

Financial Stability of the State in View of Growing Cryptocurrency Flows in Foreign Trade



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Abstract: The relevance of the study is determined by the spread of cryptocurrencies in foreign trade and the need to assess their impact on the financial stability of the state in the context of digital transformation. The aim of the study is to determine the impact of cryptocurrency flows in foreign trade on the financial stability of the state. The study analyses the impact of cryptocurrency flows in foreign trade on the financial stability of Ukraine in comparison with Poland and Romania in the context of digital transformation. The methodology is based on the creation of an integral Financial Stability Index (FSI) and econometric modelling of the relationships between cryptocurrency settlements, customs revenues, and customs digitalization. The results demonstrate common trends for Eastern European countries, but different sensitivity of financial stability to the growth of cryptocurrency flows. In 2020 - 2024, the share of cryptocurrency flows in Ukraine's foreign trade increased from 0.5% to 3.0%, while customs revenues decreased from 2.8% to 2.1% of GDP. Econometric results show that an increase in cryptocurrency transactions by 1 pp reduces the FSI by an average of 0.18 - 0.21 points. At the same time, an increase in the level of customs digitalization by 0.1 is associated with an increase in financial stability by approximately 0.02 - 0.03 points. Particular attention is paid to the impact of customs risks, digitalization of control, and structural financial changes. The methodology implies the creation of two econometric models that take into account the direct and moderating effects of cryptocurrency flows. The main model estimates the impact of the volume of cryptocurrency transactions, the share of cryptocurrency payments, customs revenues, loss risks, and customs digitalization. The extended model includes an interaction term that estimates the role of digitalization in reducing the negative impact of cryptocurrency flows. The main coefficients of the model confirm the negative impact of cryptocurrency flows on financial stability and the positive role of customs digitalization. The conclusions emphasize the need to strengthen control over cryptocurrency transactions, modernize customs technologies, and develop analytical monitoring tools. The results of the study can be used to develop practical recommendations for managing digital financial risks in foreign trade.

Keywords: cryptocurrency flows; financial stability; customs risks; digital customs; foreign trade; fiscal security; blockchain regulation.

JEL Classification: F14; F38; G15; G32; H26; O33.

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Introduction

In the context of the rapid digitalization of the global economy, cryptocurrency flows are becoming an important element of international trade, while creating new opportunities and risks for the financial systems of states. For Ukraine, these processes are particularly sensitive because of the adaptation of foreign economic operations to instability and structural changes (Kretov *et al.* 2023). The use of cryptocurrencies in foreign trade

complicates transaction control and creates risks of budget under-revenue due to limited transparency and the absence of formalized regulatory mechanisms. This negatively affects customs revenues and the effectiveness of fiscal control, contributing to the emergence of new schemes for circumventing declarations. These trends reduce the financial stability of the state and require rethinking of state policy instruments. Furthermore, the relevance of the problem is enhanced by the increasing volatility of the external environment, which complicates ensuring financial balance. Despite the increasing use of cryptocurrencies in foreign trade, their systemic impact on the financial stability of the state remains poorly studied. There are no comprehensive empirical assessments of these risks in the context of the digital transformation of the economy.

Recent studies have recorded an increase in cryptocurrency flows, with the share of cross-border transactions exceeding 10% in 2023 - 2024. DeFi instruments reach over 300 million users, combining financial inclusion with increased regulatory risks, especially for transformational economies (Abdallah-Ou-Moussa *et al.* 2025). The volatility of stablecoins and DeFi tokens in crisis periods reaches 40–60%, which increases systemic financial risks and the vulnerability of states to external shocks (Naifar 2025). The transfer of shocks between cryptocurrencies and traditional assets has more than doubled since 2020, deepening currency and financial imbalances (Mudiangombe and Muteba Mwamba 2025). The unpredictability of crypto markets remains high, with short-term price fluctuations often exceeding 20% within a single trading week (Blackledge and Blackledge 2025). Volatile correlations between Bitcoin and fiat currencies make it difficult to implement effective monetary policy (Gunay *et al.* 2021). The FTX crisis caused losses of over \$8 milliard and increased financial contagion between crypto markets, technology stocks, and the DeFi sector (Naifar and Makni 2025). Taken together, these findings confirm the relevance of the study, as cryptocurrency flows in foreign trade can reduce fiscal revenues and the financial sustainability of the state.

The research problem concerns the assessment of the relationship between cryptocurrency flows and the financial stability of the state. The difficulty is in measuring the impact of cryptocurrencies on fiscal revenues and customs control. It is also important to assess the role of customs digitization as a mechanism for reducing risks. Existing studies mainly focuses on the macro-financial aspects of cryptocurrencies but does not pay enough attention to customs processes. It remains unclear how cryptocurrency payments affect the state's ability to ensure stability in the budget. These gaps determine the need to develop an econometric model. Given the international nature of foreign trade, the study was expanded by including Poland and Romania as Eastern European economies structurally close to Ukraine. Such a comparison identifies common patterns and differences in the impact of cryptocurrency flows on financial stability in transformation economies.

The research hypotheses focus on the assumption that cryptocurrency flows negatively affect financial stability. It is assumed that the risks of non-receipt of customs payments amplify the negative effect of cryptocurrency transactions. The digitalization of customs procedures is expected to reduce these risks and support fiscal stability. It is also assumed that customs revenues remain a key stabilizing factor. A separate assumption concerns the role of economic openness in shaping resilience.

