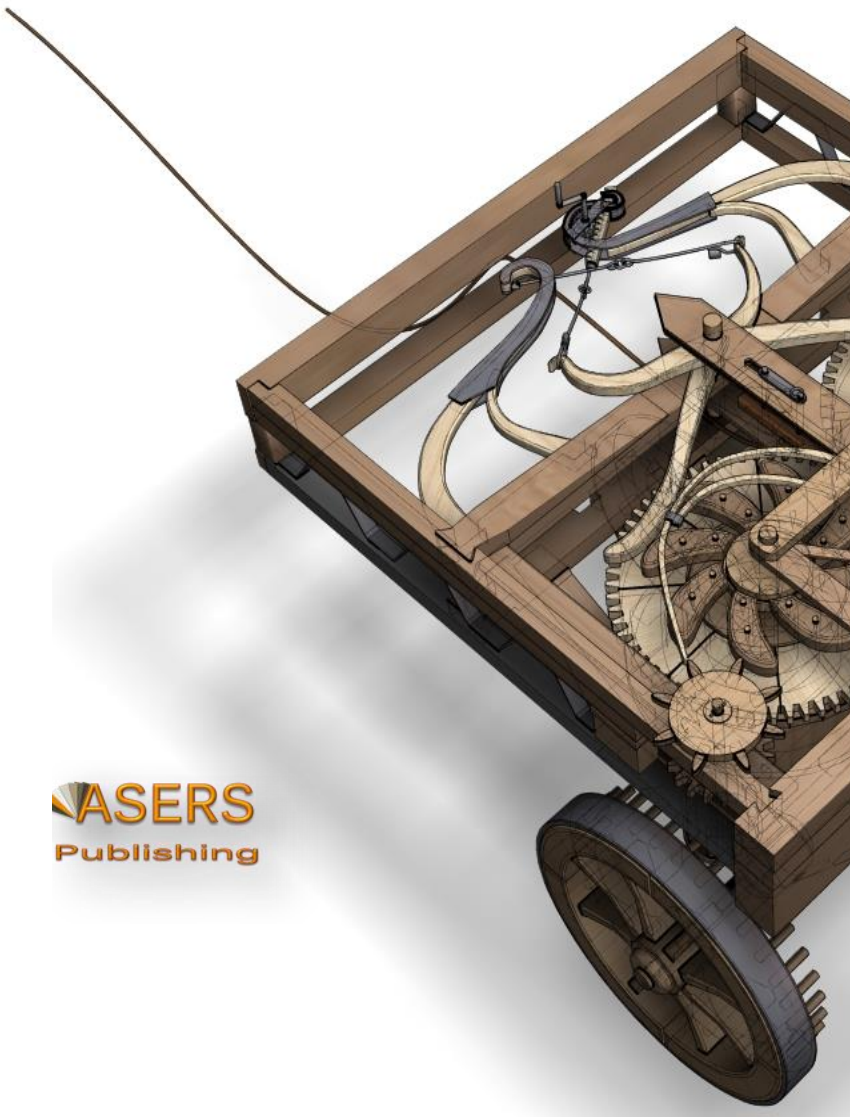
Theoretical and Practical Research in Economic Fields



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research to be conquered in order to reach the specific information they require. To combat this tendency, **Theoretical and Practical Research in Economic Fields** has been conceived and designed outside the realm of the traditional economics journal. It consists of concise communications that provide a means of rapid and efficient dissemination of new results, models and methods in all fields of economic research.

Theoretical and Practical Research in Economic Fields publishes original articles in all branches of economics – theoretical and empirical, abstract and applied, providing wide-ranging coverage across the subject area.

Journal promotes research that aim at the unification of the theoretical-quantitative and the empirical-quantitative approach to economic problems and that are penetrated by constructive and rigorous thinking. It explores a unique range of topics from the frontier of theoretical developments in many new and important areas, to research on current and applied economic problems, to methodologically innovative, theoretical and applied studies in economics. The interaction between empirical work and economic policy is an important feature of the journal.

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The primary aim of the Journal has been and remains the provision of a forum for the dissemination of a variety of international issues, empirical research and other matters of interest to researchers and practitioners in a diversity of subject areas linked to the broad theme of economic sciences.

All the papers will be first considered by the Editors for general relevance, originality and significance. If accepted for review, papers will then be subject to double blind peer review.

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IS SLOW ECONOMIC GROWTH ORIGINATING FROM THE TOTAL EXTERNAL DEBT STOCK IN DEMOCRATIC REPUBLIC OF CONGO?

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Abstract:

Unsustainable debt reduces the productivity of a country. Ten years following its "1960 independence", the Democratic Republic of Congo adopted policies that resorted to external finances while the world was at the peak of the 1970 Petro-dollar crisis. The following decade, in the 1980's, with the fall in price of raw materials, the Democratic Republic of Congo was trapped in an unsustainable debt burden cycle that stagnated its economy and according to the World Bank data, reduced its GDP per Capita. The rise of active armed conflicts in the 1990's and political unrest during the 2000's added pressures to resort to further financial support from external creditors, facilitating corruption and poverty in the process.
The inability to service debts leads to economic consequences. One of these consequences is reduction in productivity. With empirical evidence, our analysis will be looking at the Congolese productivity from independence in 1960 to the historical democratic transfers of power in late 2018 to understand the effects of external debts in its economic growth.

Keywords: *Sub-Saharan economic growth, economy of the Democratic Republic of Congo, GDP per capita, total external debt stock, general economics*.

JEL Classification: F43; H54.

Introduction

Since its independence in 1960, the Democratic Republic of Congo has been in a debt and aid cycle from external creditors. With an aim of assessing the relationship between the total external debt stock and economic growth in the Democratic Republic of Congo, this paper will have a fourfold objective by (i) providing an overview background of the Democratic Republic of Congo External Debt, (ii) have a view of the economy of the Democratic Republic of Congo since 1960 to 2019 using its GDP per Capita before (ii) exploring the total external debt stock data from the same period (iii) to conclude, *ceteris paribus*, on relationships between total external debt stock and economic growth to draw recommendations.

1. An Overview on the Democratic Republic of Congo External Debt

Ten years following its 1960 independence, the Democratic Republic of Congo solicited external financial support to maintain peace and support its economy following the Congo Crisis. The mismanagement of funds in the mid 1970's led to further political unrest fuelling corruption and poverty of the 1980's, which in turn led to further armed conflicts in the 1990's and early 2000's. According to Collier (2008), the conflict trap theory is one of the reasons negatively impacting economic growth of countries such as the Democratic Republic of Congo since armed conflicts lead to poverty and poverty is the cause of armed conflicts.

In the Democratic Republic of Congo, successive governments have been unable to end the poverty cycle with much of their policies evolving around borrowing from external creditors to tackle internal economic challenges as well as reverting to external aid for further support.

Moyo (2010) investigated the myth around financial aid to poorer countries to conclude that it failed to stimulate economic growth for African countries but contributed to corruption such as the embezzlement of US$5 billion, between 1970 to 1998, by Marechal Mobutu Sese Seko Kuku Ngbendu WA Za Banga, the late president of Zaïre (actual Democratic Republic of Congo).

Much of the Congolese debt was incurred during the Cold War era when then President Mobutu received more aid from the U.S.A. than the rest of Sub-Saharan Africa combined. According to Boyce and Ndikumana (2002), in 1993, following years of mismanagement, the World Bank suspended its financial assistant to the Democratic Republic of Congo and in 1994, annual inflation was 9,796.9%. The total external debt service increased from 119.6% in 1990 to 271.4% in 1995. In 1997, following 32 years in power, then President Mobutu accumulated a personal fortune estimated at US$5 billion, while his government ran up an estimated *total external debt stock* of around US$12 billion, which represented nearly 225% of GDP and 1,280% of export. They left the country, following a military coup, with unsustainable debts and arrears repayment of US$10.9 million. In 1998, armed conflicts financed by the government of Rwanda and Uganda added further pressures to the repayment of debts.

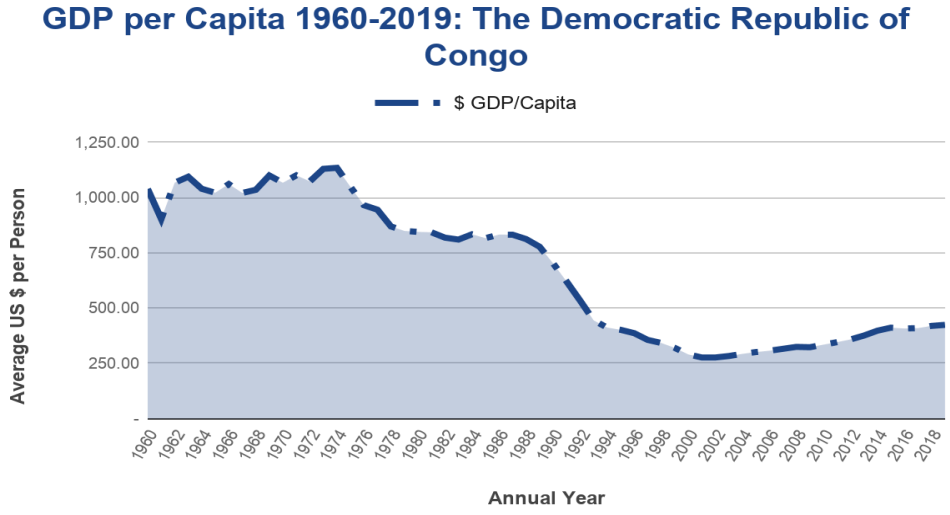
The I.M.F. and the World Bank stated that the Democratic Republic of Congo was vulnerable to financial shocks because of its debt burden and promoted S.A.P. as responsible economic policies for developing countries since the early 1980s by the provision of loans conditional on the adoption of set standard policies. And according to the joint World Bank - IMF Debt Sustainability Analysis approved by Estevão *et al.* (2019), the Democratic Republic of Congo has been making progress since the early years of 2000's.

However, The Sentry (2019) investigated corruption between Congolese officials and bankers legitimising illegal transactions from external loans using banking institutions to enrich a selected minority at the expense of the overall population, which raised the question of whether aid money and programs set by the Bretton Woods institutions are beneficial to the overall Congolese population.

2. Data and Empirical Strategy

We are aiming to look at data covering the full term in office of different governments. This paper will be looking at data from 1960 to 2018 to understand GDP per Capita and total external debt stock. We will also have a partial insight of the current government by adding data from 2019. Therefore, we will base our analysis on 60 paired observations.

