patents, and to estimate the impact of the scientific labour force, public R&D expenditures, and patents on GDP growth.

1. Literature Review

The role of scientific publications in promoting economic growth and innovation has been widely studied, particularly in emerging nations. Recent studies have focused on the obstacles that emerging nations confront in the global academic publishing scene. Vasconez-Gonzalez *et al*. (2024) shed light on the phenomenon of "publish or perish", claiming that the pressure to publish has altered research priorities in emerging nations. This pressure frequently leads to a preference for quantity over quality, with researchers in underdeveloped countries participating in methods that prioritise publication metrics above meaningful contributions to knowledge. According to the report, this dynamic may weaken the capacity for scientific research to effectively contribute to economic growth by shifting the focus away from relevant research and towards increasing publication numbers.

The commercialisation and marketing of academic research pose substantial challenges to the integrity of scientific publishing. Bauwens *et al*. (2023) critically evaluate the rising market pressures on academic institutions, contending that the commercialisation of research has created a competitive atmosphere that may jeopardise the integrity and sustainability of academic output. Their findings suggest that academic marketisation fosters a "science-for-sale" culture, in which financing and rankings take precedence over research that might have long-term social and economic advantages. This pattern, which is especially common in sustainability research, is indicative of larger structural flaws within the academic knowledge economy.

Similarly, Mills (2024) investigates the link between academic publication measures and the global research economy, with an emphasis on the role of big publishers in determining worldwide academic objectives. His analysis demonstrates that the concentration of academic publishing power in the hands of a few prominent entities has far-reaching consequences for research in developing economies. These publishers, along with prominent indexing systems, effectively control the visibility and influence of research products. This concentration of power further marginalises research from under-represented regions, since academics in underdeveloped nations struggle to achieve respect within these systems.

The history and evolution of biomedical publication have also played an important role in comprehending the contemporary issues of scientific dissemination. Sever (2023) presents a comprehensive overview of the biomedical publishing industry, tracking its evolution from conventional print media to the internet age. He discusses how the fast rise of biomedical publications has created both benefits and concerns, including the need for increased openness and equality in publication standards. Sever's work is important in the context of this research because it demonstrates how changes in publication methods have a direct impact on the accessibility and distribution of information, which are critical for fostering innovation and economic progress in poor nations.

Soler *et al*. (2023) look more deeply at the infrastructure restrictions that form the academic knowledge economy, particularly in developing regions. They claim that the present academic publishing infrastructure does not promote critical and innovative research because it frequently imposes inflexible constraints that limit the field of inquiry. This viewpoint is consistent with the wider issue of the commercialisation of academic publication, in which the emphasis on market-driven outcomes stifles the possibility for revolutionary research that may generate economic growth. They push for changes to these infrastructures to encourage more inclusive and varied research outputs.

Šojat and Skala (2023) discuss scholarly publishing's ability to improve science and technology. Their research predicts that technological advancements like artificial intelligence and blockchain will transform academic publication by improving transparency, accessibility, and peer review procedures. These advancements are especially important for underdeveloped nations, where access to publishing platforms and resources is sometimes restricted. The authors argue that technology improvements might help bridge the gap between rich and developing countries, allowing researchers from the latter to make more effective contributions to global scientific discussion and, as a result, economic prosperity.

Hyland (2023) investigates the role of academic publication in the attention economy, focussing on how the quest of visibility and effect has transformed the landscape of scientific communication. His study demonstrates that, in the competition for attention, researchers frequently prioritise subjects and approaches that are more likely to earn quick notoriety, thus sidelining research with long-term, significant benefits. This trend, as seen by Hyland, is especially troublesome in developing economies, where academics may feel driven to adhere to global trends at the expense of addressing local concerns critical to their countries' economic progress.

Synthesising this research reveals that the global academic publishing system provides both benefits and problems for emerging nations such as Albania. The commercialisation of research, the dominance of big publishers, and the emphasis on publishing metrics all contribute to a climate in which important scientific contributions are eclipsed by the chase of academic reputation. However, the possibility for change, driven by technological innovation and a reevaluation of research goals, indicates that the role of scientific publications in encouraging economic growth may still be realised.

2. Materials and Methods

In this study, secondary data is obtained from the Eurostat and INSTAT. This study includes data for a period of 27 years (1996-2022) analysed through an econometric model using the EViews (10) program. The Scimago Journal & Country Rank (n.d.) Index was used to assess the state of research and development. It is based on citations of journal articles, assigning them a value depending on this. This study used citation statistics for the period from 1996 to 2023 by country, which was used to assess the state of research and development in some countries, and in Albania in particular. Microsoft Excel was used to create figures and tables.

For testing the aforementioned hypothesis, quantitative methods were applied. The econometric model is as follows (1):

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon, \quad (1)$$

where: Y – GDPG – dependent variable; X_1 – RD – independent variable; X_2 – P – independent variable; X_3 – SLF – independent variable; β_0 – constant coefficient that indicates the value of Y when X=0; β_1 – coefficient that indicates what will be the value of Y when X1 increases or decreases by one unit maintaining the X_2 and X_3 constant; β_2 – coefficient that indicates what will be the value of Y when X2 increases or decreases by one unit maintaining X_1 and X_3 constant; β_3 – coefficient that indicates what will be the value of Y when X_3 increases or decreases by one unit maintaining the X_1 and X_2 constant; ε – error term.

After the econometric model specification and variables explanation the model of this study is as follows (2):

$$GDP = \beta_0 + \beta_1 RD + \beta_2 P + \beta_3 SLF + \varepsilon, \quad (2)$$

where: GDP – gross domestic product growth; RD – research and development expenditures; SLF – scientific labour force.

The model was used to estimate the relationship between the level of GDP per capita, research expenditures, patents and developments, and the scientific workforce, which formulated the main conclusions of the paper.

Thus, the study used many methods. For instance, econometric analysis was used to evaluate economic data and test hypotheses related to the impact of the above variables (public expenditures on R&D and the

scientific workforce) on GDP. Modelling, in turn, was used to form a system for estimating the level of gross domestic product per capita, i.e., to directly build a model for estimating gross domestic product in the country. The descriptive method was used to characterise the components and phenomena studied in the research. The graphical method was used to assess the phenomena by creating figures and graphs and analysing their information.

3. Results

Scientific research in general plays a key role in stimulating economic development in many areas. It stimulates innovation through the discovery of new knowledge and the development of technologies, which leads to the creation of new products and industries that stimulate economic growth and competitiveness (Rodríguez-Navarro and Brito 2022). In addition, this kind of research contributes to increased productivity and efficiency in various sectors, such as agriculture, healthcare, and technology, which in turn increases economic growth (Lee *et al.* 2022). Furthermore, R&D is a substantial factor in the development of human capital, contributing to education, training and skills development, thereby creating the skilled workforce needed for economic progress (Sas, 2022). This, in turn, leads to job creation in developing industries and contributes to global competitiveness by attracting investment and establishing leadership in advanced technologies. In addition, scientific research contributes to sustainable development by addressing environmental issues, developing renewable energy sources, and promoting sustainable economic practices (Xu *et al.* 2022; Guo *et al.* 2023). Overall, investment in research and innovation is vital for long-term economic growth, job creation, global competitiveness and sustainable development (Xiao *et al.* 2022; Supplee *et al.* 2021). All of this shows that stimulating research in various industries remains an important component of both innovative development and improving economic welfare.

Table 1. Global ranking of countries based on scientific publications

No.	Country	Documents	Citable documents	Citations	Self-citations	Citations per document	H Index
1	United States	15188630	13318470	467519124	195353698	30.78	2880
2	China	9239029	9080674	118957559	69618418	12.88	1210
3	United Kingdom	4502915	3775825	127998813	26862024	28.43	1815
52	Serbia	130675	123176	1682611	273775	12.88	321
95	Bosnia and Herzegovina	20261	18778	179679	17368	8.87	132
97	North Macedonia	16495	15540	221321	16979	13.42	156
116	Benin	8602	8244	149204	16948	17.35	114
112	Albania	8045	7439	83063	6528	10.32	95
118	Brunei Darussalam	8027	6930	105894	10139	13.19	117
122	Montenegro	6707	6316	67197	9598	10.02	85
242	Pitcairn	3	1	22	0	7.33	2
243	Heard Island and McDonald Islands	2	2	13	0	6.5	2

Source: compiled by the author based on SJR (2024).