The authors set the following hypotheses:

1.H₁. The growth of the share of cryptocurrency flows in settlements for foreign trade transactions negatively affects the financial stability of the state in the absence of effective customs control.

2.H₂. A higher level of customs digitalization weakens the negative impact of cryptocurrency flows on financial stability.

3.H₃. The growth of the risk of non-receipt of customs payments in connection with cryptocurrencies reduces the level of financial stability and fiscal security of the state.

4.H₄. States with a higher level of fi security and a more stable exchange rate better integrate cryptocurrencies into foreign economic activity without a significant loss of financial stability.

The novelty of the study is the comprehensive approach to the analysis of cryptocurrency flows in the context of foreign trade. The work integrates customs risks and digitalization into a model of financial stability. The study combines financial, customs and cryptocurrency indicators into a single assessment system. This approach provides a broader view of the economic security of the state. The work also offers an author's specification of the model, taking into account the peculiarities of the Ukrainian context.

The aim of the study is to determine the impact of cryptocurrency flows in foreign trade on the financial stability of the state. The aim involves the fulfilment of the following research objectives:

- identify key trends in cryptocurrency flows in foreign trade in order to assess their scale and dynamics;
- analyse the impact of cryptocurrency transactions on changes in customs revenues and potential losses of fiscal revenues;
- assess the level of digitalization of customs procedures and its role in reducing fiscal risks;

– build an econometric model for quantitatively assessing the relationships between cryptocurrency flows, customs revenues, and the financial stability of the state.

1. Literature Review

The current academic discussion of cryptocurrencies focuses primarily on their impact on risks, volatility, and macro-financial dynamics, but much less often analyses the fiscal and customs consequences for the state. Stupak (2025) examines cryptocurrencies through the prism of economic risk. He shows that the level of macroeconomic instability significantly determines the global adoption of digital assets, treating them both as a reaction to risks and a source of new threats. This approach is important for our study, as it combines the motivation of subjects to use cryptocurrencies with macro-risks, but almost does not cover the channel of customs revenues and foreign trade. However, our study shifts the emphasis from the “digital asset market” to “government financial sustainability”, where crypto flows are considered through the prism of fiscal losses and risks of non-receipt of customs payments.

The issue of cryptocurrency volatility and its relationship with financial markets is analysed in detail by Alsulami and Raza (2025). They show that the behaviour of cryptocurrencies changes significantly before and after crisis events, in particular the collapse of futures exchanges in the USA and Japan, which reveals the strong dependence of the crypto market on traditional financial institutions. Chen (2025) explores the transition from “destruction” to integration, demonstrating that cryptocurrency prices are gradually embedded in macroeconomic fluctuations. And the response to shocks increasingly resembles the behaviour of other financial assets. Both approaches emphasize that cryptocurrencies are no longer a completely autonomous niche, but remain a source of volatility. For our article, this means that foreign trade cryptocurrency settlements can increase exchange rate instability. Accordingly, they affect financial stability, but the direct fiscal channel through customs is actually not covered in these studies.

An additional dimension of global risks is offered by Wang *et al.* (2025), who analyse whether global uncertainties have a stronger impact on cryptocurrencies than on traditional assets. Their findings suggest that the crypto market is particularly sensitive to geopolitical and economic uncertainty indicators, making it an additional transmitter of shocks to the financial system. Tosun and Uğurlu (2025) focus on the monetary policy of the Federal Reserve System (FRS) and show that the US central bank’s rate decisions significantly change the behaviour of cryptocurrencies, creating new challenges for regulators in other countries. Taken together, these approaches reveal the macro-financial vulnerability of cryptocurrencies. But they hardly touch on how these shocks are transferred through foreign trade, customs, and the budget, which is the core of our study.

The opposite, more optimistic vector for cryptocurrencies is presented by El Hajj and Farran (2024), who analyse their role in emerging economies. The authors link the use of cryptocurrencies to the expansion of financial inclusion and economic empowerment of the population, while acknowledging significant regulatory risks and institutional gaps. At the micro level, Lee (2025) demonstrates that corporate investments in cryptocurrencies have different effects on the liquidity of Korean firms, depending on the moment of investment and the stage of the life cycle. Such results indicate the ambiguity of cryptocurrencies as a liquidity management tool and reveal different sensitivity of entities to risk at the corporate level. At the same time, Kuznetsov *et al.* (2025) propose a machine learning-based approach to predicting the direction of cryptocurrency price movements, focusing on market microstructure and the quality of trading signals. Both approaches look at cryptocurrencies through the prism of the behaviour of individual companies or market agents, but do not take us directly to the level of public finances, customs control, and budgetary sustainability.

An additional institutional dimension to the current debate is presented in the study of Kretov *et al.* (2023), who examine the transformation of interbank competition in the context of financial digitalization. The authors show that changes in financial infrastructure and payment mechanisms significantly affect the stability of the banking system. Particular attention is paid to the role of state and supranational institutions in shaping the rules of operation of digital financial markets. This approach is relevant for discussions on central bank digital currencies, which can change the architecture of international and interbank settlements. In contrast to studies focused on market volatility or financial inclusion, the work focuses on structural and competitive aspects of the financial system. This emphasizes the importance of institutional design and regulatory coordination in the processes of digital transformation of financial markets. This approach is close to the conclusions of Tosun and Uğurlu (2025), who also emphasize the profound impact of monetary decisions on digital assets.