2.1. Data



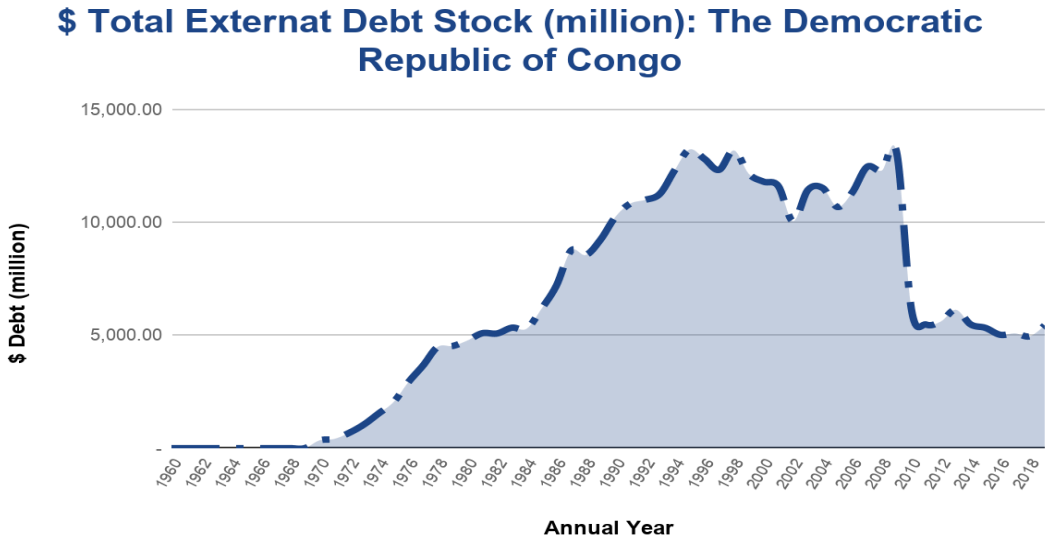
Graph 1. Average productivity of Congolese in US $ from 1960 to 2019. Data were collected from the World Bank adjusted at 2010 to exclude the effect of inflation allowing accurate economic comparison year on year

For economic growth, we will refer to GDP per Capita, which is identified as a country standard of living with data collected from the World Bank at 2010 constant[1]. The World Bank is a recognised and reliable global source of economic data. Countries' data are from their respective national statistical systems and improved to global standards to become effective analytical tools.

As the World Bank's goal is the reduction of poverty by providing loans and grants, data have been assessed by the organisation to be accurate and trustworthy for decision-making.

The annual GDP per capita will measure the value of yearly production in the Democratic Republic of Congo during the selected period and divided by the number of inhabitants in the middle of relevant years. Data are adjusted for inflation and differences at the 2010 fixed prices to allow accuracy in economic comparisons.

Graph 1 suggests that the Democratic Republic of Congo's standards of living from 1960 to 2019 has more than halved to prompt questions about economic related events from the 1970's to early 2000's. One of these factors, *ceteris paribus*, is the total external debt stock, which is defined by the World Bank[2] as debt owed to non-residents and repayable in currency, goods, or services. Total external debt stock is the sum of public, publicly guaranteed, and private non-guaranteed long-term debt, use of IMF credit, and short-term debt where short-term debt includes all debt having an original maturity of one year or less and interest in arrears on long-term debt.



Graph 2. Total External Debt Stocks of the Democratic Republic of Congo in million US $ from 1960 to 2019. Data were collected from the World Bank

Graph 2 shows the Democratic Republic of Congo total external debt stock in US$ from 1960 to 2019 suggesting an increase as an independent country from US$5,000 million in the 1970's to around US$10,000 to US$15,000 million in the 1990's and early 2000's. A sharp decrease was observed from 2008 to 2010, when analysis approved by Estevão *et al.* (2019) suggested progress was made from S.A.P.

2.2. Empirical Strategy

The paper analyses the relationship between total external debt stock in the Democratic Republic of Congo and economic growth. *Graph 1* & *Graph 2* are signalling a negative correlation, which we will further investigate with the linear regression *(eq.2.1)*:

$$G_t = \alpha + \beta D_t + \varepsilon \qquad 2.1$$

G_t represents the standard of living determine by the GDP per Capita at year *t;*

α_t is the intercept, the GDP per Capita at zero total external debt stock.

β is our slope to determine how growth will behave with additional debts.

D_t is the shock to growth, the independent variable that is debt during year *t;*

ε represent the error in our model; *ceteris paribus* factors.

[1] Data available from the World Bank: https://data.worldbank.org/indicator/NY.GDP.PCAP.KD?locations=CD

[2] The Democratic Republic of Congo data for total external debt stock were isolated from the world data that are available from the World Bank at: https://data.worldbank.org/topic/external-debt?display=d

3. *Results and Interpretation*

3.1. Main Results

3.1.1. Testing: T-Test

The T-Test determines the level of significance between our selected data (GDP per Capita & Debt) and their respective means.

Our Hypotheses are as follow:

$H_0: \mu \leq 0$; *null hypotheses assuming growth not impacted by debt*
$H_1: \mu > 0$; *alternative hypotheses that our growth increases following debt*

With a 5% significance (0.05), giving us a 95% accuracy of samples.

t-Test: Paired Two Sample for Means		
	$ GDP/Capita	$ Debt (million)
Mean	669.3261883	6290.983121
Variance	97203.59543	21128117.66
Observations	60	60
Pearson Correlation	-0.8226372648	
Hypothesized Mean Difference	0	
Df	59	
t Stat	-8.966834891	
P(T<=t) one-tail	0	
t Critical one-tail	1.671092973	
P(T<=t) two-tail	0	
t Critical two-tail	2.000995318	

The absolute value of our t-Stat at 8.9 suggests that there is greater evidence against the null hypotheses.

And with both P values (one & two tails) equal to zero, the null hypotheses (H_0) will be rejected with strong evidence of higher significance and accuracy of selected data.

3.1.2. Linear Regression

Having tested the significance/accuracy of our data, we will look into their relationships from 2.1. Our primary aim is to determine how GDP per Capita reacts as a dependent variable of the total external debt stock.

The key result will be the R Square, which determines the level in which the total external debt stock influences GDP per Capita.

It indicates that from our 60 observations, GDP per Capita is influenced at 67.67% by total external debt stock.

With the significance F lower than 0.05 at 0, we have a strong significance regression for our results and also confirmed by our T-Test in 3.1.1.

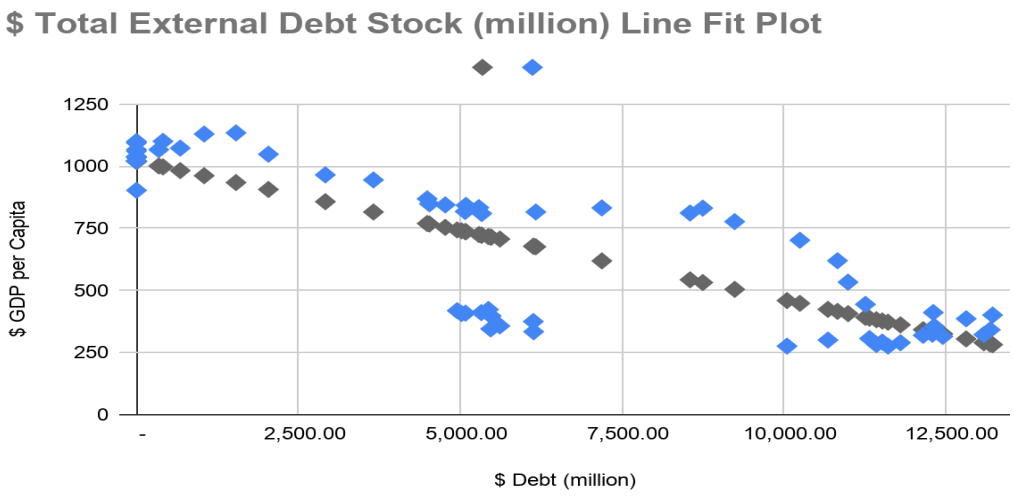
Our coefficients are suggesting that:

- we should be expecting US$1,020 GDP per Capita as intercept, at
- a negative debt of (US$0.055 million) as our slope confirming the negative relationship between debt and GDP per Capita.

By targeting a GDP per Capita of US$ 1,020, we will be reducing the total external debt stock by US$ 0.055 million. Or with a reduction of US$0.055 million in the total external debt stock, we would expect a GDP per Capita of US$ 1,020.

Looking in the P value, we can confirm that the total external debt stock has an effect on GDP per Capita because at 0, our P value are lower than 0.05

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0.8226372648							
R Square	0.6767320694							
Adjusted R Square	0.6711584844							
Standard Error	178.7864023							
Observations	60							
ANOVA								
	df	SS	MS	F	Significance F			
Regression	1	3881066.627	3881066.627	121.4177353	0			
Residual	58	1853945.503	31964.57764					
Total	59	5735012.13						
	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95%	Upper 95%
Intercept	1020.350875	39.33920073	25.93725484	0	941.604911	1099.096838	941.604911	1099.096838
$ Debt (million)	-0.0557980652	0.005063817857	-11.01897161	0	-0.06593439764	-0.04566173275	-0.06593439764	-0.04566173275



Graph 3. Total External Debt Stocks vs GDP per Capita of the Democratic Republic of Congo from 1960 to 2019. Data collected from the World Bank and process using excel scatter graph

With *Graph 3,* we are predicting GDP per Capita using coefficients from selected data. The black dots are our predicted GDP per Capita, which decreases as debt increases. The blue dots are the actual GDP per Capita fitting our expectations. The higher the total stock of external debt, the lower our GDP per Capita.

We can confirm that Eq.2.1 is a good regression and there is a negative relationship between GDP per Capita and External Debt.

Conclusion & Recommendations

Our aim was to determine whether slow economic growth was a consequence of external debt in the Democratic Republic of Congo. We selected data from 1960 to 2019 and suggested a linear regression with GDP per Capita as a dependent variable of total external debt stock. We tested our data for significance to fit our regression model. Our results confirm that **in the Democratic Republic of Congo, assuming that all other economic factors are held constant and using GDP per Capita as an indicator of productivity/standard of living, there is a negative correlation between economic growth and the total external debt**. With higher debts, productivity tends to decrease.

Therefore, the Democratic Republic of Congo required a robust national budget that will tackle the total external debt stock to support economic growth. Not prioritizing debt reduction, but sustainability is key as total external debt stock has been constantly increasing from the 1970's the late 1990's, but stabilized in the early years of 2000 when we could observe stable GDP per Capita.

Debt may influence, but it is not necessarily the main issue. Our analysis assumed that all other economic factors were constant. Roux de Bézieux (2020) stated in an interview that debt reduction in time of crisis is not necessarily the priority, but the ability to reimburse it by setting robust economic policies for the future. With regards to the Democratic Republic of Congo, robust policies are key to sustain the debt adequately by reimbursing interest and principal while promoting growth.

The total External Debt Stock of the Democratic Republic of Congo has been one of its economic challenges from 1970's to the early years of 2000, adversely influencing it by more than 60%. Reducing the Debt should be a social responsibility. The country should therefore determine its limits identifying the level where its debt does not prejudice its economic growth. Then set robust policies aiming to reach a GDP per Capita at US$ 1,020 through job creation, revised expenditures and implementing fair taxation to start repaying the total external debt stock and reduce its reliance on aid.