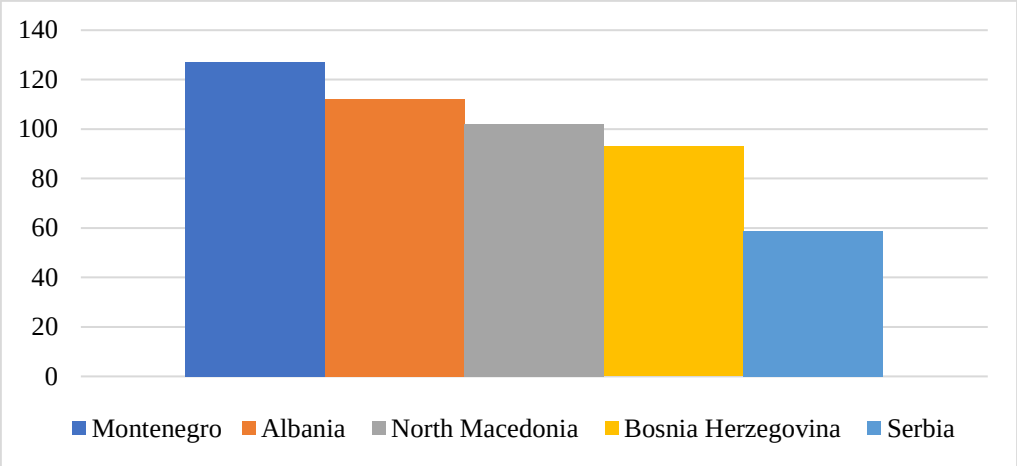
The development of society is the priority of scientific research, which is the primary goal. High bridges, highways, canals, navigational, and major hospitals are the product of constructive scientific research. If scientists do not provide evidence or publish their experiments, science would not be possible. Academic success relies heavily on scientific writing and sharing research findings through publications (Burdonos and Vynogradnya). These publications play a crucial role in showcasing a country's progress, highlighting the importance of a robust scientific research environment for both scientific and economic advancement (Meo and Al-Saadi 2007). In

Albania, the number of scientific publications remains the lowest in the regional and European scientific publications database, as may be seen in Table 1.

Table 1 shows that Albania is ranked 112th globally among 233 countries according to the SCImago Journal & Country Rank (n.d.), with 1023 international scientific research and is ranked 95th according to H-index, in 2022. H-index is a number that aims to represent the productivity and influence of a particular scientist or researcher, or group of scientists or researchers. It is calculated by counting the number of publications for which an author is cited by other authors. So, regarding Albania, a researcher has published at least 95 papers, and each one has been cited at least 95 times. The number of scientific citations for Albania is 939, marking an increase of 94 more citations compared to 2021. According to the SCImago Journal & Country Rank (n.d.), Albania has registered a slight improvement in the ranking, moving up by one position.

Compared to the countries of the region, based on the Scientific Research Index, Albania ranks penultimate, leaving behind only Montenegro, positioned in 127th place among 233 countries in total. Serbia leads the region in terms of scientific research, and the number of international publications or citations. Serbia in this index is ranked 59th, followed by Bosnia Herzegovina in 93rd place and North Macedonia positioned in 102nd place for 2022. It may be also seen in Figure 1.

Figure 1. The regional countries' ranking based on the Scientific Research Index



Source: compiled by the author based on SCImago Journal & Country Rank. (n.d.)

Research has a tangible economic impact beyond providing information that may help to increase efficiency and productivity across sectors. Products drive the economy, and new inventions draw from scientific knowledge and understanding. Through R&D, companies can also gain valuable insights into how their products work and improve upon them to create a sustainable future for customers. Corporation's fund scientific research to support their mission, provide evidence for their claims, or create a source of information for investors. These R&D investments can lead to increases in revenue and cost savings. Whether from a corporate level or a federal level, institutional bodies support discoveries because of the economic impact and growth they lead to.

As the academic publishing sector grows, the impact and spread of research discoveries in academia are on the rise. When researchers have the right tools, they can access others' findings and build upon them to further their ideas and studies. This fosters collaboration across industries and borders, leading to a variety of perspectives in research and increased visibility and revenue for journals. For instance, look at the global collaboration during the COVID-19 pandemic. Scientists teamed up to develop vaccines and treatments, leveraging diverse trials, studies, and innovations to devise effective and safe strategies against the virus. This showcases numerous instances where researchers have utilized each other's work to expedite their advancements. Based on research done for OECD countries with higher income levels, the relationship between research expenditures and economic growth is significant and positive (Guloglu and Tekin 2012). To test the hypothesis, a linear regression model is used, and the estimated results are presented in Table 2.

According to the research results, public R&D expenditures have a significant ($p<0.05$) and positive impact on GDP at the 5% level. A 1% increase in public R&D expenditures results in a 3.98% increase in GDP. This statement is correct since the significance value ($P=0.046<0.05$) is within the confidence interval. The impact of patents on GDP is positive and significant at the 1% level. When patent numbers increase by 1%, economic growth increases by 0.04%. This statement is correct since the significance value ($P=0.000<0.01$) is at the level of statistical significance. Also, the scientific labour force has a significant and positive effect on GDP growth at

the 1% level. A 1% increase in the scientific labour force results in an increase of 0.02% in GDP. This statement is correct as it is within the 1% confidence interval because (P=0.01=1%). Adjusted R^2=55.67% indicates that the variability of independent variables explains 55.67% of the variability of dependent variables.

Table 2. Regression model analysis

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	15.14	3.28	4.61	0.0001
RD	3.98	18.88	2.11	0.0467
P	0.04	0.009	4.06	0.0005
SLF	0.02	0.01	2.81	0.0103
R-squared	0.61			
Adjusted R-squared	0.56			
Durbin-Watson stat	2.27			

Source: compiled by the author

Durbin-Watson statistic is a test for autocorrelation in a regression model's output. An acceptable range is 1.5-2.5. In this study, the value of Durbin-Watson corresponds to 2.27%. This means that there is no first-order autocorrelation in the model. To test multicollinearity is used correlation matrix method, which presents the results in Table 3.

Table 3. Multicollinearity test

Variable	GDP	RD	P	SLF
GDP	1			
RD	0.37	1		
P	0.29	0.31	1	
SLF	0.78	0.61	0.59	1

Source: compiled by the author

Multicollinearity is a statistical phenomenon that occurs when two or more independent variables have a high correlation with one another in a regression model. High values (usually above 0.8 or below -0.8) indicate the presence of multicollinearity. In this study case, this is not the case, because the highest value correlation is 78% between GDP and the scientific labour force.

According to the results of the regression analysis, all the independent variables (SLF, R&D, P) were statistically significant (at a statistical significance level of 1%, 5% and 1% respectively). This means that the scientific labour force, public R&D expenditures and the number of patents affect positively the GDP per capita in Albania. It is concluded that scientific research is very important for Albania and it is a key factor for economic development. An increase in public R&D expenditures, number of scientists and patents will cause an increase in economic growth. Therefore, it is recommended for Albania to invest more in scientific research. It is necessary to allocate more funds to research and development to improve the necessary infrastructure for scientific research, like investment in scientific laboratories, digital libraries. Also, as the increase of scientist number will cause the increase of economic growth it is recommended the recognition of achievements in science through awarding prizes to encourage and promote scientific research. It is recommended to improve the efficiency and transparency of the patent system. Additionally, studying the factors that influence the level of inventive activity is also recommended. For example, a factor may be population density; a higher degree of urbanization means more ideas interacting and a higher possibility for inventiveness. Another factor may be a strong capital market; a higher level of bank deposits means more opportunity for inventors to access capital to develop their innovative ideas and as a result, the higher would be the level of patent production. Therefore, the factors that influence the level of inventive activity have to be studied to implement the right policies and reforms to increase the level of patent production.

The study emphasises the critical relationship between academic publication, collaborative research, and economic growth in Albania. As the academic publishing business expands, it aids the distribution and extension of scientific discoveries, supporting innovation and quickening progress, as shown during the COVID-19 epidemic. This collaborative atmosphere strengthens Albania's capabilities for scientific growth and economic stability. The regression findings confirm this association, demonstrating that public R&D spending, patents, and

the scientific labour force all have a considerable beneficial influence on GDP per capita. Despite these encouraging findings, Albania's low ranking in worldwide scientific publications implies that there is still opportunity for improvement. The research findings showing public R&D spending, patents, and the scientific labour force have a beneficial influence on Albania's GDP per capita can be linked to a number of interrelated variables. Public R&D investments are critical in encouraging innovation because they support the development of new technologies and processes. This financial assistance allows the development and enhancement of products and services, resulting in enhanced production and efficiency in a variety of industries, including agriculture, healthcare, and technology. Furthermore, significant R&D investment draws both domestic and foreign investors eager to fund promising ideas, putting funds into the economy and stimulating economic growth. The regression model's positive R&D coefficient emphasises the large return on investment that research funding may give, as well as its function as a catalyst for long-term economic growth.