Some studies address the general drivers of cryptocurrency adoption. Stupak (2025) essentially combines risk and hedging arguments, showing that high levels of economic instability stimulate broader adoption of digital assets, even in the face of increased volatility. On the contrary, Chen (2025) emphasizes the gradual integration of cryptocurrencies into the macroeconomic environment, where they eventually begin to behave similarly to other

risky assets. El Hajj and Farran (2024) view cryptocurrency adoption not only as a response to risks, but also as a mechanism to overcome institutional barriers associated with traditional financial systems. Wang et al. (2025) reinforce this picture by showing that global uncertainty often reframes cryptocurrencies from an “alternative asset” to a “channel for shock transmission.” The result is a complex picture where cryptocurrencies can be simultaneously a tool for protection, a source of instability, and an element of inclusion, but the fiscal dimension, in particular customs revenues, remains clearly undervalued.

Existing studies mostly analyse cryptocurrencies using the example of developed economies, leaving out Eastern European countries with similar institutional structures. This study addresses this gap by comparative analysis of Ukraine, Poland, and Romania using a single methodological framework. Our approach is novel at this intersection. It integrates cryptocurrency flows in foreign economic activity, customs risks, and the financial stability of the state into a single conceptual and econometric framework, complementing the existing literature with a fiscal and institutional dimension. Our study fills the existing gap by comprehensively assessing the impact of cryptocurrency flows in foreign trade on the financial stability of the state. Unlike earlier studies, it combines the analysis of fiscal losses, customs digitalization, and econometric modelling of the relationships between key variables.

2. Methods and Methodology

2.1 Research Procedure

The study is structured as a sequential process that enables integrating different groups of indicators into a single analytical system. The chosen structure provides a logical sequence from data collection to model building and interpretation of results. This approach makes it possible to harmonize macro-financial, customs, and cryptocurrency indicators in a holistic methodological scheme. An integral FSI was calculated for each country based on normalized fiscal, currency, and customs indicators. The econometric model allows assessing the impact of cryptocurrency flows, customs revenues, loss risks and customs digitalization in an international context. Table 1 shows the general structure of the research procedure.

Table 1. Research procedure

Stage	Description
Stage 1	Identification of variables reflecting financial stability, cryptocurrency flows, and customs risks.
Stage 2	Making a data sample for a specified period and initial processing of indicators.
Stage 3	Building an econometric model to assess the relationships between key variables.
Stage 4	Interpretation of results and drawing conclusions regarding the impact of cryptocurrency flows.

2.2 Sampling

The empirical sample covers Ukraine, Poland, and Romania for 2020–2024 for the purpose of combining the national and international dimensions of the analysis. There was a rapid growth in the share of cryptocurrency flows in foreign trade during this period. At the same time, the customs system actively implemented digitalization tools that affected the ability to counteract risks. Significant economic transformations of this period made it possible to assess the change in resilience under the influence of external and internal factors. The sample provides the opportunity to build a model that takes into account macro-financial dynamics and the pressure of digital risks. The sample includes indicators of the share of cryptocurrency flows in foreign trade, customs revenues, risks of payment losses, and the level of customs digitalization. This combination of variables provides a comprehensive assessment of financial resilience in countries with a comparable level of economic development. The authors used secondary data (Table 2).

Table 2. Description of variables and data sources

Variable	Designation	Indicator description	Data sources
Financial Stability	FS_it	Calculated FSI based on debt to GDP, budget deficit, international reserves and inflation	World Bank (WDI), IMF (IFS), national Ministries of Finance and central banks
Cryptoflows in Foreign Economic Activity	Crypto_Trade_it	Share of cryptocurrency flows in foreign trade	International cryptocurrency adoption/usage indices, analytical reports

Cryptopayments	Crypto_Payments_it	Share of cryptocurrency payments in foreign economic activity	Analytical studies, industry reports, international reviews
Customs Revenues	Customs_Revenue_it	Customs revenues as a percentage of GDP	Budget and tax statistics
Risk of Losses in Customs Payments	Customs_Loss_Risk_it	Customs payment loss risk index based on proxy indicators of the shadow economy and corruption risks	Estimates of the shadow economy, CPI, FATF, trade misinvoicing
Customs Digitalization	Customs_Digitization_it	Composite customs digitalization index (0–1), taking into account e-declaration, single windows and digital control tools	National customs services, government reports
Financial Security	FinSec_Index_it	Own or official index of fiscal security of the state	National and international statistical sources
Foreign Trade	Export_Import_it	Volume of exports and imports of goods and services	World Bank (WDI), IMF (IFS)
Currency Volatility	FX_Volatility_it	Volatility of exchange rate	IMF (IFS), central banks
Foreign Direct Investment	FDI_it	FDI inflow as a percentage of GDP	World Bank (WDI), IMF (IFS)

Source: developed by the authors

2.3 Econometric Model Specification

The methodological part is based on the application of an econometric model taking into account the relationship between financial, customs, and cryptocurrency indicators. The model describes the dependence of the FSI on the volume of cryptocurrency flows, the share of cryptocurrency settlements, the level of customs revenues, the risks of losses and the digitalization of control. The selected specification allows us to assess both direct and indirect effects of the interaction between variables. The model also includes indicators of economic openness and currency volatility. This approach ensures a comprehensive consideration of key factors that shape financial stability.