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Appendix

	Growth, Debt & Politics - DR Congo				
Year	*$ GDP/Capita*	*% growth*	*$ Debt (million)*	*Leader*	*Regime*
1960	1,038.93		-	Kasa-Vubu	Elected
1961	903.13	-13.07	-	Mobutu	Interim
1962	1,067.06	18.15	-	Kasa-Vubu	Elected
1963	1,094.01	2.53	-	Kasa-Vubu	Elected
1964	1,039.41	-4.99	-	Kasa-Vubu	Elected
1965	1,021.61	-1.71	-	Kasa-Vubu	Elected
1966	1,060.77	3.83	-	Mobutu	Dictatorship
1967	1,020.79	-3.77	-	Mobutu	Dictatorship
1968	1,034.88	1.38	-	Mobutu	Dictatorship
1969	1,099.68	6.26	-	Mobutu	Dictatorship
1970	1,066.77	-2.99	345.22	Mobutu	Dictatorship
1971	1,100.42	3.15	410.05	Mobutu	Dictatorship
1972	1,073.00	-2.49	676.59	Mobutu	Dictatorship
1973	1,129.87	5.30	1,046.51	Mobutu	Dictatorship
1974	1,134.30	0.39	1,538.50	Mobutu	Dictatorship
1975	1,048.55	-7.56	2,038.61	Mobutu	Dictatorship
1976	965.20	-7.95	2,918.45	Mobutu	Dictatorship
1977	944.92	-2.10	3,661.97	Mobutu	Dictatorship
1978	869.07	-8.03	4,491.70	Mobutu	Dictatorship
1979	848.75	-2.34	4,527.13	Mobutu	Dictatorship
1980	844.50	-0.50	4,770.69	Mobutu	Dictatorship
1981	842.57	-0.23	5,090.79	Mobutu	Dictatorship
1982	818.23	-2.89	5,078.79	Mobutu	Dictatorship
1983	809.72	-1.04	5,335.73	Mobutu	Dictatorship
1984	833.58	2.95	5,289.77	Mobutu	Dictatorship
1985	816.14	-2.09	6,171.27	Mobutu	Dictatorship
1986	832.28	1.98	7,190.75	Mobutu	Dictatorship
1987	831.65	-0.08	8,749.84	Mobutu	Dictatorship
1988	812.00	-2.36	8,553.69	Mobutu	Dictatorship
1989	777.26	-4.28	9,243.64	Mobutu	Dictatorship
1990	702.13	-9.67	10,250.73	Mobutu	Dictatorship
1991	619.80	-11.73	10,831.93	Mobutu	Dictatorship
1992	533.53	-13.92	10,995.02	Mobutu	Dictatorship
1993	444.05	-16.77	11,263.66	Mobutu	Dictatorship
1994	411.49	-7.33	12,311.69	Mobutu	Dictatorship
1995	401.19	-2.50	13,229.23	Mobutu	Dictatorship
1996	386.11	-3.76	12,819.90	Mobutu	Dictatorship
1997	355.53	-7.92	12,326.99	Mobutu	Dictatorship

	Growth, Debt & Politics - DR Congo				
Year	*$ GDP/Capita*	*% growth*	*$ Debt (million)*	*Leader*	*Regime*
1998	341.78	-3.87	13,192.16	Kabila (L-D)	Dictatorship
1999	319.56	-6.50	12,155.73	Kabila (L-D)	Dictatorship
2000	289.99	-9.26	11,804.40	Kabila (L-D)	Dictatorship
2001	276.14	-4.77	11,612.18	Kabila (J)	Dictatorship
2002	276.06	-0.03	10,051.61	Kabila (J)	Dictatorship
2003	282.65	2.39	11,433.51	Kabila (J)	Dictatorship
2004	292.35	3.43	11,524.22	Kabila (J)	Dictatorship
2005	300.56	2.81	10,683.99	Kabila (J)	Dictatorship
2006	306.53	1.98	11,326.30	Kabila (J)	Elected
2007	315.26	2.85	12,459.47	Kabila (J)	Elected
2008	324.04	2.78	12,296.41	Kabila (J)	Elected
2009	322.42	-0.50	13,093.04	Kabila (J)	Elected
2010	334.02	3.60	6,136.64	Kabila (J)	Elected
2011	345.27	3.37	5,473.72	Kabila (J)	Elected
2012	357.60	3.57	5,615.75	Kabila (J)	Elected
2013	375.22	4.93	6,132.47	Kabila (J)	Elected
2014	397.34	5.90	5,481.89	Kabila (J)	Elected
2015	411.02	3.44	5,327.95	Kabila (J)	Elected
2016	407.29	-0.91	5,021.57	Kabila (J)	Elected
2017	408.92	0.40	5,083.90	Kabila (J)	Elected
2018	418.99	2.46	4,955.69	Kabila (J)	Elected
2019	423.64	1.11	5,437.55	Tshisekedi (F)	Elected

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PLURALISM AS A RECOMMENDED RESEARCH PRACTICE FOR CENTRAL BANKS IN ADDRESSING WELFARE CONCERNS ON THE EXPERIENCE OF COVID-19

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Abstract: *The theoretical discourse of pluralism in this paper has paved the way for central banks research approach to accommodate variety in methodological application, which currently seem to be skewed in the direction of monism. In the interest of ensuring welfare concern for citizens is addressed in the best possible way, this paper has expanded its discourse to incorporate economic pluralism that favours variety of methods. This notably include qualitative and quantitative approaches, with the emphasis of digressing on the new entrant of Mixed Research Synthesis (MRS). Such an approach will seek to explore research capacity in support of addressing opportunities for decent citizens' welfare as the impact of COVID-19 unfold itself.*

Keywords: pluralism; Mixed Research Synthesis (MRS); Central Bank Research; livelihood concerns; COVID-19

JEL Classification: B40; B41; B50.

Disclaimer: Views expressed in this article are those of the author and do not in any way reflect any of the aforementioned institution(s) to which he is associated.

1. Introduction

The concept of pluralism as applied in this study is championed as a form of philosophical discourse in a bid to address methodological mixed approach in support of improving welfare conditions of citizens across the global economy. Technically speaking, the motive behind central banks' action for commissioning empirical research is to ensure welfare concern is addressed equitably. This then avail the opportunity for people to make informed choices on how best to utilise their resources, given the influence of perturbed state of things as witnessed with COVID-19. In that vein, research outcomes as produced from forecast models for example, must be well supported by effective policy intervention so as to avail consumers / economic agents scope of making well-informed decisions about their habit formation and welfare gains in relation to price dynamics (Jackson 2021).

While it is the norm for econometric research to be utilised as the main tool for monetary policy deliberation in central bank research undertakings, critics have resounded their views in favour of embracing pluralism (Jackson 2018a; Dow 2012; Lawson 2009; Downward and Mearman 2007). It is believed that such methodological pursued approach will help address decent welfare state for citizens during abnormal times as witnessed in the case with COVID-19. As specifically expressed by Dow (2012) on the financial crisis of 2007-2009, it is believed that pluralist tactics should be utilised, with its approach to embracing mixture of methods. The accommodation of mixture could involve usage of qualitative and quantitative methods that takes cognisance of differences in cultural values of people in society. The incidence of COVID-19 is a wakeup call for governments and institutions to embrace innovation pertaining to human rational behaviour, as the crisis unearth concerns

around existing economic theories. It is on the backdrop of such concerns in the economics field that pressure groups like academics, think-tank professionals and students alike have championed the case for a rethink of existing curriculum in the economics field (Negru 2010; Dow 2012; Reardon 2017).

The (frequent) occurrence of perturbed incidences in the global economy arguably, warrant a call for pluralism that is more or less subdued in mainstream economics research endeavours (Negru 2010). Notable example of perturbations to global economic state of affairs include the decade gone global financial crisis (2007-09) and more recently, COVID-19 pandemic. The continued fallibility of knowledge pursued efforts, and backed by years of theoretical refinements in the field of economics, has made it more endearing for innovative thinking to be pursued in the direction of pluralism. On the basis of the aforementioned discourse, the research question for this paper is hereby stated as follows: *What approaches can be used in a bid to challenge existing uniformity that characterize current economics research (as rooted from the past)?*

The motivation to pursue this theoretical (viewpoint) research is based on the need to champion change in the direction of pluralism. This will supposedly embrace mixture of research methods, with the objective of addressing decent welfare conditions for citizens in the global community. The outcome of this study will prove beneficial to policy makers in terms of their effort to embrace a research culture that utilizes methodological pluralism. The focus of this is to ensure decent welfare is sustainably maintained for citizens in the global economy amidst perturbed conditions (Warburton and Jackson 2020). In order to answer the above theoretically constructed (viewpoint) research question, the approach to this study is set to achieve the highlighted research objectives: *(i) "To explore opportunities for discourses pertaining to pluralism in economic research that favourably addresses central banks price stability mandate; (ii) To proffer recommendations that support collaborative efforts amongst researchers and scholars in the economics field*.

2. Exploration of Pluralism and its Justification for Emerging Research Inquiry

In order to explain the meaning of pluralism, it is best that a dichotomy is drawn between pluralism and plurality. As Dow (2012, 3 – originally in Miki, 1997) explains it, the latter (plurality) involve variety of techniques, while the former (pluralism) is in advocacy of plurality. Pluralism as paraphrased by Negru (2010, 186) involve diversity as opposed to the purported predefined monist economic theory approach utlilsed by economist. There is the general belief that diversity, which is a characteristics of pluralism can bring about greater scope for intellectual engagement within the discipline of economics. At the same time, it can also increase the possibility of social engagement in addressing efficient policy formulation (Rethinking Economics, 2018).

As will be addressed in the next section, pluralism engineer space for emerging innovation in human thinking, which would have almost been impossible to decipher without the thought about accommodating variety. As explored by Jackson (2018b), there is richness in the scope for pursued scientific inquiry ascribed to pluralism. This can be justified through variety of means (qualitative and Quantitative), thereby bringing Popper's falsification in the fore of scientific assertion.

To explore the concept very clearly, it is but very important to digress on the different categories in which the concept of pluralism can be addressed. These basically include four categorised levels (Dow 2012, 3), namely:

- the Ontological level, which explores the reality of pluralism;
- the epistemological level, otherwise referred to as the meta-methodological level is supposedly the level that facilitate the process of quantitative evaluation of two or more researcher who for some reasons have utilised the same research question(s);
- the methodological level, assert strategies and rationale for pursued empirical endeavours, and finally;
- the practice level, which is to do with the application of concepts.

All of the highlighted levels are thought to be linked with theories that guide their practical use in the world of scientific enquiry. While the discourse has been expressed in terms of addressing the aforementioned categories of pluralism, the tenet of pluralism is highly skewed in the direction of its openness to variety of methodological approaches as contextualized in this study. This then brings about great contrast in terms of its diversified approach to knowledge enquiry as opposed to the purported '*monistic*' view on which economic theory seem to have framed the mindset of its supporters (Negru 2010; Dow, ibid). As emphasised by Caldwell (1982), while the pluralist approach is based on interrogation of validity, driven by logical positivism, the practice of monism as purportedly utilised by many in mainstream economics is built on the application of deductive logic and empirical testing, against undisputable and inclusive evidence(s) about reality. The affirmed dictate of mainstream economics seem to have come up with tremendous criticism as expressly stated in Lawson's (2009) work. In this, he provided a critique on the deductive approach used in econometric testing, which is restricted to mathematical formulation.