Patents and a strong scientific labour force promote economic growth by encouraging innovation and safeguarding intellectual property. Patents encourage inventors and businesses to create by guaranteeing that their ideas are legally protected, attracting investment and facilitating the commercialisation of innovative technology. This results in the formation of new industries and the expansion of existing ones, which contribute to GDP growth. Meanwhile, a well-educated and trained scientific staff is critical for maintaining high research productivity and turning scientific discoveries into practical applications. The scientific workforce not only promotes constant innovation, but it also helps Albania compete on a global scale by promoting international cooperation and knowledge sharing. The study's findings show that when these aspects work together, they have a synergistic impact that greatly improves economic performance.

4. Discussions

To boost the development of scientific research in the country, several recommendations can be considered. For instance, the allocation of more financial resources to research and development is highly effective. This includes increasing public funding, encouraging private sector investment, and establishing research grants and fellowships to support researchers and organisations. It is also important to improve the research infrastructure by upgrading laboratories, purchasing modern equipment and expanding access to advanced technologies and scientific databases. In addition, cooperation between researchers, academia, industry and government agencies should be promoted. Encourage interdisciplinary research projects and establish partnerships with international research institutions to tap into global expertise and resources. Expanding education and training programmes in science, technology, engineering and mathematics, as well as providing incentives for students to pursue careers in these fields, also remains very effective.

One way to promote research in the country is to create a favourable environment for innovation and entrepreneurship by offering incentives such as tax breaks, grants and support for start-ups and small businesses engaged in research and development. Simplification of regulatory processes in this area, including those related to scientific research, intellectual property rights and technology transfer, also remains important. Thus, it is necessary to ensure that regulations promote innovation and facilitate the commercialisation of research results. To ensure easier access to information among scientists, it is worth developing the open data model, encouraging the publication of research results in the public domain, and promoting cooperation and transparency in the scientific community. It is also worth noting that research should be aligned with social needs and issues, such as healthcare, environmental sustainability, renewable energy and digital transformation (Pang *et al.* 2022). The introduction of mechanisms for monitoring and evaluating the impact of research investments, measuring research results and assessing the effectiveness of research policies and initiatives also remains an important component of the state's activities in this area (Edler *et al.* 2022). Thus, by implementing all these recommendations, the country can create a favourable environment for research and innovation, which will lead to accelerated economic development, technological progress and social well-being.

The impact of R&D expenditures on another area, namely the environment, was studied by Adedoyin *et al.* (2020). They noted a significant negative relationship between R&D expenditure and environmental footprint in the long term, suggesting that higher R&D expenditure contributes to environmental sustainability in the countries studied. Given that the development of renewable energy sources leads to an increase in economic growth as such, it can be concluded that greater investment in research and development leads to an improvement in the welfare of citizens, among other things (Mohsin *et al.* 2022). The present study obtained similar results, although they were not directly related to the assessment of R&D for environmental development. However, these results, as well as those described above, also confirm the fact that scientific research has a positive impact on economic

development. Moreover, this demonstrates the complex nature of this influence, as it is evident not only directly but also through other components, in this case, through the development of renewable energy sources.

Bakari (2021) investigated the relationship between public and private sector R&D expenditure and economic growth in Central and Eastern European countries. The aforementioned study showed that R&D has a crucial and positive role in influencing economic growth. The findings indicate that the estimated coefficients associated with researchers are positive, ranging from 0.018316 to 0.025239, and are statistically significant at the 1% level. This implies that a 1% increase in the researcher count corresponds to an economic growth increase ranging from 0.018316% to 0.025239%. The present study also identified this relationship, which demonstrates the relevance of policies aimed at improving the situation with R&D.

The impact of research and development on the economic well-being of a country, depending on their income level, was assessed by Wang and Zhang (2020). Researchers concluded that increased investment in R&D leads to a 0.8122% reduction in carbon dioxide emissions for the BRICS countries on which the study was based. They also concluded that this, among other things, led to an increase in economic growth. Their results showed, among other things, that there is indeed a complex relationship between investment in research and development and economic growth and environmental sustainability. This study has not assessed how the impact of innovation developments on economic development differs across countries. Nevertheless, it is worth noting that these reflections may turn out to be true, as they also sound logical from a theoretical point of view. However, additional research should be conducted in the future to confirm or refute the results.

The role of research and development in green economic growth through the development of renewable energy sources was discussed by Fang *et al.* (2022). Researchers have observed that the importance of green finance in promoting green initiatives, technological advancements and the growth of the green economy is high. The study also highlighted the role of renewable energy sources in different regions of the countries to meet the growing demand for energy sources. This study did not focus as much on assessing research and development in the area of renewable energy. Nevertheless, it is worth noting that the development of the latest technologies in any field is an important part of the development of certain sectors of the economy.

The analysis of this research underlines the critical significance of scientific research in driving Albania's economic growth, consistent with current literature that shows a favourable relationship between R&D spending and economic success. The study emphasises the importance of strategic investments in public R&D, patents, and a strong scientific labour force by proving that they considerably increase GDP per capita. Compared to regional studies by Bakari (2021) and Wang and Zhang (2020), the findings confirm that nurturing a robust research environment not only increases economic growth but also promotes sustainability and creativity. To expand on these findings, Albania must implement comprehensive policies that enhance research and development funding, improve infrastructure, and promote cross-sector and cross-border collaboration. Furthermore, improving the patent system and providing education and incentives to the scientific workforce would strengthen the foundation for long-term economic and technical growth. By implementing these recommendations, Albania may successfully use scientific research as a foundation for long-term economic well-being and competitiveness on the world stage.

Conclusions

Thus, scientific research plays a key role in stimulating economic development in various sectors. By fostering innovation through the discovery of new knowledge and technological advances, scientific research contributes to the creation of new products, industries and employment opportunities, thereby stimulating economic growth and competitiveness. They also significantly contribute to the development of human capital by promoting education, training and professional development, as well as creating a skilled workforce.

The study shows that factors such as the scientific labour force, public expenditure on research and development, and the number of patents created have a positive impact on the gross domestic product per capita in Albania. The study also concluded that scientific research is significant for the state, being a key factor in economic development. Increased government spending on R&D leads to increased economic growth, and recommendations for more active investment in R&D are therefore relevant. Recommendations were also made to improve the transparency of the patent system, increase training opportunities for more scientists. Effective research is also about simplifying regulatory processes related to research, facilitating the sharing of open data and aligning research with the needs of society are crucial to maximising the impact of research initiatives. The study also noted that monitoring and evaluating the effectiveness of research policies and investments are also important aspects that governments need to consider to ensure that research continues to drive economic

growth, technological progress and social well-being. By applying all these practices, it is possible to achieve a more efficient level of not only economic development but also social welfare in the country.

Further study of other factors that may affect research opportunities in the country is relevant for future research. This way, the impact of factors such as the degree of urbanisation, capital market indicators, the level of bank deposits and others can be checked.

Credit Authorship Contribution Statement

Jonida Goduni: Conceptualization, Investigation, Methodology, Project administration, Software, Formal analysis, Writing – original draft, Supervision, Data curation, Validation, Writing – review and editing, Visualization, Funding acquisition.

Declaration of Competing Interest

The author declares that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Declaration of use of generative AI and AI-Assisted Technologies

The author declares that they have not used generative AI.

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Echoes of Conflict: Unveiling the Interconnected Tapestry of Russia-Ukraine Warfare, Oil Price Ballet, and the Asian Stock Symphony

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Abstract: The purpose of this research is to look into the impact of the Russia-Ukraine war on the relationship between oil prices and the Asian stock market. While earlier studies have investigated the impact of oil prices on stock markets, there has been little research into the impact of crude oil prices on the Asian stock market in the context of the Russia-Ukraine war. For this purpose, the data is collected from NSE and Bloomberg database the study's findings imply that the Russia-Ukraine war has had a major impact on the relationship between crude oil prices and stock market indices in numerous Asia-Pacific countries. The study suffers from a few limitations such as it only examines the relationship between crude oil prices and stock market indices but there are other macroeconomic factors, such as interest rates, inflation, and political instability which also affect the market.

Keywords: asian stock market; Russia-Ukraine war; event study; crude oil price.

JEL Classification: G12; G15.