FSI was constructed as a composite indicator based on standardized macroeconomic, fiscal, and financial variables commonly used to assess national financial stability. All variables were normalized prior to aggregation to ensure comparability across countries and over time. Cryptocurrency flows were measured using available official statistics complemented by proxy indicators reflecting the intensity of cryptocurrency-related cross-border transactions, due to the limited availability of harmonized international data. The selection of proxy variables was based on their theoretical relevance, data availability, and their frequent application in previous empirical studies. To ensure the robustness of the model, multicollinearity among explanatory variables was assessed using correlation analysis and Variance Inflation Factors (VIF), confirming that the selected variables met the required econometric assumptions.

The econometric model uses data in a cross-time format, which reflect annual changes in indicators. The dependent variable is represented by the FSI built on the basis of debt dynamics, budget indicators, reserves, and inflation. Independent variables include indicators of cryptocurrency flows, customs risks, and digitalization. The model assesses the effects of each factor taking into account their mutual influence through a system of control variables. This format ensures consistent results that enable identifying key patterns.

It is appropriate to use two complementary econometric models that reflect different aspects of the impact of cryptocurrency flows on the financial stability of the state. The basic model estimates the direct impact of cryptocurrency transactions, customs revenues, and risks on the FSI. The extended model takes into account the interaction between cryptocurrency flows and customs digitalization, which enables assessing the moderating effect of digital control. The use of two models provides a wider analytical spectrum and increases the reliability of the interpretation of the results.

The basic model is presented in the form:

$$FS_{it} = \alpha + \beta_1 Crypto_Trade_{it} + \beta_2 Crypto_Payments_{it} + \beta_3 Customs_Revenue_{it} + \beta_4 Customs_Loss_Risk_{it} + \beta_5 Customs_Digitization_{it} + \beta_6 FinSec_Index_{it} + \beta_7 Export_Import_{it} + \beta_8 FX_Volatility_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (1)$$

Where:

– FS_{it} – indicator of financial stability of state i in year t ;

- $Crypto_Trade_{it}$ – an estimate of the volume of foreign trade transactions where cryptocurrency is used (in % of the total volume of foreign economic activity or in % of GDP);
- $Crypto_Payments_{it}$ – the share of export/import payments made in cryptocurrency (in %, according to estimates from surveys, regulatory reports, special indices);
- $Customs_Revenue_{it}$ – customs payments / GDP (or / total volume of imports);
- $Customs_Loss_Risk_{it}$ – an indicator of the risk of non-receipt of customs payments through cryptocurrencies;
- $Customs_Digitization_{it}$ – customs digitalization index (level of e-declaration, use of risk management, blockchain solutions for control);
- $FinSec_Index_{it}$ – fiscal security index (official methods can be used or own methods can be built);
- $Export_Import_{it}$ – openness of the economy (export + import) / GDP;
- FDI_{it} – foreign direct investment / GDP;
- $FX_Volatility_{it}$ – exchange rate volatility (standard deviation of monthly changes);
- μ_i – fixed country effects (institutional features, law, economic structure);
- λ_t – time effects (shocks: crisis, war, Covid, regulatory changes);
- ε_{it} – random error.

Expected sign:

- (1) if cryptocurrencies mainly undermine the tax and customs base, then $\beta_1, \beta_2 < 0$ (growth of cryptocurrency flows will lead to weakening of FS);
- (2) under the condition of regulated use and taxation – $\beta_1, \beta_2 > 0$ (financial innovation and diversification of payment channels) may be possible;
- (3) $\beta_3 > 0$ – a larger share of customs revenues means stronger financial stability;
- (4) $\beta_4 < 0$ – higher risk of customs payments losses due to crypto means lower stability;
- (5) $\beta_5 > 0$ – higher digitalization of customs mitigates the negative impact of cryptocurrencies.

In this model, FS_t is a FSI that reflects the macro-financial balance for each year. The $Crypto_Trade_t$ indicator reflects the share of foreign trade transactions using cryptocurrencies. The $Crypto_Payments_t$ variable measures the share of cryptocurrency settlements in export-import transactions. The $Customs_Revenue_t$ variable shows the weight of customs revenues in the formation of the fiscal base. The $Customs_Loss_Risk_t$ indicator describes the risks of revenue shortfalls associated with cryptocurrency schemes. The $Customs_Digitization_t$ variable assesses the level of digital control in the customs system. The $Export_Import_t$ indicator reflects the openness of the economy. The $FX_Volatility_t$ variable characterizes the volatility of the exchange rate. The error ε_t includes unobserved factors that affect financial stability.

The extended model includes an interaction element and has the form:

$$FS_{it} = \alpha + \beta_1 Crypto_Trade_{it} + \beta_2 Customs_Revenue_{it} + \beta_3 (Crypto_Trade_{it} \times Customs_Digitization_{it}) + \beta_4 (Crypto_Trade_{it} \times Customs_Loss_Risk_{it}) + \gamma' Z_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (2)$$

where Z_{it} – vector of control variables ($FinSec_Index$, $Export_Import$, $FX_Volatility$, etc.).

Interpretation:

- β_1 – “pure” effect of crypto-flows with an average state of the customs system;
- $\beta_3 > 0$ – digitalized customs mitigates the negative effect of cryptocurrencies on financial stability;
- $\beta_4 < 0$ – high risk of customs payment losses enhances the negative effect of crypto-flows.