While it is seen that the monist approach is highly skewed in the direction of utilising a particular way of testing economic phenomenon, the experience of COVID-19 is a justification for pluralist thinking as the way forward in economic research inquiry. If one consider the unpredictability of events in the world economy, then habit formation, which on assumption could be classified as a variable, is capable of changing the dynamics of things or outcomes of research. This is on the basis that the unpredictable nature of events in the global economy (as revealed by COVID-19) could have serious implications on physical variables like assets as critically addressed by Jackson (2020a) in the domain of the Sustainable Livelihood Framework (SLF).

In pursuit of epistemological facts finding, there is always the possibility of uncertainty, which then makes it possible for thoughts about variety to be addressed, seemingly skewed in the direction of methodological pluralism. As expressed by Downward and Mearman (2009) and Jackson (2018b), limitations inherent in mainstream monism is making it justifiable for the use of varied methods (notably, heterodox views and even the use of Critical Realism). The use of variety is considered very relevant in a bid to assert inductivism in scientific research endeavours. The need for variety within the domain of methodological pluralism has made it possible to ascertain the uniqueness of pluralist approach in carving an answer towards the pursuance of ontological facts finding. Some economist may be forthright in ascertaining their research practices to variety, which in many cases seem to be highly reliant on the use of mathematically derived formalities (McCloskey 1985).

3. Innovation through Mixed Research Synthesis (MRS) Technique

Methodological plurality is a concept that has being in the domain over decades ago; notable usage of it applies to the incidence of 2007-2009 financial crash, which almost resulted in a total collapse of the world's financial system. Given the level of uncertainty human beings are exposed to across the world, it is now believed that pandemics are something that can occur, whether we like it or not. It could appear in any form, but more emergent in this discourse of pluralism is that of COVID-19. The emergence of COVID-19 came with a difference - one that has never being experienced in the current generation of human existence. It resulted in the collapse of the world economic system, with economies brought to a standstill in a bid to save lives (Jackson, 2020b).

he manner in which COVID-19 presented itself and its influence on macroeconomic variables projection (e.g., Gross Domestic Product and Consumer Price Index) is one of a surprise. COVID-19 pandemic has made it more convincing for economic pluralism to be utilised as a complement to support conclusive evidence on research endeavours, which also add value on human understanding about the perturbed state of things in the global economy.

Discourse in this section is one that lend support for both monism and pluralism. Pluralism is in advocacy of methodological mix, involving both quantitative and qualitative approaches. The use of quantitative approach as mentioned here can incorporate trials with methods not already utilised in mainstream economic inquiry, while the use of qualitative approach can be utilised as a complement to quantitative approach given its openness in accommodating opinions. This in reality is needed to facilitate collaboration on methodological grounds, particularly in the current state of things with COVID-19.

The more commonly utilised econometric approach to economic research is a laudable venture, but critics of monist approach as purportedly utilised in economics (reference to Dow 2012; Safdar 2012; Negru 2010) resounded their thirst for the use of variety in a bid to affirm conclusive outcomes from research endeavours. As a regular user of econometric methodology tools in addressing policy formulation, one will be more cautious in being overly critical about the monist approach to economic research endeavours. The use of econometrics and its model formulation is very important in addressing the practicability of scientificity in economics, which could also be extended to accommodate pluralist approach to decipher complex economic problems, normally associated with human irrational behaviour or that which is in cognisance with unexpected perturbations as revealed with COVID-19.

The emergence of COVID-19 has made it quite obvious for pluralists in the discipline of economics to demystify existing economic theories and particularly, the heavy-weighted and uniform application of econometrics to address problems connected with human habit formation and perturbation arising from natural disasters. More overtly, the incidence of COVID-19 has made it more realistic for quantitatively biased economists to be more realistic about the need to consider variety as an option in justifying their affirmation on the continued use of econometrics. Given the reliance of econometric investigation to utilise secondary data in pursuit of scientific enquiry, the incidence of COVID-19, which almost brought the world economy to a standstill has made it more authoritative for research efforts to utilise dummies as a way of projecting (stylised) performances of economic variables (Jackson *et al.* 2019).

Given the highlighted concerns that prevailed with existing economic theories, it is almost certain now for researchers (both pluralist and monist) to think in the direction of embracing variety. Pluralism as construed here is accommodative of variety (quantitative and qualitative) as opposed to the quantitatively '*mixed econometric methods*' approach mostly utilised in economic research endeavours, seemingly restricted to instruments like VAR, VECM, ARDL, etc. (Jackson 2018c; Rethinking Economics 2018).

On this note, there is now a call for policy actions in many central banks to accommodate variety (particularly in developing economies around Africa), which may involve survey technique that incorporate options for quantitative and qualitative interrogation (Sousa and Yetman 2016; Bindere 2017; Binder and Rodrigue 2018; Abuselidze 2020). Such approach is now in use by many central banks across the globe, with its highly favoured usage during the COVID-19 pandemic in a bid to project realistic opinions about macroeconomic trends, notably inflation given limitations encountered in accessing high frequency historical and real-time data (Parkinson, July 6, 2020; Binder 2020). On this note, this paper seem to have carved its emphasis on "*Mixed Research Synthesis (MRS)*' tehnique (Sandelowski *et al*. 2010), which is not necessarily considered as an alternative, but complementary to the most favoured econometric model approach normally utilised by many central banks in the world.

MRS is a new emergent in the domain of mixed methods research repertoire as emphasised by Sandelowski *et al.* (2010). This approach addresses problems generated within the diversity of qualitative and quantitative methods by utilizing three basic research designs, namely: (i) *segregated - this separate the selected qualitative from qualitative methods by analyzing information from data collected and then synthesizing the findings through configuration of outcomes; (ii) integrated- this makes use of research questions to extort mixture of qualitative and quantitative empirical outcomes, which are then integrated to make sense out of data generated; and finally, (iii) contingent – this finally utilize both or either of the two methods to make sense out of research issues or problems*". In a nutshell, MRS technique provide a means for synthesizing outcomes from research findings in a bid to make sense about target phenomenon, which is relevant for practice and policy formulation.

The points above may have positive implications for central bank research endeavours in which case, econometric approach can be combined with variety of instruments like (inflation expectation) surveys to elucidate concerns pertaining to inflation dynamics and perception about trends in economic outputs (Milliken 2020; Barrios and Hochberg 2020; Bholat *et al.* 2019). In the interest of accommodating variety, the use of econometric model approach can be synthesized with non-traditional economic approaches (connected with subjective forecast and other innovative means of surveys), which technically support the proposed new entrant (MRS) in the domain of research plurality. The approach of accommodating variety can create an opportunity for Monetary Policy Committee (MPC) members to affirm their confidence when communicating news to the public about future outlook in an economy, typically associated with inflation dynamics.

The effort of many central banks across the globe to utilise suite of restricted econometric mixed-methods like Quarterly Projection Models (QPM), notably '*Forecasting and Policy Analysis System (FPAS)*' and short term models like *Autoregressive Integrated Moving Average (ARIMA), Vector Autoregression (VAR)*, etc. should also be complemented with non-traditional econometric technique (see Jackson and Tamuke 2019; Jackson *et al.* 2019; Jackson *et al.* 2020). Non-traditional econometric techniques when utilised should factor things like surveys, incorporating both qualitative and quantitative options. To be more specific, qualitative approach like '*Intersectionality*' (Jackson and Jabbie 2020) could also be utilised, with its capability of exploring welfare attributes that cuts across gender, cultural and ethnic groupings. This will ensure conclusive evidences are objectively championed, as trends in pandemics like COVID-19 continue to unearth bleak outlook in the world economy.

4. Critical Appraisal of the Relevance of Pluralist Approach to Central Bank Research

Many critics pertaining to pluralism in economics (Backhouse 1998, 144; Bachmann 2017) have demystify the use of mixed approach as unscientific. This is based on the notion that the concept seem to have carved itself on the need for variety, without much focus on what is considered to be justifiably pluralistic in a bid to effect positive change in the economics profession. In a bid to diffusing such critics' affirmation, the use of grounded theory approach for example, can also serve as an innovative complement to economic pluralism in the ontological pursuit of exploring social phenomenon in the world. Against this backdrop of critiques levied, Grabner and Strunk (2019, 1) noted two main challenges that advocates of pluralism face in their effort to cajole those on the traditional side of economic practices. The first of these include an approach that builds adequate quality criteria in support of pluralist economic practices, while the second involves the inevitability of offering strategies that makes it possible to communicate the need for variety across research paradigms. Some of these strategies

are also explored in the remaining parts of this paper, which also account for innovation in a paradigmatic manner as emphasised with the use of grounded theory.

Given the dynamic trend in the world economic order, highly influenced by the incidence of pandemics (notably COVID-19), there is a need for researchers to continue an effort in pursuing a venture towards pluralism in economics. The use of the term pluralism can also be challenged when it comes to addressing changes in the direction of effective economic management, given the state of economic affairs that countries journey themselves through. In order to make it worthwhile for pluralism to be seen as a worthwhile entrant in the discipline of economics, professionals must endeavour to engage themselves in discourses that lend support to accommodate change.

The redundant state of many established theories in economics, which seem to have experienced criticism on account of the emergence of COVID-19 can still be championed in the direction of incorporating the judicious application of MRS in a bid to generate new order thinking, which mirror that of '*Grounded Theory*' approach (Glaser and Strauss 1967; Glaser 1998; Strauss and Corbin 1998). Where effort is made transparently to adopt pluralist approach that favours use of both qualitative and quantitative techniques, there is a high scope for outcomes to support progress and dialogue in enhancement of professional objectivity. In the same token, there is high possibility for other established theories to be tested through integration of variety, which can be utilised for effective policy purposes by central banks across the globe.

For central banks that are disguising themselves under the umbrella of monism (on account of their insistence in restricting research endeavours to econometric techniques), efforts must be made to embrace research instrument(s) that incorporate both qualitative and quantitative or at best a mixed survey instrument. This will certainly set the pace for objectivity in opinions pertaining to the choices of instrument(s) that can be utilised in a bid to addressing sustained welfare of people, and trends in macroeconomic outlook during distress times of pandemics.

5. Scientific Contribution to the Field of Economic Knowledge

The philosophical ideology of pluralism by nature is certainly a means to addressing emerging thoughts in the field of economics and its research practices. In this regard, the consideration to approach a new order thinking in the direction of adding value to the existing body of economic theories and thinking is considered welcoming given the dynamic nature of the subject, as crystalized in the recent incidence of COVID-19. The purported monist approach to economic research endeavour seem to be losing credence, given the trajectory of macroeconomic trends as revealed with COVID1-9. Economics approach to empirical investigation during this time of COVID-19 crisis has come under intense criticism in proffering solution to global state of economic stagnation. This could be attributed to its uniformed approach to research inquiry, which is heavily reliant on econometrics.