Introduction

Oil is one of the most crucial sources of energy and is frequently used as an important measure of economic stability due to the country's reliance on oil items. Numerous theories and academic articles have highlighted the impact of oil price fluctuations on economic fluctuations, both theoretically and empirically. It is considered a global shock with the potential to simultaneously affect multiple economies. (Kling, 1985) for example, concluded that crude oil price increases are associated with stock market declines. Chen *et al.* (1986), in contrast, suggested that oil price changes have no effect on asset prices. Jones and Kaul (1996) reported a stable negative relationship between oil price changes and aggregate stock returns. Huang *et al.* (1996), however, found no negative relationship between stock returns and changes in the price of oil futures, and Wei (2003) concluded that the decline in U.S. stock prices in 1974 cannot be explained by the 1973–1974 oil price increase.

On theoretical grounds, oil price shocks affect stock market prices or returns through their effect on expected earnings. On the other hand, the stock market is often considered as a barometer of a nation's economic well-being. If the stock prices plummet, it can cause significant economic disruptions worldwide by reducing household income. This, in turn, may lead to a decrease in consumer spending, as investors become more cautious due to their losses in the stock market. As a result, it may become challenging for companies to raise capital by issuing more stocks due to the lower stock prices. Over the last few years, the stock market and crude oil markets have developed a mutual relationship, with virtually every production sector in the global economy relying heavily on oil as an energy source. Crude oil prices are expected to have a significant impact on the manufacturing sector.

The stock market plays an important role in a country's growing industries and commerce, which eventually affects the economy. Crude oil is a commodity that is in high demand all over the world. Any change in crude oil prices can have an immediate and indirect impact on the economies of the various countries. The volatility of crude oil prices drove many businesses away, affecting the stock market as well. An increase in the price of oil causes a temporary decrease in total output because investors postpone business activities due to rising oil prices (Do, 2022).

Previous economic studies show that understanding the fundamentals of supply and demand in the oil market is critical for understanding short-run and long-run fluctuations. These fundamental changes, in particular, provide more pricing information for investors/producers to determine which investments are profitable. One of the most significant events that led to a significant increase in crude oil prices was the 1973 oil crisis. This was triggered by the Organization of Arab Petroleum Exporting Countries (OAPEC) imposing an oil embargo on countries that supported Israel during the Yom Kippur War. This caused a sharp rise in crude oil prices and led to a global recession. The stock market experienced significant declines, with the S&P 500 falling by about 30% over the next two years. Another event that affected crude oil prices and the stock market was the 1990 Gulf War. The war led to a brief but significant increase in crude oil prices, with Brent crude oil reaching a high of $40 per barrel. The stock market was also impacted, with the S&P 500 falling by 17% during the first six months of the conflict.

On 24 February 2022, Russia invaded Ukraine in a major escalation of the Russo-Ukrainian War.

One immediate impact of the Russia-Ukraine conflict on crude oil prices is the threat of supply disruption. Ukraine is a key transit route for Russian oil and gas exports to Europe, with about 40% of Europe's natural gas imports coming from Russia via Ukraine. Any escalation of the conflict, including the possibility of a Russian invasion of Ukraine, could lead to disruptions in the supply of Russian oil and gas to Europe, leading to a spike in crude oil prices.

Several studies have investigated the impact of the Ukraine-Russia war on stock market returns. Gęstwa and Kudła (2018) used an event study approach to analyze the impact of the Ukrainian conflict on the stock markets of 13 European countries. They found that the war had a negative impact on the stock markets of these countries, with the largest effects observed in Russia, Poland, and Germany. Similarly, Zolotareva, Kuga and Nazarova (2019) examined the impact of the Ukraine-Russia crisis on the stock markets of Russia, Ukraine, and the United States. They found that the conflict had a negative impact on stock market returns in all three countries, with the effect being most pronounced in Russia.

In contrast, some studies have found that the impact of the Ukraine-Russia war on stock market returns has been limited. For example, Fidrmuc, Tresl and Senaj (2018) examined the impact of the conflict on the stock markets of eight Central and Eastern European countries. They found that the war had a limited impact on stock market returns, with the effects being confined to a few days surrounding the escalation of the conflict. Similarly, Li and Li (2020) analyzed the impact of the conflict on the stock markets of Russia and Ukraine. They found that

the war had only a short-term impact on stock market returns and that the effects were not significant in the long run.

Furthermore, some studies have investigated the transmission channels through which the Ukraine-Russia war affects stock market returns. For example, Gęstwa and Kudła (2018) found that the conflict had a negative impact on the oil and gas sector in the affected countries, which in turn affected the stock market returns of these countries. Similarly, Zolotareva *et al.* (2019) found that the conflict had a negative impact on the banking sector, which in turn affected the stock market returns of Russia and Ukraine. The extensive research available on the subject only investigated the impact of the Russia-Ukraine war on the stock market, and crude oil prices of the various countries or industries and concluded a negative impact but to the best of the author's knowledge no research has been done on investigating the interconnection tapestry of Russia Ukraine warfare, crude oil prices in Asian stock market

These historical events highlight the complex relationship between crude oil prices and the stock market. In general, a sharp increase in crude oil prices can lead to reduced corporate earnings and slower economic growth, while a sharp decrease in crude oil prices can have a positive impact on economic activity and corporate earnings.

A study by the International Monetary Fund (IMF) found that a $10 per barrel increase in oil prices can lead to a 0.2% reduction in global economic growth in the short term, with a more significant impact in oil-importing countries. This, in turn, can lead to lower corporate earnings and a decline in stock prices. Crude oil prices ranged from $73 to $132.3 at their peak between 2000 and 2008, before plummeting to $39.95 following the subprime loan crisis. When the global economy recovered from the crisis, crude oil prices soared to more than $100 per barrel in 2011. Nonetheless, it fell to 26.68 in 2016, the lowest ever. Until now, the price of crude oil has risen to more than $70. As a result, the fluctuation in the price of oil affects asset prices and increases volatility, which has a direct impact on the financial market.

The overall effect of rising oil prices on stock prices is determined by whether a company is a consumer or producer of oil and oil-related products. Because there are more companies in the world that consume oil than produce it, rising oil prices are expected to have a negative impact on stock markets (Basher & Sadorsky, 2006). The theoretical underpinning for the relationship between oil price and stock returns reflects that oil prices can directly affect stock market by impacting future cash flows or indirectly through an impact on the interest rate used to discount future cash flows (Salisu and Oloko, 2015).

Hammoudeh and Yuan (2008) found that crude oil prices had a significant impact on stock market returns in major oil-importing countries such as Japan, South Korea, and Taiwan. They observed that the stock prices of oil-refining companies in these countries were negatively affected by rising oil prices, while the stock prices of oil-extracting companies were positively affected. Similarly, Li and Chen (2018) studied the impact of crude oil prices on stock returns in China and found that oil prices had a significant impact on the stock prices of energy-related companies. They also observed that upstream companies in China, such as PetroChina and Sinopec, tended to benefit from rising oil prices while downstream companies, such as China Petroleum & Chemical Corporation, tended to suffer.

These findings are consistent with the idea that there are upstream and downstream companies that may be affected in opposite ways by changes in crude oil prices. As a result, the overall impact of crude oil prices on the stock market may be balanced out to some extent. The impact of extreme events on crude oil markets is critical in crude oil price analysis because these events generally have a large impact on crude oil markets (Zhang, 2009).

Several studies for Asian countries such as Malaysia, India, China, and Pakistan have been conducted to assess the relationship between oil price and stock market (Bani and Ramli, 2019; Echchabi and Azouzi, 2017; Jebran et al., 2017; Ekong and Ebong, 2016). Sharma *et al.* (2018) investigates the link between crude oil prices and the Indian stock market. Russia and Ukraine account for less than 2% of global trade, but they control a significant portion of many commodities, including 37% of global palladium supply, 17% of natural gas supply, 13% of wheat supply, and 12% of oil supply (Goel, 2022).

To address this literature gap, this study aims to explore link between oil prices and emerging Asian stock markets particularly during Ukraine and Russia War of 2022.

The Russia-Ukraine conflict has been a major source of instability in the crude oil market, and its effects can be felt across the world. The conflict has led to disruptions in the supply of crude oil, which in turn has led to fluctuations in crude oil prices. This volatility in energy prices has had a direct impact on the Asian stock market, as many companies in the region are heavily dependent on crude oil.