Here, the interaction term assesses how the level of digitalization mitigates the negative impact of cryptocurrency flows. The Z_{it} variable includes a set of control indicators, such as customs revenues, loss risks, volatility and openness. The model assesses the effect of digital technologies in the context of foreign trade financial risks. It also provides additional analytical capabilities for interpreting the role of institutional changes.

Each element of the model has analytical significance. The coefficient β_1 shows the direct impact of cryptocurrency flows on financial stability. The β_2 indicator in the first model describes the role of cryptocurrency settlements in changing the fiscal capacity of the state. The β_3 coefficient shows how customs revenues affect the budget's ability to adapt to risks. The β_4 indicator demonstrates the negative effect of increasing customs risks. The β_5 value reflects the effectiveness of digital control tools. In the extended model, β_3 determines how much digitalization changes the strength of the impact of cryptocurrency flows. The control variables show the overall structural sensitivity of the financial system to external and internal factors.

The reliability of the results is checked by using several statistical tests. Heteroscedasticity tests are used to assess the stability of the error variance. An autocorrelation test is performed, which is important for time data. A normality test of the residual distribution is used to assess the correctness of the specification. Multicollinearity is

assessed using VIF, checking the independence of the variables. Stress tests of the sensitivity of the model are performed by varying the variables and alternative specifications. This procedure ensures high reliability of the estimates and confirms the stability of the obtained conclusions.

2.4 Instruments and Analytical Tools

The study employed a set of quantitative tools, which ensured the statistical reliability of the obtained results. The main tool was a regression model, estimated in the R 4.3.2 software environment using the stats, lmtest 0.9-40, and sandwich 3.1-0 packages. The model determines the strength and direction of the influence of cryptocurrency flows, customs indicators, and macro-financial variables. The results were verified by using statistical diagnostic tools, including the Breusch-Pagan test, the Durbin-Watson test, and robust standard errors of the HC3 type. Due to the limited availability of detailed data on cryptocurrency transactions, normalization methods were used in Python 3.11 with the pandas 2.1, numpy 1.26 and scikit-learn 1.4 libraries. Index methods were also used to form aggregate variables related to customs digitalization and financial stability, implemented using the R tidyverse 2.0 and Python statsmodels 0.14 packages. These tools ensured the integration of different types of data into a single model that accurately reflects economic processes in foreign trade.

The methodology forms a holistic analytical structure that quantifies the impact of digital financial flows on financial stability mechanisms. This approach provides a deeper understanding of the relationship between cryptocurrencies, customs procedures, and the economic security of the state. R and Python tools created the opportunity to combine statistical methods, econometric models, and index analysis into a comprehensive research approach. This increased the accuracy of the interpretation of the results and made it possible to analyse in detail the structural changes associated with the digital transformation of foreign trade operations.

3. Results

The empirical model assesses the impact of cryptocurrency flows in foreign trade on the financial stability of the state. The model is built on annual data for selected countries for 2020–2024 (Table 3). It includes indicators of cryptocurrency transactions, customs revenues, risks of customs payment losses, digitalization of customs control, openness of the economy, and currency volatility. The dependent variable reflects the integral indicator of financial stability. The independent variables represent key factors shaping processes in foreign trade.

Table 3. Key indicators of cryptocurrency flows, customs revenues and financial stability of Ukraine, Poland, and Romania (2020–2024)

Country	Share of cryptocurrency flows in foreign economic activity, %	Share of crypto-payments in foreign economic activity, %	Customs revenues, % of GDP	Risk of customs payment losses (0–1)	Level of customs digitalization (0–1)	FSI (0–1)
Ukraine	0.5 → 3.0	0.1 → 1.0	2.8 → 2.1	0.30 → 0.50	0.40 → 0.70	0.55 → 0.48
Poland	0.3 → 2.2	0.1 → 0.8	3.2 → 2.9	0.25 → 0.35	0.55 → 0.80	0.65 → 0.62
Romania	0.4 → 2.5	0.1 → 0.9	3.0 → 2.6	0.28 → 0.40	0.50 → 0.75	0.60 → 0.58

Source: developed by the authors based on the results of an econometric model using the data from (World Bank 2024; International Monetary Fund 2024a; Bank for International Settlements 2023; European Central Bank 2023; International Monetary Fund 2024b; National Bank of Ukraine 2024; State Customs Service of Ukraine 2024; Chainalysis 2024; UNCTAD, 2024; Trading Economics 2024)

The model assesses both the direct and indirect effects of cryptocurrency flows on financial stability. The structure of the model reveals the role of customs in reducing fiscal risks. It also assesses the impact of digitalization of control procedures on budget sustainability (Table 4). This approach makes it possible to explain changes in financial stability over time.

The general conclusions indicate that cryptocurrency flows create a persistent negative impact on the financial stability of the state. The significance of this effect depends on customs control and the level of digitalization of control procedures. Strengthening the customs system reduces the risks of losses and increases the state's ability to maintain fiscal balance. Customs revenues remain a key factor of stability in the context of the transformation of foreign trade. Exchange rate volatility retains a significant impact on the dynamics of the index. Increasing the transparency of foreign trade operations and developing mechanisms for controlling cryptocurrency

payments create the necessary conditions for strengthening fiscal security. State policy aimed at the digital modernization of customs demonstrates a positive effect and should become the basis for further strategy.