In a bid to affirm confidence in the discipline of economics, many researchers and think-tank institutions are now championing the case for pluralist methodology as a justification to assert scientific ground on which knowledge is explored (Rethinking Economics 2018; Heise 2016; Dow 2012; Negru 2010). Conclusions based on scientific evidence as asserted in Popper's falsification theory requires valid outcomes, which can conclusively be proven through (varied) test outcomes (Jackson 2017). In this regard, the use of pluralism that entails both quantitative and qualitative methods can be seen as a justified means of proving economic scientificity. This then warrant the need for incorporating pluralism in economic inquiries in a bid to ensure conclusive outcomes are varied seen as means of test outcomes as opposed to the purported uniformed approach utilised in econometric studies.

In the effort of justifying the scientificity of pluralist approach to economic inquiry, there is a belief that the use of variety can make it perfectly justifiable to ascertain inductive reasoning, which is based on evidences drawn from variety of empirical procedures (Heis 2016). In this regard, the need to address pluralism in economics can also align itself with other social science specialties like Sociology and Political Science, which seem to have embraced interpretivist paradigm on account of their focus to accommodate variety in pursuit of scientific knowledge exploration. In effect, it is believed that pluralism instigate the means of distinguishing between objective knowledge (akin to the truth) as opposed to that which is proven by means of prejudice or error on account of the non-scientific means of exploration. In this regard, pluralism is now makes it possible for researchers to affirm conclusive evidences that can be justified through variety of methods applied in their research endeavours.

In this regard, various researchers and academics have attested to the need for central banks to embrace pluralism in their approach to affirming conclusive evidences on which policies are formulated, notably Monetary

Policy Rate (Downward and Mearman 2009). The use of variety, which include established econometric techniques with that of surveys (incorporating mixture of qualitative and quantitative features) for example, can enrich the outcome of research endeavours. This can be construed as realistic during state of perturbed conditions (*e.g*., COVID-19) given the difficulty of accessing sufficient historical and real-time data on which valid judgments about economic realities can be based. The use of variety as enshrined in instruments like (inflation expectation) surveys, specifically tailored to support central banks' policy decisions, can prove more effective in addressing reality pertaining to citizens' well-being and projecting trends in macroeconomic variables.

Conclusion and Policy Recommendation(s)

The aforementioned discourses have made a strong case for embracing plurality as enshrined in the research question, in this regard, both quantitative and qualitative approaches are the most favoured, given the unique characteristics ascribed to each technique. Economics as practiced through its purported monist approach for decades can be redefined to accommodate plurality as clearly emphasised by critics and this study in particular (Lawson 2009; Negru 2010; Dow 2012; Jackson 2018b).

The entirety of this research paper has touched on the core objectives. In the first place, discourses are skewed in the affirmative of pursuing research that lend support for the use of pluralist methodology, notably mixture of qualitative and quantitative. The use of variety will certainly make it possible for the profession to warrant credibility on account of the emphasis to embrace variety of methods. The purported uniformed approach to econometrics inquiry pursued by researchers in many central banks is limiting the opportunity for policy makers to address practical concerns around welfare, given the absence of pluralism in their efforts on empirical research. In that vein, pluralism, which favours opinionated and as well as closed question responses from people in all walks of life (*e.g*., incorporating the business community, retailers and consumers) could be an affirmation of researchers' scientific judgments about economic realities. Such pursued approach cases can minimise critics' concerns about their so-called pursued monist campaign about economic sciences' research ventures.

On the way forward in proffering effective and sound recommendations for an efficient means of addressing livelihood concerns, there is a need to ensure collaborative effort is pursued by professionals. This should commence with those at leadership level in central bank institutions globally, more specifically in developing economies in Sub-Saharan Africa (SSA) to make sure recruitment of technical personnel takes into consideration variety in the knowledge background of people to enrich higher scope for research pluralist practices. Equally, there is a need to embrace the use of variety in research pursued efforts that incorporate use of qualitative and quantitative methodologies as opposed to the skewed direction towards the uniformed econometric techniques.

In a bid to address current means of curtailing concerns that bothers around the COVID-19 pandemic, the use of alternative methods of inquiry is highly warranted, more so in the present state of constrained access to historical and real-time data, which seem to have dominated professional practice in economic research endeavours for decades. More importantly, authorities must also endeavour to avail much needed resources to capacitate staff skillset and also, their willingness to explore change that incorporate variety, particularly in under-developed economies, notably SSA.

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Theoretical and Practical Research in Economic Fields

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ESTIMATING THE RELATIONSHIP BETWEEN GOVERNANCE, ECONOMIC GROWTH, INEQUALITY AND POVERTY

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Abstract:

The main purpose of this paper is to estimate the relationship between governance, economic growth, inequality and poverty for 81 countries for the period 2000-2016. We divided the countries into three groups, low-income countries, lower-middle-income countries and upper-middle-income countries. To answer our research question, we use a structural model with simultaneous equations on Panel data. Our results show that the positive or negative impact of governance on the growth-inequality-poverty triangle changes depending on the dimension of governance taken into account and the sample being studied. Given the negative relationship between inequality and growth, democracy should a second time positively affect economic growth through the reduction of inequalities.

Keywords: governance, economic growth, inequality, poverty.

JEL Classification: D73 ; O43.

Introduction

The empirical literature shows mixed messages about the effects of inequality on poverty reduction. Without considering the effects of inequality on growth, Dollar and Kraay (2002) show that growth is an asset for all social groups, with the elasticity of poverty with respect to growth not being affected by income redistribution. Adams (2004) finds that in developing countries growth reduces poverty only when measured in terms of average income or consumption. Ravallion (2001) nevertheless underlines the moderating effects of inequalities on the poverty reduction capacity of growth. In Africa more particularly, Ali and Thorbecke (2000) find that poverty increases when inequalities are high, since the effects on the distribution of income predominate those of growth on poverty. Fosu (2009) notes that in Africa the elasticity of poverty with respect to decreases with initial inequality. Other recent studies have confirmed that poverty has decreased in Africa, but the rate of poverty reduction remains low compared to other developing countries with similar growth (Sala-i-Martin and Pinkovskiy 2010; Young 2012) .

Although theoretical assumptions about the inverse relationship between inequality and economic growth have been empirically verified on several occasions (Bourguignon 2004), the debate on the effects of inequality on growth and poverty is not over. In Barro's (2000) analysis, for example, inequality increases growth in rich countries and reduces it in poor countries. Two fundamental theories relate the important inequalities to the reduction of growth. The first is the theory of the constraining effects of credit (Aghion and Bolton 1997), and the other is the theory of political economy factors, according to which large inequalities can distort policy responses,

reducing the effectiveness of reforms (Alesina and Rodrik 1994; Bardhan, Bowles and Ginitis 2000). Ngepah (2011b) provides an overview of these theoretical approaches.

Most studies on the link between growth, poverty and inequality have three critical limitations. They mainly consider the direct effects on poverty, analyzing growth and inequalities separately; average inequality is often used; and cross-sectional or panel data are used with GDP per capita as a variable for economic growth. Income inequality and economic growth for years has been seen as the major contributor to poverty (Vo et.al 2019; Le Caous and Huarng 2020).

Usually, when the subject of development is open, the concern is whether to prioritize either economic growth or poverty or inequality. Researchers have raised many issues: Is growth enough to reduce poverty? Does Inequality Spread Poverty? What trade-off is between inequality and growth in the fight against poverty?

Following the shortcomings of the classic models of exogenous growth which explain the stability of economic growth in equilibrium, several authors (Romer 1986; Lucas 1988; Barro 1989; Grossman and Helpman 1991; Aghion and Howitt 1998) interested in new models of so-called endogenous growth in order to determine the factors that explain economic growth such as the accumulation of physical and human capital as well as productivity. This generation of growth models has failed to explain how countries have variety in economic growth, productivity and innovation.

Thus, several economists have raised the subject of the quality of institutions and governance. In this regard Alesina and Perotti (1996) integrates political instability, Barro (1996) raises the subject of democracy, Mauro (1995) deals with the subject of corruption, Clague *et al.* (1996) discuss the issue of property rights and (Kaufmann *et al.* 1999; Rodrik 1999) discuss the quality of governance, etc.

This paper studies the relationship between quality governance and the economic growth and poverty triangle. In order to study the effect of the quality of governance on poverty reduction and economic growth, we will build a simultaneous equation model on a sample made up of 81countries grouped according to their income level according to the ranking carried out by the World Bank. The study uses annual data for the period 2000-2016. We opted for this period depending on the availability of data relating to poverty.

Our study differs from previous empirical work by studying a rectangular relationship to test the effect of the quality of governance on the triangle: growth-inequality-poverty. This strategy allows us to identify the direct effect of governance on poverty and its indirect effect through economic growth and inequality on poverty. The introduction of governance indicators plays the role of an exogenous external shock that acts on the triangular relationship linking growth, inequalities and poverty. It is therefore necessary to estimate its effect on poverty by taking into account its simultaneous effect on growth and on inequalities.

2. Literature Review

Empirically, several studies prove that good governance is a stimulus for a country's economic growth. Of course, it is clear that the accumulation of capital and technical progress are not the only factors, which determine the progress in development between countries. The recent literature on the determinants of growth clearly highlights the role of the quality of governance as a catalyst for growth. Likewise, studies that address the relationship between the quality of governance and income inequality often show a negative and significant link between the two.

Thus, Mauro (1996) studied the relationship between governance and economic growth. He concluded that the effect of corruption on growth is small. He also showed that the causality between corruption and investment is as negative as it is strong. Gyimah and Brempong (1999) show that corruption discourages the incentive to invest and therefore harms economic growth. Likewise, Mo's study (2001) also confirms that corruption is detrimental to economic growth and causes political instability. Aidt *et al.* (2005), use the threshold effect method of Caner and Hansen (2004) to study the relationship between corruption and economic growth. They prove that corruption has a negative and significant impact on economic growth in countries characterized by good governance. While for countries with poor governance, the effect of corruption on growth is low to zero. Li *et al.* (2000) discuss the link between economic growth, income redistribution and the level of corruption. They use a sample that covers 47 countries during the period 1980-1992. Their empirical results show that corruption has a negative impact on growth, but corruption alone explains little of the growth differences. Dollar and Kraay (2000) have shown that economic growth can reduce poverty in the least developed countries and that poor quality of governance determined by corruption and political instability can worsen poverty. Glaeser *et al.* (2004) show that poor countries are likely to overcome poverty through good policies Easterly (2002, 2007) studies the relationship between the level of income inequality and the quality of governance. He takes the indicators of Kaufmann and Kraay (2002) as a measure of governance. As for the measures of inequalities, he uses the

WIDER database (2000). The author finds a negative relationship between the level of income inequality and the quality of governance. Gymah-Brempong *et al.* (2006) analyze the effect of corruption on economic growth and income distribution using a panel of 61 countries at different stages of economic development over a 20-year period. Using two measures of corruption, they find that the impact of corruption on per capita income is statistically significant by region. They find that African countries are the most damaged by the effect of corruption on growth. Anyanwu (2013) seeks to study well the different factors that determine poverty as the policy changes that are able to reduce the incidence of poverty in Africa and foster inclusive growth. He asserts that socio-economic strategies and policies that are conducive to the existence of inclusive growth help to facilitate the process of poverty reduction in Africa. Henri (2013), confirms that the quality of economic regulation and political stability positively affect economic growth. Ahou (2015) studies the link between governance indicators and economic growth. It concludes that some governance variables. Akobeng. E (2016) studies the effect of GDP per capita and sectoral growth on poverty. It checks that institutions can strengthen the growth-poverty link. The study of Achim (2017), shows that corruption significantly reduces, being a major obstacle for economic growth. Following to Bot *et al.* (2018), which investigate the influence of corruption and shadow economy upon the economic development.