Oil prices had a significant impact on Asia-Pacific stock returns following the global financial crisis, with Indian stock returns being the most dependent on crude oil prices. The relationship between oil prices and Asia-Pacific stock prices is generally weak. (Hui-Ming Zhu, 2013). The Russia-Ukraine crisis is about to drive up prices even further. The South Asian market is one of the largest consumers of crude oil and petroleum products. For example, after the United States, China, and Japan, India is the fourth-largest net importer of crude oil and petroleum products. Furthermore, India currently imports more than 70% of its crude requirements, and this dependence could rise to 90% due to limited supply and stagnant domestic production (Ghosh and Kanjilal, 2016). Similarly, Pakistan and Sri Lanka import massive amounts of crude oil and related products.

According to Naranpanawa and Bandara (2012), Sri Lanka's expenditure on petroleum imports increased by approximately 39.3 percent in 2010 (an increase in expenditure on oil imports from US$ 2.2 billion in 2009 to US$ 3 billion in 2010). Oil import expenditures account for one-third of Pakistan's total import bill. Oil is an important commodity in this region because all of these countries primarily produce agricultural products, and various sectors such as industry, transportation, and agriculture rely heavily on crude oil. Thus, oil price shocks appear to have a significant impact on the economies under consideration. As a result, it is critical to investigate the dynamic relationship between global oil prices and the stock returns of the selected emerging markets. An increase in the price of oil puts downward pressure on foreign exchange rates while pushing up domestic inflation rates in these countries (Ha-Le & Chang, 2011).

The Russia-Ukraine war will have far-reaching economic consequences for Asian economies, as Russian energy is the region's primary driver of economic growth. The Southeast Asian region, particularly the Association of Southeast Asian Nations, does not have direct economic links with Russia; however, there has been a surge in commodity prices, particularly oil, which has become relatively expensive, thereby augmenting producer and consumer price inflation in the region.

This study aims to examine the impact of the Russia-Ukraine war on the relationship between oil prices and the Asian stock market. While previous studies have investigated the impact of oil prices on stock markets, there is limited research that focuses specifically on the impact of crude oil prices on the Asian stock market in the context of the Russia-Ukraine war. This study seeks to contribute to this field of research by conducting an in-depth analysis of the relationship between crude oil prices and the Asian stock market during the war.

According to Lee and Zeng (2011), the degree of dependence between oil prices and stock returns increases during bearish and bullish periods. As a result, we investigate the extreme dependence between crude oil prices and stock returns in the Asia-Pacific region in our research. The study will help in analysing the effect of this war on the Asian Stock market, which in turn will base our understanding of its effect on the national economy and long-term effects of the war.

1. Literature Review

Sahu and Mondal, D. (2014) concluded in their study that there is a positive long-run relationship between oil prices and the movement of stock market indices, though crude oil prices have no significant causal effect on the Indian stock market. The evidence from this study provides a comprehensive understanding of the dynamic relationship between the oil price and the Indian stock market. Bagchi, B. (2017b), analysed the dynamic correlation between stock markets in emerging economies, specifically in BRIC (Brazil, Russia, India, and China) countries, and crude oil price volatility, particularly in the context of the continuous sharp decrease in crude oil prices. Positive and negative shocks have different effects on volatility in the BSE Sensex and crude oil, and returns and volatility are negatively correlated, suggesting that bad news will increase volatility. Utilising an event study methodology, (Küçükçolak, *et al.* 2024) examined how the Russia-Ukraine situation has affected energy businesses listed on European, Asian, and American stock exchanges demonstrating how fear and market responses to rising tensions caused the war to result in positive anomalous returns in Asian and European markets. In contrast, American energy corporations held steady throughout the same time frame. Furthermore, the markets promptly took into account Russia's declaration of selling natural gas in Rubles, demonstrating a proficient adjustment in stock values.

Hashmi, *et al.* (2021), talks about the short- and long-term effects of oil prices in the context of bullish, bearish, and normal stock market conditions in countries that export and import oil, with oil exporting nations including Russia, Mexico, Venezuela, and Norway and oil importing nations including India, China, Japan, and Norway. Mbah, R. E., & Wasum, D. 2022 claimed that the goal of the international financial sanctions on Russia is to destroy its economy and discourage more attacks on Ukraine, but they also have an effect on the world economy as a whole. Oil, petrol, and food prices are driving up inflation, causing supply chain disruptions, and driving up energy costs in sanctioned nations including the U.S., the UK, Canada, and the EU. Also natural

disasters and geopolitical risk factors exhibit a moderate level of connectedness with stock returns (Vuković, D. B., *et al.* 2023). Ozili, P. K. (2024) study reflects that Russia-Ukraine war led to rising prices including rising energy prices and commodity prices and a rise in food prices, thereby leading to a rise in global inflation. Behera, Chinmaya (2023) study also confirmed the presence of volatility transmission among the stock returns and oil prices. The study by Palash Bairagi, 2014 showed that over the long run, oil prices typically follow supply and demand economic fundamentals. Noor, H., & Dutta, A. (2017), investigated the volatility relationship between the global oil market and the major South Asian equity markets. They find no significant evidence of volatility transmission from equity markets to the global oil market, which is not surprising. Aziz, T. (2023) also reflected that volatility does not transmit from global oil prices to the equity markets of the selected SAARC countries. Zou, H., Li, R., & Li, S. (2014) suggested that the use of time-varying copulas can best capture tail dependence and that incorporating tail correlation can enhance the accuracy of Value at Risk (VaR) estimates. Their findings have crucial implications for investors in the Asia-Pacific region seeking to diversify their portfolios, manage risk, and allocate assets internationally.

The conflict between Russia and Ukraine has had a major impact on the world energy market, especially on the price of crude oil. According to Zhang, Qi *et al.* (2024), there is a significant one-way relationship between the war and changes in oil prices; throughout the conflict, WTI and Brent crude prices increased by 52.33% and 56.33%, respectively. Yousaf, I., & Hassan, A. (2019), explored the spillover effects of crude oil on emerging Asian stock markets with regard to returns and volatility and revealed that crude oil price fluctuations had a positive causal impact on the majority of the stock markets under consideration. Gaio, *et al.* (2022), showed that the index's return series exhibits multifractality during times of crisis. The evidence contradicts the market efficiency hypothesis and suggests that asset prices are predictable during times of instability and global financial crisis. The ethnic tension created due to the Russia- Ukraine war led to the long-memory effect on the volatility of Brent crude oil and currency exchange prices (Bagchi, B. 2023). Huang, M., Shao, W., & Wang, J. (2023) examined the impact of the Russia-Ukraine conflict on the crude oil market as well as the stock market chain reaction in importing and exporting countries. The study found that the efficiency of the crude oil market decreased following the Russia-Ukraine conflict, as evidenced by the generalized Hurst exponents, mass exponents, and multi-fractal spectrums. Adekoya, O. B., *et al.* 2022 showed that the connectedness between crude oil prices and other financial assets is stronger during the war compared to before it. The results highlighted the transitory nature of the spillover effect and the importance of understanding the relationship between different markets during times of market turbulence caused by a war. Escribano, A. *et al.* (2023) study also highlighted that during political and financial events anld also in the aftermath of natural disasters have spillover effects on the returns and volatility among crude oil prices and stock markets. Ready, R. C. (2018), findings of their research displayed a strong positive correlation with market returns and economic output, while supply shocks have a strong negative correlation. The negative correlation between supply shocks and returns is strongest in industries that produce consumer goods, while the positive correlation of demand shocks is stronger in industries that use large amounts of oil as an input. Sreenu, N. (2022), indicated a significant negative relationship between crude oil price uncertainty and stock market returns in India. The study finds that an increase in oil price uncertainty leads to a decline in the Indian stock market returns, which suggests that high levels of oil price uncertainty can have adverse effects on the Indian stock market. Alam, *et al.* (2022), studied the relationship between gold and silver with stock prices in Western countries and concluded that such commodities transmitted the most shocks to the United States, Canada, China, and Brazil stock markets during the Russian invasion crisis. This implies that these stock markets were more vulnerable to the crisis than the other commodities/markets studied. Using data from six continents, Chowdhury, E.K. and Khan, I.I. (2023) investigates the initial consequences of the Russia-Ukraine conflict on international stock markets in the first four months following Russia's invasion in February 2022. When the EGARCH models and event study approach are used, substantial volatility is shown, with varying effects on various markets. According to regression study, increasing oil prices have a negative impact on anomalous returns, but growing market volatility (VIX) has a favourable effect.