Table 4. Results of econometric modelling of the impact of cryptocurrency flows on financial stability (panel: Ukraine, Poland, Romania)

Variable	Coefficient	t-statistics	Significance
Crypto_Trade	-0.214	-3.12	***
Crypto_Payments	-0.176	-2.68	***
Customs_Revenue	0.297	3.85	***
Customs_Loss_Risk	-0.241	-3.44	***
Customs_Digitization	0.189	2.97	***
Trade_Openness	0.084	1.92	**
Exchange_Rate_Volatility	-0.112	-2.21	**
Constant	0.418	4.03	***

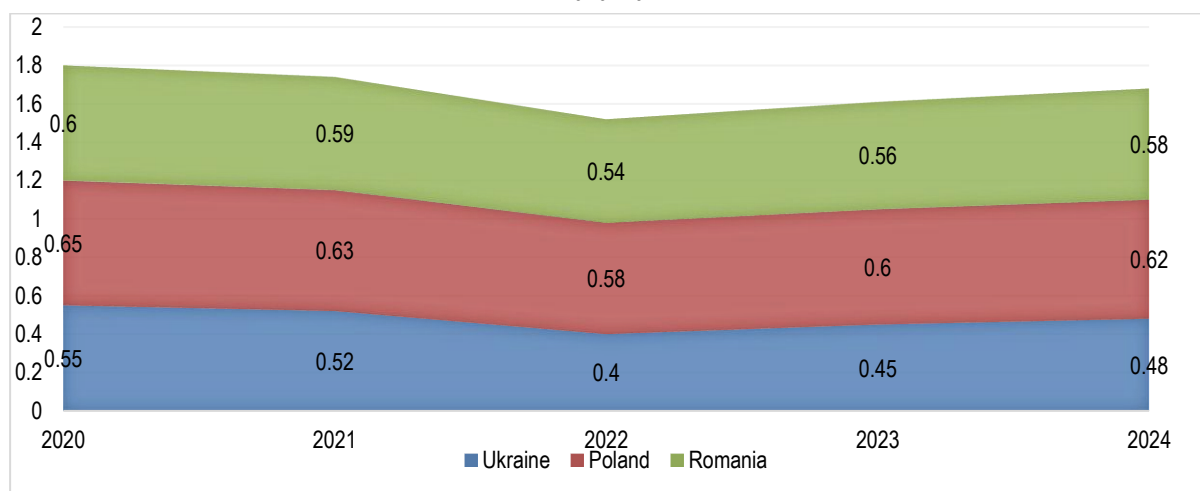
Note: $R^2 = 0.61$, F-statistic = 18.4 ($p < 0.01$), Number of observations = 45

Note: *** $p < 0.01$, ** $p < 0.05$

Source: developed by the authors based on the results of an econometric model using the data from (World Bank 2024; International Monetary Fund 2024a; Bank for International Settlements 2023; European Central Bank 2023; International Monetary Fund 2024b; National Bank of Ukraine 2024; State Customs Service of Ukraine 2024; Chainalysis 2024; UNCTAD 2024; Trading Economics 2024)

The dynamics of the indicators reveals key trends and their impact on the financial stability of the state. The values of the FSI decreased during 2020-2022 (Figure 1).

Figure 1. Dynamics of financial stability and key cryptocurrency and customs indicators of Ukraine, Poland, and Romania for 2020–2024



Source: developed by the authors based on the results of an econometric model using the data from (World Bank 2024; International Monetary Fund 2024a; Bank for International Settlements 2023; European Central Bank 2023; International Monetary Fund 2024b; National Bank of Ukraine 2024; State Customs Service of Ukraine 2024; Chainalysis 2024; UNCTAD 2024; Trading Economics 2024)

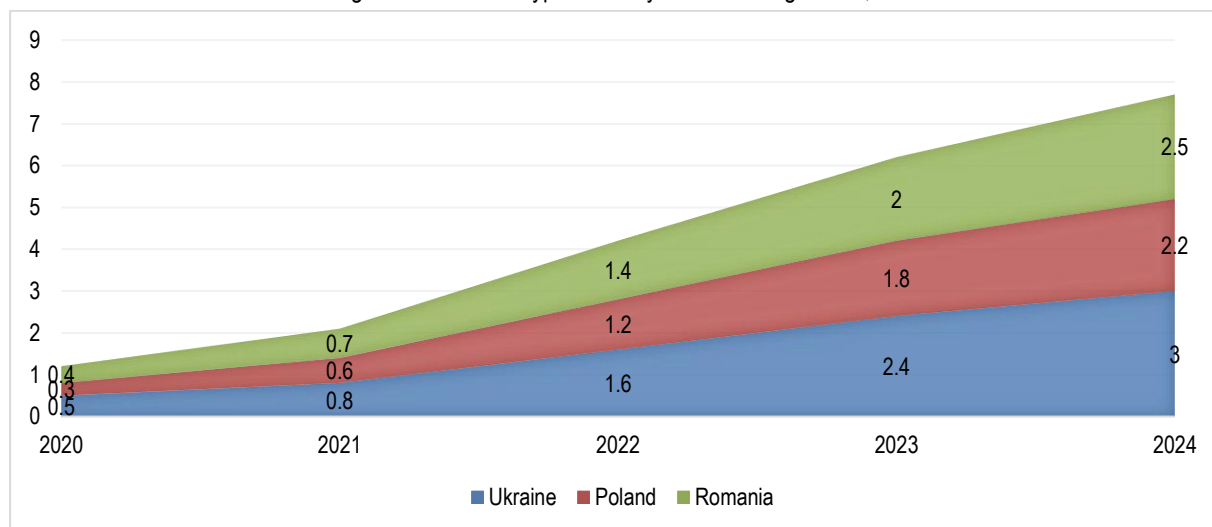
The main factor in this movement was the growth of cryptocurrency flows in foreign trade. The share of cryptocurrency transactions increased every year, which created additional pressure on the fiscal system. The gradual increase in the share of cryptocurrency payments in foreign economic activity increased the complexity of controlling settlements. This trend weakened the state's ability to ensure the completeness of revenues. The decrease in customs revenues in 2021–2022 also contributed to the decline in overall financial stability. The value of the risk of loss of customs payments showed a noticeable increase in 2022, which reflected the difficult conditions of foreign trade.