Nguyen *et al.* (2020) analyzed the concurrent relationship between government quality, economic growth and income inequality within Vietnam in the period 2006–2017 with Stata tool with 3-stage regression model. The results show that higher government quality will boost economic growth and reduce inequality among provinces.

Egla *et al*. (2020) analyze the factors that impact poverty and compare these results between countries within the European Union and post-communist countries that include the Western Balkan (WB) countries: Albania, Bosnia and Herzegovina, Montenegro, North Macedonia, and Serbia. The method used consists of both descriptive statistics and multiple regression analysis using the fixed effect model where poverty is taken as the dependent variable. The results show that income inequality does indeed impact the further progress of poverty for both the EU and WB, while economic development in terms of GDP is shown to have a more significant impact on EU than in WB, where the most significant impact was through income per capita.

Yogeeswari *et al.* (2021) study the impact of microfinance on poverty and income inequality in developing countries, utilising the experiences of 34 developing countries for the period 2009 to 2016, the role of microfinance on poverty in these countries is examined. The results imply that the degree to which the existing forms of microfinance effectively reduce extreme poverty is less workable in developing countries, particularly when the hardcore poor are likely being deprived of receiving access to microfinance.

3. Methodology

To study the simultaneous interaction between economic growth and inequality and to add a third equation that measures poverty, we use a structural simultaneous equation model. This approach allows us to distinguish the direct and indirect effects of governance indicators on poverty through economic growth and inequality.

We build a model that has three equations. The first explains the economic growth Barro (2001). As for the second, it explains inequalities (Deininger and Squire 1998; Forbes 2000 and Squire 2003). Finally, the third explains poverty (Ravaillon 1997; Dollar and Kraay 2000). These three equations are estimated in order to introduce the different relationships between the endogenous variables where the governance variables are considered to be exogenous. The aim of our empirical study is to identify the factors that determine poverty while taking into account the simultaneous effect of economic growth on inequality.

The functional form of our structural model with simultaneous equations is written as:

$$\begin{cases} GRGDPP_{it} = \alpha_0 + \alpha_1 GINI_{it} + \alpha_2 GOV_{it} + \alpha_3 A_{it} + \mu_{it} & 3.1 \\ GINI_{it} = \beta_0 + \beta_1 GRGDPP_{it} + \beta_2 GOV_{it} + \beta_3 B_{it} + \vartheta_{it} & 3.2 \\ IPOV_{it} = \gamma_0 + \gamma_1 GRGDPP_{it} + \gamma_2 GOV_{it} + \gamma_3 GOV_{it} + \gamma_4 C_{it} + \varepsilon_{it} & 3.3 \end{cases}$$

With i = 1, ……,81 ; T = 2000……..2016

$GRGDPP_{it}, IPOV_{it}, GINI_{it}$ *and* GOV_{it} Represent respectively the growth rate of GDP per capita, the incidence of poverty, the Gini index and the governance indicators.

A_{it}, B_{it} *and* C_{it}: represents the vector of variables specific to each equation.

μ_{it}, ϑ_{it} *and* ε_{it} : represent the error terms.

The ratio of the number of poor to the total population of a country or the incidence of poverty corresponds to the absolute approach to poverty where the threshold is set according to the basic needs of the local population. In our study, we relied on the definition of income poverty, which is based on the situation of individuals who are unable to meet their basic needs essential to their survival. This design has been widely used in the work of the

World Bank. Indeed, anyone with an income below an absolute threshold ($ 1.2 or $ 1.9 per day ...) is considered poor.

The GINI index is a frequently used criterion to measure income inequality within a population. This variable is used to detect the effect of income distribution on poverty and economic growth. Governance indicators are introduced into the growth equation based on the work of Kaufman D. Kraay A. and Mastruzzi M. (2003), according to which the quality of governance is an important factor for the economic growth of a country.

Solving the simultaneous equation model requires verification of the model identification condition, Bourbonnais (2002). Indeed, this condition is determined equation by equation in order to avoid that the results are biased. The application of the identification conditions shows that all the equations in the model are over-identified. In our study, we will only use the triple least squares method (3SLS). The triple least squares method takes into account endogeneity problems. Greene (2005) shows that, among all the estimators of instrumental variables, the triple least squares estimator is asymptotically efficient. The triple least squares method (3SLS) starts by estimating each equation by the double least squares (or the instrumental variables), then uses the residuals of this first step to estimate the relationship between the residuals of the different equations and finally uses the least squares generalized (GCM) to globally estimate the whole model taking this information into account. The choice of the triple least squares method for the estimation of our model is justified by the fact that it uses all the information available on the variables and offers efficient estimators.

4. Results and Discussion

Let us first recall that the econometric procedures implemented aim to study the relationship between governance, economic growth and poverty. To do this, a model of simultaneous systems of equations was estimated. We are going to make estimates by groups of countries while introducing dummy variables (dummy-1, 2 and 3), and on which we perform the same regressions. This will allow us to check whether the variables have the same effects in the different groups, namely low-income countries, lower middle-income countries and upper middle-income countries.

The correlation matrix analysis shows that there is a strong correlation between the governance indicators themselves, that is why we will introduce them one by one.

4.1 Estimation Results for Low-Income Countries

The estimation results of the growth equation for low-income countries; it mainly illustrates the effects of income inequality and the quality of governance on economic growth.

First, the effect of inequality on the GDPP growth rate is negative and statistically significant at 1%. This result is consistent with the work of Alesina and Rodrik (1994), Clarke (1995), Fishlow (1995) who find a negative link between the GDPP growth rate and the GINI index. Then, the analysis of the results shows that governance variables such as citizen voice (CV), political stability (PS), government efficiency (GE), regulatory quality (RQ) positively affect economy growth in low-income countries. These results correspond to empirical results, which demonstrate that improving the quality of governance is an essential factor for economic growth. This positive relationship between these governance indicators and the GDPP growth rate confirms the work of Kaufman *et al*. (2003).

Indeed, economic growth improves through the participation of civil society in political life and the contribution to civil and human rights. Likewise, many low-income countries have poorly exploited and sometimes-unexploited natural resources, the existence of an effective government (good management of state expenditure and revenue, better quality of services provided by the government public administration and highly qualified state personnel) is able to stimulate economic growth. In addition, political stability is essential for economic growth. Several empirical studies claim that political stability positively affects economic growth either directly (Barro and Sala – i – Martin, 1997) or indirectly through the investment channel (Alesina and Perotti 1996 and Svensson 1998).

In contrast, the corruption control variable (CC) negatively affects economic growth. This finding contrasts with empirical studies that show that corruption harms economic growth either directly or indirectly (eg, the investment channel). The unexpected sign of the corruption control indicator does not justify that corruption is good for economic growth. However, it is likely that a new approach to fighting corruption, tailored to poor countries, would be more adequate. The latter suffer from the existence of a failing market, excessive bureaucracy and asymmetry of information. Indeed, in countries characterized by high transaction costs, recourse to corruption may be justified to facilitate transactions.

For the control variables, we notice the statistical significance of trade openness which positively affects the growth rate of GDP per capita. It is the same for the population growth rate which has a positive impact on the growth rate of GDP per capita. With regard to education, its effect is statistically insignificant although it positively affects economic growth.

This equation shows two effects, namely the effects of governance indicators and those of the GDPP growth rate on inequality. The relationship between growth and inequality is verified in two ways. The first relationship analyzes the effect of the GDPP growth rate on inequality.

The second tests the quadratic effect by introducing the logarithm of GDPP and its square (Log (GDP) and Log (GDP) ²). Lundberg and Squire (2003) to test the link between inequality and growth have also used this method. Analysis of the results shows the negative link between the GDPP growth rate and the GINI index. Regarding the Kuznets hypothesis, the results show that the quadratic relationship between the logarithm of the GDPP and the GINI index is confirmed. Several empirical studies confirm this finding. Indeed, Mbabazi *et al.* (2002) study the impact of economic growth on inequality using a dummy variable that indicates countries in Sub-Saharan Africa. They find that growth reduces inequalities by a coefficient equal to 0.8.

The estimation results of the third poverty equation show that the effect of the GDPP growth rate on the incidence of poverty is negative and statistically significant. Economic growth is therefore a major factor in reducing poverty in low-income countries. This result is consistent with previous empirical studies on the major role of economic growth in poverty reduction (Deininger and Squire 1996; Dollar and Kraay 2002; Meng *et al.* 2005).

The relationship between inequality and the incidence of poverty is statistically insignificant even though the link between them is positive, suggesting that reducing inequalities may reduce poverty.

Furthermore, the analysis of the results shows that none of the governance variables is significant and that the signs vary from one indicator to another. It therefore appears that the quality of governance has no direct effect on poverty reduction in low-income countries during the study period. However, this result can be justified by the fact that our measure of poverty concerns only the monetary approach to poverty. Based on the capabilities approach adopted by Sen, it turns out that theoretically there is a direct relationship between poverty and the quality of governance.

4.2 Estimate Results for Lower Middle-Income Countries

The results estimation of growth equation for lower-middle-income countries show two main relationships, namely the effect of income inequality and the quality of governance on economic growth.

First, the effect of inequalities on the GDPP growth rate is negative and statistically significant at 1%. These results are consistent with some empirical work that believes that reducing inequalities is favorable to economic growth. For governance indicators, we note that only three indicators have a positive and significant effect of 5% on the GDPP growth rate, which confirms the work of Kaufman et al (2003). Indeed, the two indicators: citizen voice and political stability and absence of violence, which represent political governance, constitute a favorable climate for growth. Likewise, corruption control stipulates the factors of production, creates an economic environment beneficial to productivity, and therefore stimulates economic growth.

The estimation results for this equation reveal the effects of the GDPP growth rate and the quality of governance on inequalities. The effect of the GDPP growth rate on the GINI index is negative and statistically significant. As for the Kuznets hypothesis, the quadratic effect (Log (GDP) and Log (GDP) ²) is statistically insignificant.

In addition, the inclusion of governance variables in the inequality equation gives rise to a negative and statistically significant relationship between inequality and four governance indicators namely political instability, government effectiveness, state law and control of corruption. Indeed, the quality of governance is necessary for a better distribution of income.