In study by Boungou and Yatié's (2022), findings showed that the Ukraine-Russia war had a significant negative impact on the stock returns of countries across the globe. The negative impact was most pronounced in Eastern Europe, followed by Asia, the Americas, and then Western Europe. Furthermore, the magnitude of the impact varied across different sectors, with financials, utilities, and energy sectors being the most affected. Li, Alshater, and Yoon's (2022) found in their study that the Russia-Ukraine conflict had a negative impact on stock returns, exchange rates, and commodity prices. The authors noted that the magnitude of the impact varied across different financial markets, with the Russian market being the most severely impacted. Mahunta, R. (2011), investigated the long-term and causal relationship between NSE NIFTY 50 of the National Stock Exchange and

crude oil prices, using econometric techniques within the time frame of January 2010 to December 2014 and the results suggested that the relevant variables act together in the long run, indicating a strong interdependence between the stock market index and crude oil prices.

2. Research Methodology

The current study includes unit root tests, correlation analysis, Granger causality tests, and regression analysis. The techniques used for the study on the impact of crude oil prices on the Asian stock market during the Russia-Ukraine war are regression and correlation analysis. The primary data source for crude oil prices will be a reliable and publicly available database, such as the Energy Information Administration (EIA) or the International Energy Agency (IEA). This data will provide information on the daily or weekly prices of crude oil during the period of the Russia-Ukraine conflict and the data on the Asian stock market will be obtained from a reputable financial database, such as Bloomberg, and NSE website. This data will provide information on the performance of the stock market, including stock prices, market indices, and market returns, during the period of the Russia-Ukraine conflict.

The relationship of between stock market indices and crude oil prices is modeled with a linear regression equation

Hypothesis of the study -

H1: There is an effect of crude oil price on the performance of Asian stock markets during the Russia-Ukraine war

H2: Crude oil returns Granger cause Asian stock markets during Russia-Ukraine war

H3: There is a long run relationship between crude oil returns and Asian stock market returns during the Russia-Ukraine war

Table 1. The stock market indices used for the study include

COUNTRY	STOCK INDEX
MALAYSIA	BURSA MALAY
CHINA	SZSE COMPOSITE INDEX
BANGLADESH	DSE 30
INDONESIA	IDX COMPOSITE
PAKISTAN	KARACHI 100
SOUTH KOREA	KOSPI
PHILLIPINES	PSEI INDEX
SINGAPORE	SGX NIFTY
TAIWAN	TAIEX
THAILAND	SET INDEX
VIETNAM	VNI
INDIA	NIFTY 50
JAPAN	NIKKEI 225

Source: author compilation

The study may also use secondary sources, such as academic journals, books, and news articles, to provide additional context and background information. These sources may also provide insights into the broader economic and geopolitical context that may have influenced the relationship between crude oil prices and the Asian stock market during the period of the conflict

3. Analysis and Discussion

The results of the unit root test given in Table 2 indicates that the data is stationary at the level, as all countries have a probability value of 0. When the data is stationary, it allows us to use statistical techniques to analyse the relationship between variables over time. Overall, these results provide a good foundation for further analysis of the impact of crude oil price fluctuations on the stock markets of these countries.

Table. 2 Unit Root Test

Country	At level		Decision
	T STAT	P VALUE	
Malaysia	-15.56	0.000	I(0), Stationary at Level
CHINA	-16.07	0.000	I(0), Stationary at Level
Bangladesh	-13.45	0.000	I(0), Stationary at Level
Indonesia	-14.62	0.000	I(0), Stationary at Level
Pakistan	-17.13	0.000	I(0), Stationary at Level
South Korea	-15.69	0.000	I(0), Stationary at Level
Philippines	-15.64	0.000	I(0), Stationary at Level
Singapore	-16.14	0.000	I(0), Stationary at Level
Taiwan	-13.28	0.000	I(0), Stationary at Level
Thailand	-21.27	0.000	I(0), Stationary at Level
Vietnam	-15	0.000	I(0), Stationary at Level
India	-15.8	0.000	I(0), Stationary at Level
Japan	-15.64	0.000	I(0), Stationary at Level

Source: author compilation

Table 3. Correlation Coefficient

Countries	Pre-Invasion (Crude Oil)	Post Invasion (Crude Oil)
Malaysia	0.150674597	-0.368048884
CHINA	-0.05204088	-0.265860548
Bangladesh	-0.12438657	-0.329636877
Indonesia	-0.1994478	-0.227549118
Pakistan	-0.09745259	-0.036312285
South Korea	-0.21618877	-0.277296399
Philippines	0.177661558	-0.047654746
Singapore	0.15380892	-0.194135502
Taiwan	-0.10244536	-0.177426851
Thailand	0.347940454	-0.150775315
Vietnam	0.009319465	0.178612272
India	-0.21087279	-0.294393155
Japan	0.205839319	0.122829804

Source: author compilation

Note. The table compares the Pre-Invasion and Post-Invasion correlation coefficients.

Based on the Granger causality test results given in Table 3, the null hypothesis of no Granger causality is rejected for Malaysia, China, Bangladesh, South Korea, and India at a significance level of 0.05, indicating the presence of a unidirectional causality relationship between crude oil prices and the stock market index for these countries. This suggests that changes in crude oil prices cause changes in the stock market index for these countries, but not vice versa. On the other hand, the null hypothesis of no Granger causality cannot be rejected for Indonesia, Pakistan, the Philippines, Singapore, Taiwan, Thailand, and Vietnam at the significance level of 0.05, indicating that there is no significant causality relationship between crude oil prices and the stock market index for these countries.

Table 4. Granger Causality Test

Pairwise granger causality	Observation	P value	Decision
Malaysia→Crude	166	0.3554	Unidirectional
Crude→Malaysia		0.0469	
China→Crude	166	0.282	Unidirectional
Crude → China		0.0478	
Bangladesh → Crude	166	0.1	Unidirectional
Crude → Bangladesh		0.0484	
Indonesia → Crude	166	0.95	Independent
Crude → Indonesia		0.054	
Pakistan → Crude	166	0.51	Independent
Crude → Pakistan		0.41	
South Korea → Crude	166	0.19	Unidirectional
Crude → South Korea		0.0469	
Philippines → Crude	166	0.25	Independent
Crude → Philippines		0.064	
Singapore → Crude	166	0.16	Independent
Crude → Singapore		0.053	
Taiwan → Crude	166	0.09	Independent
Crude → Taiwan		0.067	
Thailand → Crude	166	0.3	Independent
Crude → Thailand		0.074	
Vietnam → Crude	166	0.79	Independent
Crude → Vietnam		0.27	
India → Crude	166	0.3	Unidirectional
Crude → India		0.042	
Japan → Crude	166	0.78	Independent
Crude → Japan		0.06	

Source: author compilation

According to Table 4 the beta coefficient is a measure of the relationship between the dependent variable (stock index of Malaysia) and the independent variable (crude oil) in the regression model. A positive beta coefficient indicates a positive relationship between the two variables, while a negative beta coefficient indicates a negative relationship. In the case of the pre-war data, the beta coefficient of 0.096001 suggests a weak positive relationship between the stock index of Malaysia and crude oil. On the other hand, in the post-war data, the beta coefficient of -0.20365 suggests a negative relationship between the stock index of Malaysia and crude oil.

In the pre-invasion analysis, the R-squared value is 0.077083 for china, indicating that only 7.7% of the variance in the dependent variable is explained by the independent variable. The adjusted R-squared value is 0.05258, which suggests that the model may not fit the data well. The beta coefficient is -0.1127, indicating that there is a negative relationship between the stock index and crude oil, and for every unit increase in crude oil, the stock index decreases by 0.1127 units. The beta coefficient is -0.3694, which suggests a negative relationship between crude oil and the stock index, and for every unit increase in crude oil, the stock index decreases by 0.3694 units. Overall, the results indicate a negative relationship between crude oil and the stock index in both pre- and post-invasion analysis, and the impact of crude oil on the stock index is greater in the post-invasion analysis than in the pre-invasion analysis.