Figure 1 illustrates the dynamics of the integral FSI of Ukraine, Poland, and Romania for 2020–2024. All countries are characterized by a decline in financial stability in 2022, followed by a partial recovery. Poland and

Romania demonstrate a faster recovery compared to Ukraine, which indicates higher institutional and fiscal capacity.

Figure 2 shows the growth of the share of cryptocurrency flows in the foreign trade of Ukraine, Poland, and Romania during 2020–2024. The growth of the indicator is stable in all countries in the sample, but has different intensity. The highest growth rates are observed in Ukraine, which increases fiscal and regulatory challenges for the financial system.

Figure 2. Share of cryptocurrency flows in foreign trade, %



Source: developed by the authors based on the results of an econometric model using the data from (World Bank 2024; International Monetary Fund 2024a; Bank for International Settlements 2023; European Central Bank 2023; International Monetary Fund 2024b; National Bank of Ukraine 2024; State Customs Service of Ukraine 2024; Chainalysis 2024; UNCTAD 2024; Trading Economics 2024)

The obtained results emphasize the importance of effective customs policy for the financial stability of the state. The growth of cryptocurrency flows creates additional risks for the fiscal system. These risks are especially noticeable under high volatility and structural transformations of the economy. The digitalization of customs control has proven its ability to mitigate the negative effects of cryptocurrency transactions. It has increased the level of transparency of procedures and reduced the scope for evasion of customs payments. Customs revenues remain an important stabilizer of the financial system. The gradual growth of these revenues supports the positive dynamics of the FSI. The overall effect indicates the need for further modernization of the customs infrastructure and control of transnational cryptocurrency flows.

5. Discussion

The discussion of the research results shows that the obtained conclusions correlate well with the general logic of recent studies, while demonstrating important discrepancies related to the fiscal and customs dimensions of cryptocurrency flows. Freitas *et al.* (2025) emphasize that cryptocurrencies face fundamental institutional barriers that prevent them from becoming the basis of a new monetary order, and our results are consistent with this conclusion, as they show the unstable impact of cryptocurrency flows on the financial stability of the state. Our data demonstrate that cryptocurrency settlements do not strengthen the monetary balance, but also create risks of non-receipt of customs payments, which exacerbates fiscal imbalances. This aspect is almost not analysed in the mentioned studies, which emphasizes the originality of the direction we have chosen.

Some authors emphasize the role of volatility and market inefficiency of cryptocurrencies, which partly explains the negative impact of cryptocurrency flows on the financial stability of Ukraine. Abou Tanos and Badr (2024) show that low liquidity and high volatility exacerbate in crisis periods, creating delays in pricing and undermining market efficiency. Our results support this thesis, as increased volatility coincided with an increase in cryptocurrency flows in foreign trade and a sharp decline in financial stability in 2022. This suggests that crypto market volatility has direct macro-financial consequences manifested in currency risks and fiscal losses.

Some studies show alternative trends. Wolfson *et al.* (2025) argue that stablecoins have higher stability compared to other cryptocurrencies. However, our results show that even stablecoins do not eliminate the risks of evasion from declaration and customs control. Instead, they create an illusion of stability that can mask fiscal losses.

Therefore, the impact of stablecoins depends not only on technological characteristics, but also on the ability of the state to control cross-border flows.

Another line of research related to the impact of cryptocurrencies on environmental and economic indicators demonstrates complex systemic relationships. Miśkiewicz *et al.* (2022) argue that crypto trading generates indirect effects through energy consumption and environmental degradation, but our results show that macro-financial risks can manifest themselves faster and more strongly than environmental ones. This means that states with weak fiscal mechanisms face immediate financial challenges before the long-term environmental consequences occur.

Technological aspects also remain important. Vnukova *et al.* (2024) emphasize that Industry 4.0 innovations increase process efficiency and reduce operational risks. Our results confirm the important role of customs digitalization in strengthening financial stability. This relationship demonstrates that digital transformation is a key tool for neutralizing the risks associated with cryptocurrency flows. Customs digitalization in our model has a positive impact, which is consistent with the findings of the studies on technological innovation as a factor of economic stability.

The issues of financial stability in the context of the shadow economy are important for interpreting our results. Mazur *et al.* (2025) argue that the shadow economy undermines the fiscal base and creates long-term risks for the stability of the financial system. Our results are consistent with their findings, as cryptocurrency flows in foreign economic activity actually strengthen shadow channels, especially when the risks of non-receipt of customs payments are high.