Analysis of the empirical results relating to the third equation shows that the effect of the GDPH growth rate on the incidence of poverty is negative and statistically insignificant. On the other hand, the relationship between inequality and the incidence of poverty is statistically insignificant even if the link between them is positive, which suggests that a reduction in inequalities is able to reduce poverty.

Analysis of the results shows that certain governance variables negatively affect the incidence of poverty in lower middle-income countries. Indeed, government effectiveness (GE), rule of law (RL) and regulatory quality (RQ) are of paramount importance for economic growth. Thus, protecting property rights and reducing transaction costs through the rule of law can reduce poverty. This idea is confirmed by other studies (Acemoglu *et al.* 2001; Kaufmann *et al.* 2002) which establish a relationship between the rule of law and economic growth. Likewise,

improving the quality of regulations is useful in ensuring the harmonization and proper functioning of the market economy in order to stimulate economic growth, which contributes, in the long term, to poverty reduction.

4.3 Estimation Results for Upper-Middle-Income Countries

The estimation results for upper-middle-income countries mainly show the effects of income inequality and the quality of governance on economic growth.

First, the effect of inequalities on the GDPH growth rate is negative and statistically significant at 1%. This negative and significant effect corroborates theoretical studies, which have shown that inequality can negatively affect the growth rate of PIBH (Alesina and Rodrik 1994; Forbes 2000). For governance indicators, only three governance indicators are statistically significant. Indeed, the citizen voice (VA) variable and government efficiency (GE) affect economic growth positively. On the other hand, corruption control affects economic growth negatively. This result may be explained by the fact that corruption does not affect economic growth negatively in the early stages of development provided an effective government controls it. Thus, some studies Méon and Sekkat (2005) are of the opinion that corruption can be justified because it allows evading regulations and ineffective institutions. Then, corruption would be able to develop economic growth since it decreases the administrative obstacles and the transaction costs of companies which seek to face excessive regulations Transparency international (2014).

For the control variables, we note that trade openness is positively correlated with the GDPH growth rate with a significance of 1%. Indeed, various empirical studies demonstrate the beneficial effect of trade openness on economic growth (Yanikkaya 2002; Caupin and Saadi 2003; Gries and Redlin 2012). Likewise, we note the statistical significance of the variable credit granted to the private sector (CPS) which positively affects the GDPP growth rate.

Through the analysis of the results, we notice that, for upper-middle-income countries, increasing income inequality reduces the growth rate of GDP per capita. The Kuznets hypothesis is also confirmed, thus the logarithm of GDPP and its square (Log (GDP) and Log (GDP) ²) are statistically significant. Indeed, the coefficient of Log (GDP) is positive while the sign of the coefficient of Log (GDP) ² is negative. This result shows that the inverted "U" shape of Kuznets which explains the long-run relationship between average income and inequality holds.

The negative impact of inequality on growth has been confirmed by several empirical studies. Brueckner and Lederman (2015) empirically show that income inequality hurts economic growth in advanced economies. They also show that, in high- and middle-income countries, increasing income inequality reduces human capital. The results also show that the effect of governance indicators on inequality is negative and statistically significant. Political governance such as political stability (PS) and citizen voice (CV) affect inequality negatively. The quality of governance in upper-middle-income countries determines the level of inequality.

The analysis of the results of the third equation of the model, which concerns poverty, shows that the effect of the GDPP growth rate and that of inequalities on the incidence of poverty is statistically insignificant. Regarding governance indicators, the results of the estimates of this equation show that:

The Citizen Voice (CV) and Political Stability (PS) indicators, which represent the political dimension of governance, affect the incidence of poverty negatively and are statistically significant.

On the one hand, civil rights, political responsibility and freedom of information consolidate the political voice and participation of the poorest social class. Effectively, the poor find favorable ground for their political demands so government can effectively respond to the demands of the poor Sen (2000).

On the other hand, insecurity and violence slow down the pace of growth by destroying a country's economic potential. Thus, certain social layers of the population slide into poverty and the poor themselves see their situation worsen Collier (2007).

On the other hand, when it comes to the rule of law (RL), we note that it has a positive and statistically significant impact on the incidence of poverty. The reasons why the rule of law might be a negative factor in poverty reduction are unknown.

Indeed, strict law enforcement may prevent the poor from having a livelihood, especially those that are sometimes prohibited by public authorities. Finally, the fight against corruption, respect for the law and the protection of property rights enable the poor to access opportunities and escape poverty Gupta *et al.* (2002).

Conclusion

The application of the simultaneous equation model, which deals with the relationship between governance, economic growth, inequality and poverty, shows that this link seems more complex given the

existence of the cross and multiple causalities that link the growth-inequality-poverty triangle. The latter remains a subject of controversy to this day. Our results show that the positive or negative impact of governance on the growth-inequality-poverty triangle changes depending on the dimension of governance taken into account and the sample being studied. For this reason, we find that some governance indicators appear more significant than others do. It is crucial to see how good governance directly affects poverty especially in the countries that suffer from it the most as the international community implements various poverty reduction programs in these countries.

Regarding the direct link that links the quality of governance to poverty, our results show that no statistically significant correlation could be detected between any of the six governance indicators and the incidence of poverty in low-income countries. The other two groups revealed a statistically significant relationship between certain governance indicators and the incidence of poverty. These results suggest that international development institutions must take into account the stage of development of a given country before stipulating good governance as a necessary condition that serves to reduce poverty directly.

Thus, the direct link between good governance and poverty reduction which has been adopted by international institutions in order to achieve the millennial development goals set in 2015, seems to have a weak empirical basis for low-income countries whose more 50% of the population suffer from poverty. This shows that, for these countries, the most effective means of reducing poverty would be through accelerating the pace of growth and reducing inequalities through better redistribution of wealth. Indeed, our results show that the growth rate of GDP per capita negatively affects the incidence of poverty at the same time inequality has a cause and effect relationship with growth. On the other hand, for the two other groups, this direct link can exist. Indeed, poverty can be reduced by improving the quality of governance. Our empirical results show that for lower middle-income countries, there is a negative and significant relationship between the incidence of poverty and indicators of economic governance; whereas, for upper middle-income countries, this link concerns political and administrative governance. Indeed, at a certain level of development, the nature of the political regime plays an essential role in poverty reduction.

In addition, our study has shown that governance indicators have a dual effect on the one hand on growth and on the other hand on inequalities for the three groups studied. This binary link can take the opposite direction as it moves from one level of development to another.

Our estimation results suggest that the positive impact of good governance on growth can be mitigated in the presence of strong inequalities that hamper efforts to reduce poverty through economic growth.

Likewise, the results obtained lead us to believe that it is possible that threshold effects and multiple equilibrium exist. The most concrete example is the effect of corruption control on economic growth, which is negative for low-income countries. This same effect becomes positive for lower middle-income countries and then becomes negative again for upper middle-income countries. Certain governance indicators are sometimes interdependent. For example, the positive effect of democracy depends on political stability, and controlling corruption also requires the existence of an effective government and so on.

In addition, in the case of upper middle-income countries, we notice the existence of a triple effect for the citizen voice indicator. First, this indicator is positively related to economic growth, second, it has a negative and significant effect on inequality and finally it negatively affects the incidence of poverty. This sequence confirms the idea that democracy is an essential factor for economic growth. It is able to reduce inequalities since it promotes an egalitarian position. Therefore, it allows the poorest class of society to access decision-making, which leads to a better redistribution of income. Given the negative relationship between inequality and growth, democracy should a second time positively affect economic growth through the reduction of inequalities.

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IMPROVEMENT OF METHODICAL APPROACHES TO THE MANAGEMENT OF THE SYSTEM OF ECONOMIC SECURITY OF BAKERY INDUSTRY ENTERPRISES

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Abstract.

The article investigates the methods of improving the methodological approaches to the management of the economic security system of the bakery industry. It was found that the creation of such a system requires the intensification of scientific and practical research to improve the theoretical and methodological foundations of economic security systems that would take into account general and specific problems of the industry and were effective in both short and long term. The approaches to the definition of the concept of "economic security of the enterprise" are generalized and systematized and the author's definition of this category is given. The guidelines of the research within the system approach are determined. The components of the economic security management system of the bakery enterprises and their correlation are investigated and substantiated. A system of economic security management of enterprises of the bakery industry has been developed, which takes into account theoretical and methodological studies of systems theory and systems analysis in the field of economic security. Within the framework of the developed system, its main elements are studied and a conclusion is made about the peculiarities of its implementation and functioning.

Keywords: economic security; system; system approach; system elements.

JEL Classification: Q18; I15; M11.

Introduction

At the present stage of development of the economy of Ukraine, the practice of economic activity to ensure the economic security of the enterprise on a systemic basis is becoming widespread. The formation and functioning of the system of economic security of the enterprise is the basis for creating a reliable and continuous provision of its economic activity. As practice shows, situational measures and actions that are responses to emerging threats cannot fully ensure the economic security of the enterprise and are often situationally ineffective, especially for bakery enterprises. Thus, in order to create an effective basis for ensuring the economic security of the bakery industry, it is urgent to intensify scientific and practical research to improve the theoretical and methodological foundations of economic security systems that would take into account general and specific problems of the industry and be effective in both short and long term and periods.

Improvement of Methodical Approaches to the Management of the System of Economic Security of Bakery Industry Enterprises

Many economists have studied system analysis and constructions of universal and operating systems, including in the field of economic security of enterprises, namely: Shulga IP (2011), Belousova IA (2010),

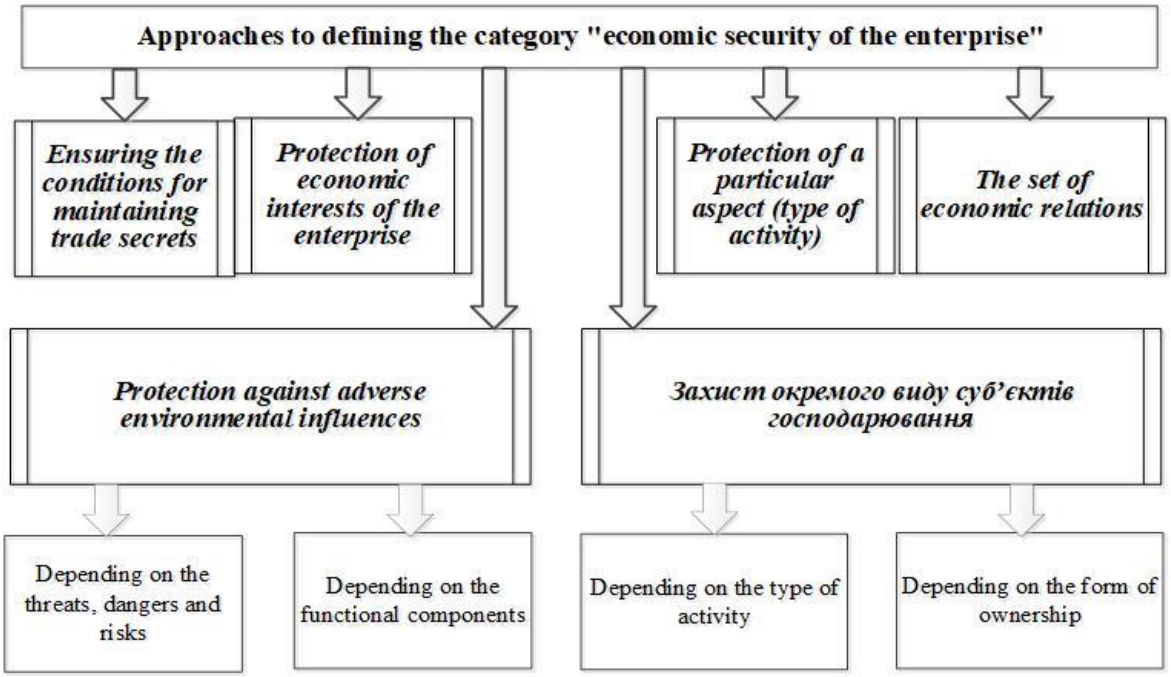
Lyashenko OM (2011), Rach VA (2012), Mordovtsev OS (2018), Lopatinsky Yu.M. (2014), Kim Yu.G. (2009), Ovcharenko EI (2013), Ryabushka LB, Surkalo BI (2014), Andrenko OA (2020). Despite the theoretical and methodological and practical results obtained by these scientists, the problem of construction, implementation and effective functioning of the management system of economic security of enterprises is still at the stage of continuous improvement and search for innovative solutions.