Table 5. Regression Analysis findings

Regression Statistics	Pre-Invasion Analysis	Post Invasion Analysis
Malaysia		
R Square	0.072568	0.246307
Adjusted R Square	0.066031	0.15683
Beta Coefficient	0.096001	-0.20365

Standard Error	0.02202	0.04519
China		
R Square	0.008942	0.1106818
Adjusted R Square	0.05258	0.0909091
Beta Coefficient	-0.1127	-0.369410
Standard Error	0.022299	0.0442374
Bangladesh		
R Square	0.015472	0.10866
Adjusted R Square	0.007268	0.08969
Beta Coefficient	-0.322932	0-1.9434
Standard Error	0.02168	0.043605
Indonesia		
R Square	0.098899	0.162688
Adjusted R Square	0.056389	0.150888
Beta Coefficient	0.03359	-0.028239
Standard Error	0.007332	0.010348
Pakistan		
R Square	0.009497	0.001319
Adjusted R Square	0.001378	-0.01993
Beta Coefficient	-0.21064	-0.138796
Standard Error	0.021669	0.046204
South Korea		
R Square	0.146737583	0.1597473
Adjusted R Square	0.138448344	0.1431149
Beta Coefficient	0.050533926	-0.015625
Standard Error	0.021543496	0.0099824
Philippines		
R Square	0.177662	0.002271
Adjusted R Square	0.031564	-0.01809
Beta Coefficient	0.365181245	-0.15191
Standard Error	0.021125	0.045609
Singapore		
R Square	0.023657	0.037689
Adjusted R Square	0.015588	0.018442
Beta Coefficient	0.33741	-1.192164
Standard Error	0.021456	0.044509
Taiwan		
R Square	0.010495	0.03148
Adjusted R Square	0.00166	0.011303
Beta Coefficient	0.269435	0.632903
Standard Error	0.022097	0.045
Thailand		
R Square	0.121063	0.022733
Adjusted R Square	0.11342	0.001488
Beta Coefficient	1.1674	-0.8819
Standard Error	0.020412	0.045179
Vietnam		
R Square	0.00009	0.031902
Adjusted R Square	-0.00861	0.01254
Beta Coefficient	0.022107	0.516128
Standard Error	0.022124	0.044642
India		
R Square	0.044467	0.099101
Adjusted R Square	0.03637	0.091738
Beta Coefficient	-0.312863	-0.331147
Standard Error	0.02103	0.044634
Japan		
R Square	0.04237	0.015087
Adjusted R Square	0.03397	-0.00543
Beta Coefficient	0.34723	0.364644
Standard Error	0.021116	0.045405

It is evident that there is a negative correlation between the Dhaka DSE 30 stock index and crude oil prices. This is indicated by the negative beta coefficient in both the pre- and post-invasion analyses. In the pre-invasion analysis, the beta coefficient of -0.322932 suggests that for every unit increase in crude oil prices, the Dhaka DSE 30 stock index is expected to decrease by 0.322932 units. The R square and adjusted R square values indicate that crude oil prices explain only a small portion of the variation in the stock index, with the model accounting for only 1.55% of the variation. The data suggests that crude oil prices have a significant negative impact on the Dhaka DSE 30 stock index, with this impact becoming more pronounced after the invasion. Similarly, the pre-invasion analysis shows that there is a positive relationship between the Indonesian stock index IDX and crude oil, as evidenced by the beta coefficient of 0.03359. This means that an increase in crude oil prices is associated with an increase in the stock index of the Indonesian market. The post-invasion analysis shows that there is a weaker, negative relationship between the Indonesian stock index IDX and crude oil, as evidenced by the negative beta coefficient of -0.028239465. Overall, these results suggest that the relationship between crude oil prices and the stock index of the Indonesian market is not particularly strong and may be influenced by external factors such as political instability and weak market development. The weak result in the regression analysis between the Indonesian stock index IDX and crude oil may be due to the fact that the Indonesian stock exchange is not as well developed as other exchanges. The Beta Coefficient of -0.1387965 for Pakistan which suggests that there is still a negative relationship between the stock index and crude oil price after the invasion, but the effect size is small, which means that crude oil price has a limited impact on the stock index. For south Korea, the pre-invasion analysis, the R Square value is 0.1467, which suggests that about 14.67% of the variation in KOSPI can be explained by changes in crude oil prices. The adjusted R Square is 0.1384, which indicates that the model is reliable and not overfitting the data. The beta coefficient is negative at -0.0505, indicating that a decrease in crude oil prices is associated with an increase in KOSPI. For Philippines, we see a significant decrease in the beta coefficient, indicating that the relationship between the PSEI Index and crude oil prices has weakened. The beta coefficient is now -0.152, which suggests a negative relationship between the two variables. The R-squared value of 0.002 indicates that only 0.2% of the variance in the PSEI Index can be explained by changes in crude oil prices. These results suggest that the impact of the Russia-Ukraine war on the PSEI Index and crude oil prices was significant, and that the relationship between the two variables has changed. Overall, the analysis suggests that the PSEI Index is negatively impacted by the Russia-Ukraine war, as evidenced by the negative beta coefficient in the post-invasion analysis.

The regression analysis for Singapore SGX Nifty and crude oil prices shows that the pre-invasion R-squared value is 0.023657, indicating that only 2.37% of the variance in SGX Nifty can be explained by changes in crude oil prices. The beta coefficient of 0.33741 suggests a weak positive correlation between the two variables.

In the post-invasion period for Taiwan , the R square value is 0.03148, which suggests that 3.15% of the variation in TWSE can be explained by changes in crude oil prices. The beta coefficient is 0.632903, which indicates that a 1% increase in crude oil prices leads to a 0.632% increase in TWSE. The adjusted R square value is 0.011303, which suggests that the model has only slightly higher explanatory power than the pre-invasion period. The negative correlation coefficients of -0.10244536 and -0.177426851 indicate that as the price of crude oil increases, the stock market index in Taiwan tends to decrease. This negative correlation is stronger in the post-invasion period, with a larger absolute value of the coefficient.

The correlation coefficient for Thailand shows a significant shift from positive correlation pre-invasion to negative correlation post-invasion. Before the invasion, there was a strong positive correlation between crude oil prices and the stock market index of Thailand, suggesting that as the oil prices increased, the stock market index also increased. However, post-invasion, there is a stronger negative correlation between crude oil prices and the stock market index of Thailand, indicating that as oil prices decreased, the stock market index also decreased.

In the post-invasion analysis, the R-squared value has increased to 0.031902, suggesting that the relationship between crude oil and VNI may have strengthened. The adjusted R-squared value is also higher than the pre-invasion analysis, indicating that the model is a better fit for the data. The beta coefficient of 0.516128 is positive, indicating that there is still a positive relationship between crude oil prices and the VNI index, but the coefficient is larger than in the pre-invasion analysis, suggesting a stronger relationship. The standard error of 0.044642 is also relatively high, suggesting that there is still a high degree of variability in the data.

The R square value of 0.044 indicates that only 4.4% of the variation in Nifty 50 India can be explained by changes in crude oil prices, and the beta coefficient of -0.312 suggests that there is a negative impact of crude oil prices on Nifty 50 India. The beta coefficient of -0.331 suggests that there is a negative impact of crude oil prices on Nifty 50 India, meaning that as crude oil prices increase, Nifty 50 India tends to decrease.

The R Square value of 0.04237 for Japan indicates that only about 4.2% of the variation in the Japan Nikkei stock index can be explained by changes in crude oil prices before the war. The Adjusted R Square value of 0.03397 indicates that when taking into account the number of variables in the model, the explanatory power of the model is even lower.

The positive Beta Coefficient value of 0.364644 suggests that there was still a positive correlation between crude oil prices and the Japan Nikkei stock index after the war. However, the R Square and Adjusted R Square values suggest that the correlation is even weaker after the war. This may suggest that other factors, such as changes in government policies, market sentiments, or geopolitical developments may have become more influential in driving the Japan Nikkei stock index after the war.

Johnsen Cointegration Test Results

In order to measure the relationship between Returns of Crude oil and different countries indices Cointegration test is conducted, this study helps to find out the long-term equilibrium relationship. Results from the below table shows the relationship existing between respective country's stock index returns and crude oil returns during the selected period of crisis, it shows the high convergence of crude oil and market during the war period as well, hence portfolio managers have to consider hedging strategy through diversification.

Table 6. Empirical Results of Johnsen Cointegration

Country	Trace Statistics	Result
Bangladesh	101.82*** 45.50	Cointegration exists
China	103.66*** 47.82	Cointegration exists
Indonesia	93.29*** 39.41	Cointegration exists
Pakistan	111.50*** 47.19	Cointegration exists
South Korea	102.39*** 47.44	Cointegration exists
Malaysia	100.11*** 43.30	Cointegration exists
India	91.65*** 38.72	Cointegration exists
Japan	115.34*** 52.63	Cointegration exists
Philippines	119.82*** 53.13	Cointegration exists
Singapore	86.63*** 32.21	Cointegration exists
Thailand	94.12*** 41.24	Cointegration exists
Taiwan	97.99*** 44.30	Cointegration exists
Vietnam	94.27*** 35.49	Cointegration exists

Significance at 1% with critical values at 15.49 and 3.84
Source: author compilation

The Empirical results of GARCH for the selected period are illustrated in the below table. ARCH term (α) of the equation represents recent news which is short term and its value of all the countries are statistically significant and, which implies the recent news has impacted stock market volatility except in the case of Pakistan. Whereas GARCH ($\boldsymbol{\beta}$) term implies the impact from old news which is significant in all the markets except in the case of Malaysia. Result shows that changes in crude oil have a greater impact on the Asian stock market returns during the Russian-Ukraine war period.