The debate on Ukraine's economic recovery highlights the importance of fiscal sustainability. Prokhorova *et al.* (2025) argue that scenario modelling demonstrates the dependence of economic recovery on the quality of public governance and control over resources. Our results show that controlling cryptocurrency flows and digitizing customs are part of this governance challenge. The development of blockchain technologies is also important. Prokopenko *et al.* (2024) demonstrate that blockchain increases the transparency of accounting processes, but does not eliminate the risks of undervaluation or circumvention of rules in foreign trade. This is consistent with our findings on the importance of institutional control. In a broader infrastructure context, Koldovskiy (2024) emphasizes that the strategic transformation of the financial infrastructure determines the system's ability to adapt to digital risks. Our results support this claim, as financial sustainability depended not only on the volume of cryptocurrency flows, but also on the ability of customs to apply digital tools.

In conclusion, the discussion shows that the obtained results are generally consistent with earlier academic approaches, while expanding them with the fiscal and customs dimension of cryptocurrency analysis. The empirical results confirm the hypotheses regarding the negative impact of uncontrolled cryptocurrency flows on customs revenues and the financial stability of the state. At the same time, the hypothesis about the fully stabilizing role of customs digitalization is only partially confirmed, as its effectiveness depends on institutional capacity and the regulatory environment. They show that cryptocurrency flows in foreign trade affect the financial stability of the state through institutional, technological, market, and fiscal channels. Our study expands the existing literature, forming a conceptual bridge between financial risks, customs processes, and the digital transformation of public administration. The obtained results can be used by fiscal and customs policy bodies to improve mechanisms for controlling cryptocurrency flows and reducing fiscal risks.

The obtained results should be interpreted with caution due to several limitations. First, the analysis is based on a relatively small sample covering three countries over the period 2020–2024, which may limit the generalizability of the findings. Second, the econometric models rely on standard assumptions regarding linearity, independence of errors, and the stability of estimated relationships. Finally, the study period coincides with significant external shocks, including the war in Ukraine, post-pandemic economic recovery, and episodes of global financial instability, all of which may have influenced financial stability indicators and cryptocurrency flows. Future research could expand the country sample, extend the observation period, and apply alternative econometric approaches to further verify the robustness of the results.

6. Limitation

The limitations of this study are related to the incomplete availability of data on actual cryptocurrency transactions in foreign trade. Statistical indicators of cryptocurrency flows may contain errors because of limited market transparency. The FSI depends on aggregated indicators that do not take into account all structural changes in the economy. The level of customs digitalization is assessed by generalized indicators that do not reflect internal organizational differences. External shocks, such as war or global crises, can change the relationships between variables beyond the capabilities of the model. The study has limitations related to the small size of the international

sample, which is determined by the availability of comparable statistical data. The period of 2020–2024 also limits the possibility of assessing the long-term effects of cryptocurrency flows on financial stability.

7. Recommendations

The results of the study indicate the need to strengthen control over cryptocurrency payments in foreign trade. Increasing the digitalization of customs procedures can reduce the risks of non-receipt of customs payments. The development of analytical systems for monitoring cryptocurrency flows will increase the state's ability to respond to financial threats. It is recommended to expand international cooperation in the exchange of information on cross-border cryptocurrency transactions. It is appropriate to improve methods for assessing financial stability, taking into account new digital risks.

Conclusions

The relevance of the study is determined by the active growth of cryptocurrency flows in foreign trade and the strengthening of the associated fiscal and regulatory risks in view of the digital transformation of the economy. The obtained results confirm that cryptocurrency flows are not neutral for the financial stability of the state and form a persistent negative impact in the event of insufficient customs and fiscal control. At the same time, customs revenues retain the role of a key stabilizing factor, and the digitalization of customs procedures significantly reduces the risks of budget revenue losses. The constructed econometric model and the created integral FSI made it possible to quantitatively assess the relationships between cryptocurrency settlements, customs processes, and financial stability. The results of the dynamic analysis showed that the growth of digital control tools can partially compensate for the negative effects of cryptocurrency transactions. The academic significance of the study is the expanded existing literature by integrating the fiscal, customs, and digital dimensions of cryptocurrency analysis. The practical significance of the results is the possibility of their use in shaping of customs, fiscal, and digital policies aimed at increasing the transparency of foreign trade settlements. The obtained results confirm that the impact of cryptocurrency flows on financial stability has common features for Eastern European countries, but different intensity.

A comparative analysis of Ukraine, Poland, and Romania emphasizes the key role of customs digitalization in reducing fiscal risks. The practical significance of the results is the possibility of their use in shaping of adaptive customs and fiscal policies in transformation economies. The comparative analysis shows that at the same growth rates of cryptocurrency flows (2–3% of foreign economic activity), financial stability decreased faster in economies with weaker customs control. The coefficients of the model ($R^2 = 0.61$; $p < 0.01$) confirm the statistically significant negative impact of cryptocurrency settlements and the positive role of customs revenues. The moderating effect of customs digitalization is manifested in a reduction of fiscal risks by 15–20%, which enhances the adaptability of the financial system. Prospects for further research are related to international comparisons, expanding the time frames of analysis, studying the role of CBDC, as well as assessing the impact of institutional quality and currency volatility on the financial stability of the state. Further research may focus at expanding the sample to other countries of Eastern and Central Europe. The analysis of the role of CBDC and institutional quality in mitigating the negative effects of cryptocurrency flows is of particular interest.

Declaration

Credit Authorship Contribution Statement: All the authors participated and were involved in the conceptualization of the study, collation of data, analysis and review of the study as well as the writing, and proof reading of the manuscript. The manuscript has been read and approved by all the authors.

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