Table 7. Empirical results based on the GARCH model for the whole period

Country	μ	α	β
Bangladesh	1.08E-05*	0.1448***	0.7074***
China	1.53E-05*	0.0906**	0.8358**
Indonesia	6.63E-06	0.1564**	0.7536**
Pakistan	9.38E-06	0.0038	0.9148***
South Korea	1.68E-05	0.1451*	0.7103***
Malaysia	7.84E-05***	0.7573***	-0.0046
India	7.08E-06	0.1562***	0.7904***
Philippines	2.78E-05	0.1007*	0.7026***
Singapore	1.73E-05***	0.3053**	0.3812***
Thailand	7.79E-06	0.1183*	0.7332***
Taiwan	4.74E-06*	0.0975**	0.8657***
Vietnam	7.82E-06***	0.1784***	0.7870***

* denotes significant at 10%, ** denotes significant at 5%, *** denotes significant at 1%
Source: author compilation

Findings and Conclusion

The finding of this study suggests that the Russia-Ukraine conflict has had a significant impact on the relationship between crude oil prices and stock market indices of several countries in the Asia-Pacific region. The extensive research available on the subject only investigated the impact of the Russia-Ukraine war on the stock market and crude oil prices of the various countries or industries and concluded a negative impact, but to the best of the author's knowledge no research has been done on investigating the interconnection tapestry of Russia-Ukraine warfare, crude oil prices in Asian stock markets.

The study shows that the data for all the countries under consideration is stationary at level based on the unit root test. This suggests that the time series data for all the countries have no unit root, and thus, they are stationary. Specifically, Malaysia, China, Bangladesh, Indonesia, Taiwan, South Korea, and India showed a stronger negative correlation between crude oil prices and stock market indices post-invasion. This suggests that the war has affected the economic conditions of these countries, leading to changes in the relationship between oil prices and their respective stock markets.

Furthermore, the Granger causality null hypothesis was rejected for Malaysia, China, Bangladesh, South Korea, and India, indicating that there is a causal relationship between changes in crude oil prices and stock market movements in these countries. Regression analysis also showed that Malaysia, China, Bangladesh, the Philippines, Singapore, Thailand, and India had a stronger negative beta coefficient post-invasion, indicating that changes in crude oil prices have a greater impact on these countries' stock markets post-invasion.

It is important to note that some countries did not show a significant relationship between crude oil and their stock market indexes during the post-invasion period. This may be due to a variety of factors, such as underdeveloped stock markets, low economic dependence on crude oil, or other unique characteristics of the country's economy.

There are several potential avenues for further research. Firstly, it would be valuable to investigate the reasons behind the stronger negative correlation observed between crude oil and stock market indices of certain countries post-invasion. This could involve exploring the specific economic and geopolitical factors that contributed to these correlations, and how they differed from those in other countries. Secondly, further investigation into the rejected null hypothesis of Granger causality for certain countries could provide additional insights into the causal relationship between crude oil prices and stock market indices. This could involve exploring alternative causal models or conducting more rigorous statistical tests.

While the findings of our study demonstrate a negative correlation between crude oil prices and certain Asian stock indices during the Russia-Ukraine War, it is worth exploring why other stock indices did not exhibit such a relationship. One possible avenue for further investigation is to examine the unique characteristics of the stock markets in question, such as differences in market structure, investor sentiment, or regulatory frameworks, that may have shielded them from the impact of oil price fluctuations.

The study suffers from a few limitations such as it only examines the relationship between crude oil prices and stock market indices but there are other macroeconomic factors, such as interest rates, inflation, and political

instability which also affect the market. The Russia-Ukraine conflict is just one of many geopolitical events that can affect crude oil prices, the future researchers can also consider Israel humas war, middle east conflict etc to test the impact. This study does not attribute all of the fluctuations in Asian stock markets to oil prices, as it is only one of many factors influencing corporate earnings, such as inflation, GDP, exchange rate, and so on. As a result, there is still room for further research into the impact of individual as well as collective macroeconomic factors on the value of stocks in Asian and global stock markets.

Credit Authorship Contribution Statement

Anubha Srivastava has given idea for conceptualization of the paper and contribution to methodology of the paper. **B.S. Arjun** has worked on its methodology and software to be used for analysis. **Ritu Wadhwa** has written the first draft and take care of Data. **Purwa Srivastava** has supervised the entire paper and validated the data. **Neha Singh** and **Chaandni Gautam** has done all review and editing.

Declaration of Competing Interest

No Competing interest amongst the authors.

Declaration of Use of Generative AI and AI-Assisted Technologies

No use of generative AI in the paper.

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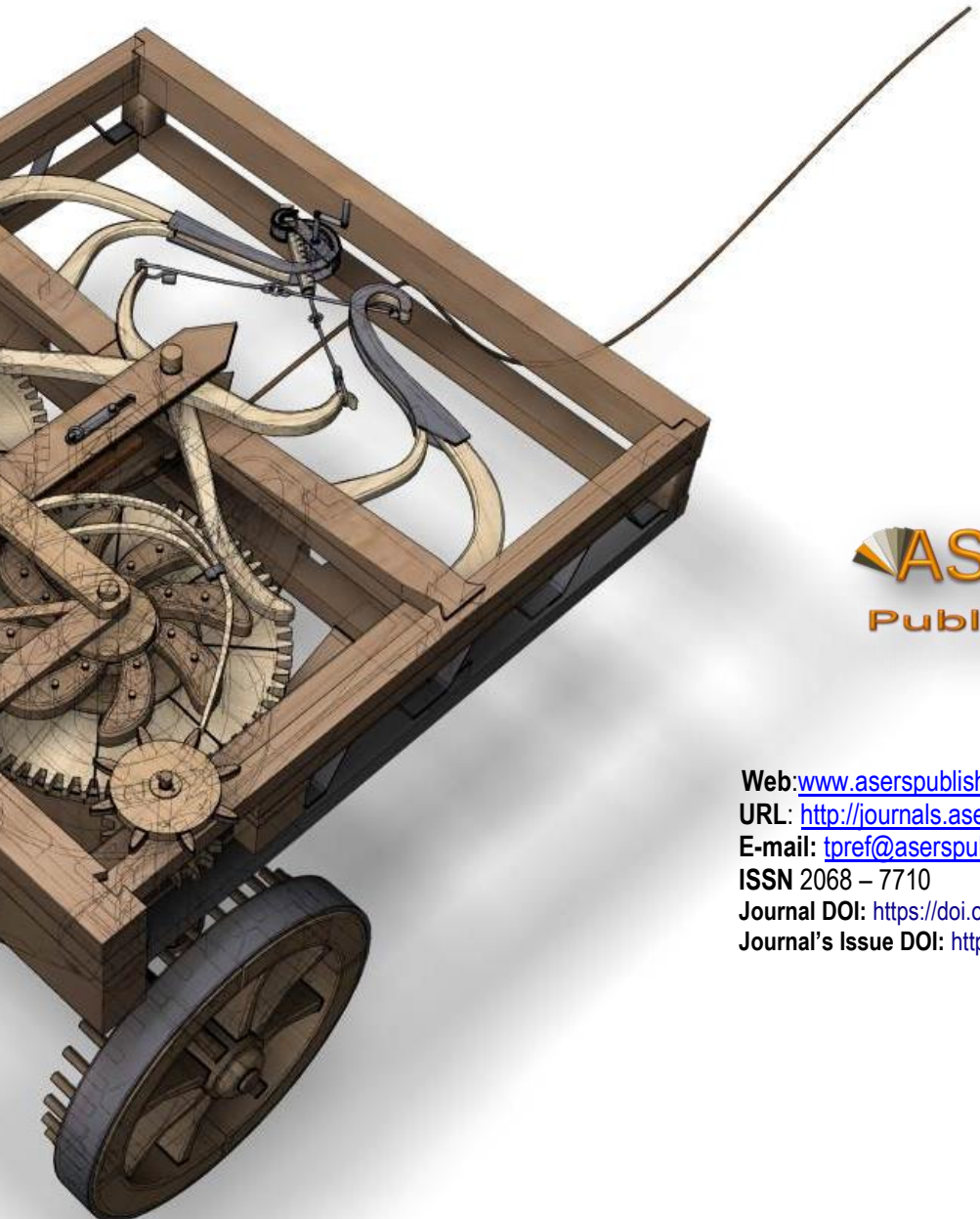

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