The purpose and objectives of the study. The purpose of the article is to implement proposals for improving methodological approaches to managing the system of economic security of bakery enterprises.

Presenting main material. The objective need to form effective economic security of Ukrainian bakery enterprises is caused by a number of problems that are directly related to unforeseen changes in their external and internal environment, namely: instability of the financial and economic system, constant changes in resource supplies and consumer markets, dynamism development of information and scientific and technological progress. It should be noted that the economic security of the bakery should characterize the company's ability to generate profits at a sufficient level, taking into account all possible areas of business. An effective system of economic security is designed to protect the company, promote its capitalization and market value through short-term and long-term planning of its development, taking into account the improvement of decision-making based on optimization and reliability of business processes, their resilience to changes in the environment. Therefore, in order to improve the methodological approaches to the management of the economic security system, it is necessary to clarify and separate the concepts of "economic security of the enterprise" and "economic security system of the enterprise" and provide author's definitions of these concepts.

Summarizing the study and systematization of approaches to the interpretation of the concept of "economic security of the enterprise" (Fig. 1), we can conclude that the essence of economic security of the enterprise can be considered as a function (process) and the result of the enterprise's response to external and internal factors of destabilization. as well as its impact on the environment, taking into account the standards of standardization and certification of major production processes and product quality.

Figure 1. Systematization of approaches to the interpretation of the concept of "economic security of the enterprise"



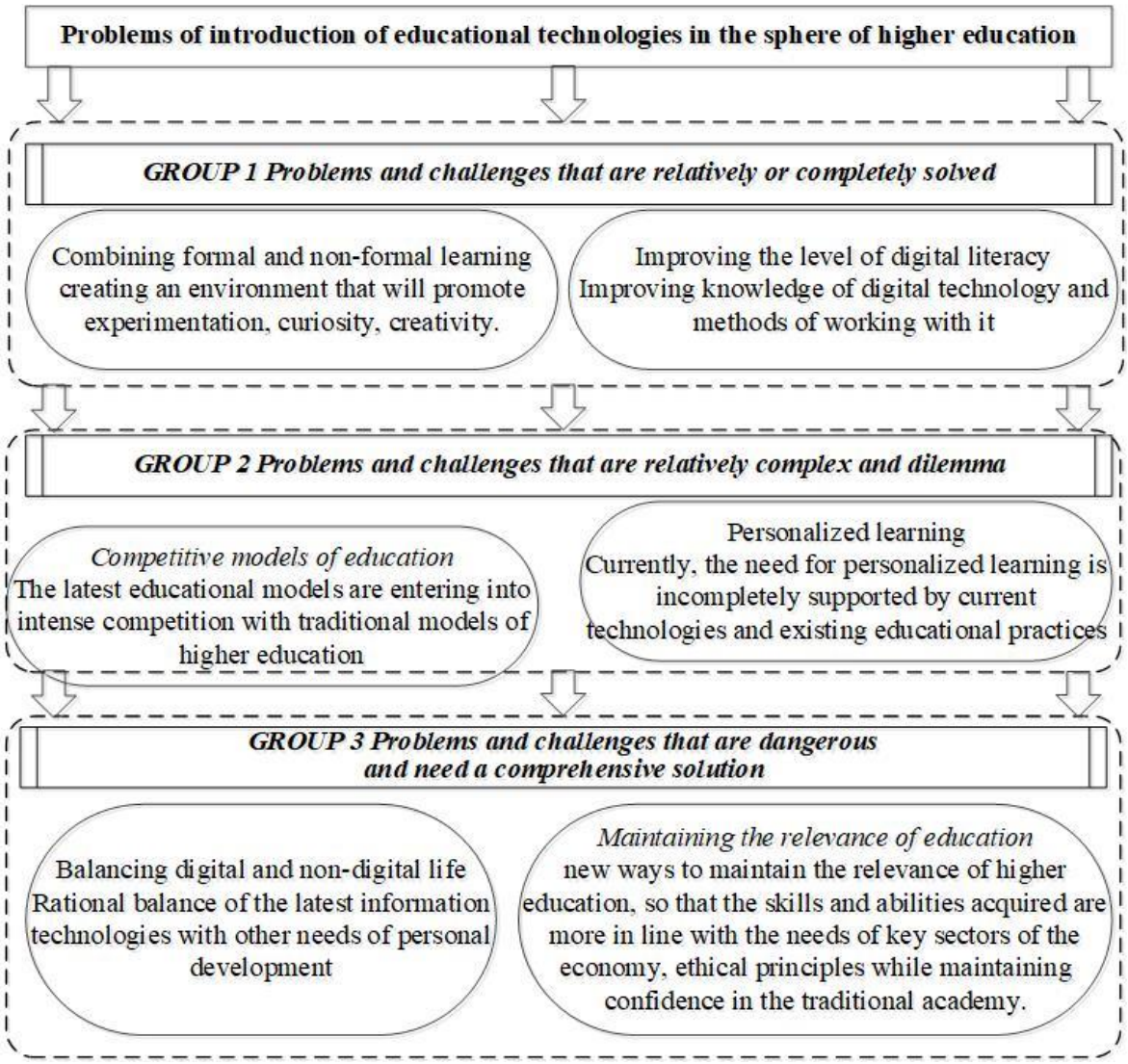
Source: developed by the author on the basis of Belousova 2010, Lyashenko 2011, Rach 2012, Shulga 2011

The concept of "system of economic security of the enterprise" has not yet found a permanent categorical and conceptual place in modern economics.

In a general sense, the systems approach is based on the study of a phenomenon or process, taking into account not only the complex of internal components, but also the environment of these processes and / or phenomena. The main advantage of using a systems approach is the ability to establish relationships between the elements of the complexes of internal and external components and on this basis to build judgments about the general rules and principles of existence of processes and

phenomena within a certain integrity. Therefore, the use of a systems approach requires the study of aspects, which are shown in Figure 2.

Figure 2. Research guidelines within the system approach.

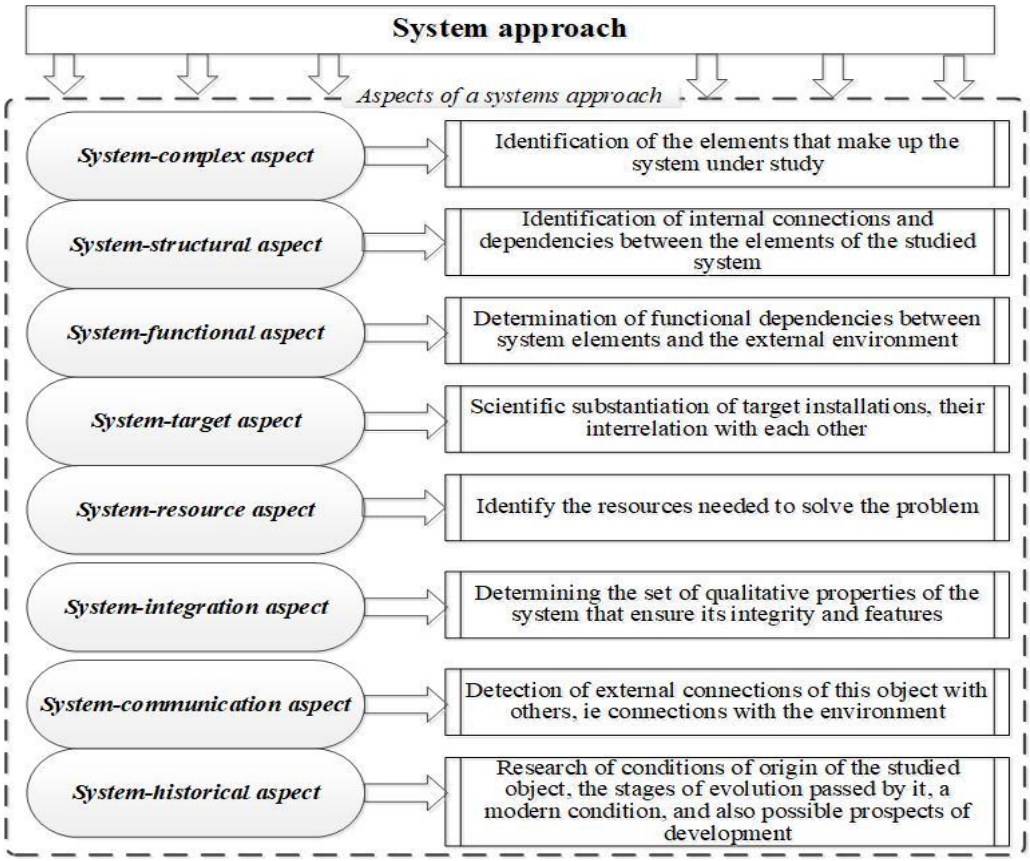


Source: developed by the author on the basis of Kim 2009, Lopatynsky 2014, Mordovtsev Wu Ngok 2018

The possibility of identifying systems and the full general establishment of theoretical and methodological principles of their existence is based on the application of a number of concepts that allow meaningful description and further analysis of a particular system. Such concepts of the structure of the system include the following: element, component, subsystem, supersystem; as well as those that reflect the essential and functional features of the structural parts of the system, namely: feature, property, attribute, etc. It should be noted that according to Shulga IP "An integral part of the system is usually understood as a certain spatial, meaningful, material, functional isolation. But such isolation is conditional, more precisely, isolation is a certain autonomy of a part in the composition (structure) of the system, which can be expressed in the form, size, functions of this part" (Shulga 2011).

Therefore, in Figure 3 it is advisable to show the ratio of such components of the system as: element, component, subsystem and supersystem in relation to the economic security of the enterprise.

Figure 3. Components of the economic security management system of the bakery industry and their correlation



Source: developed by the author on the basis of Ovcharenko 2013

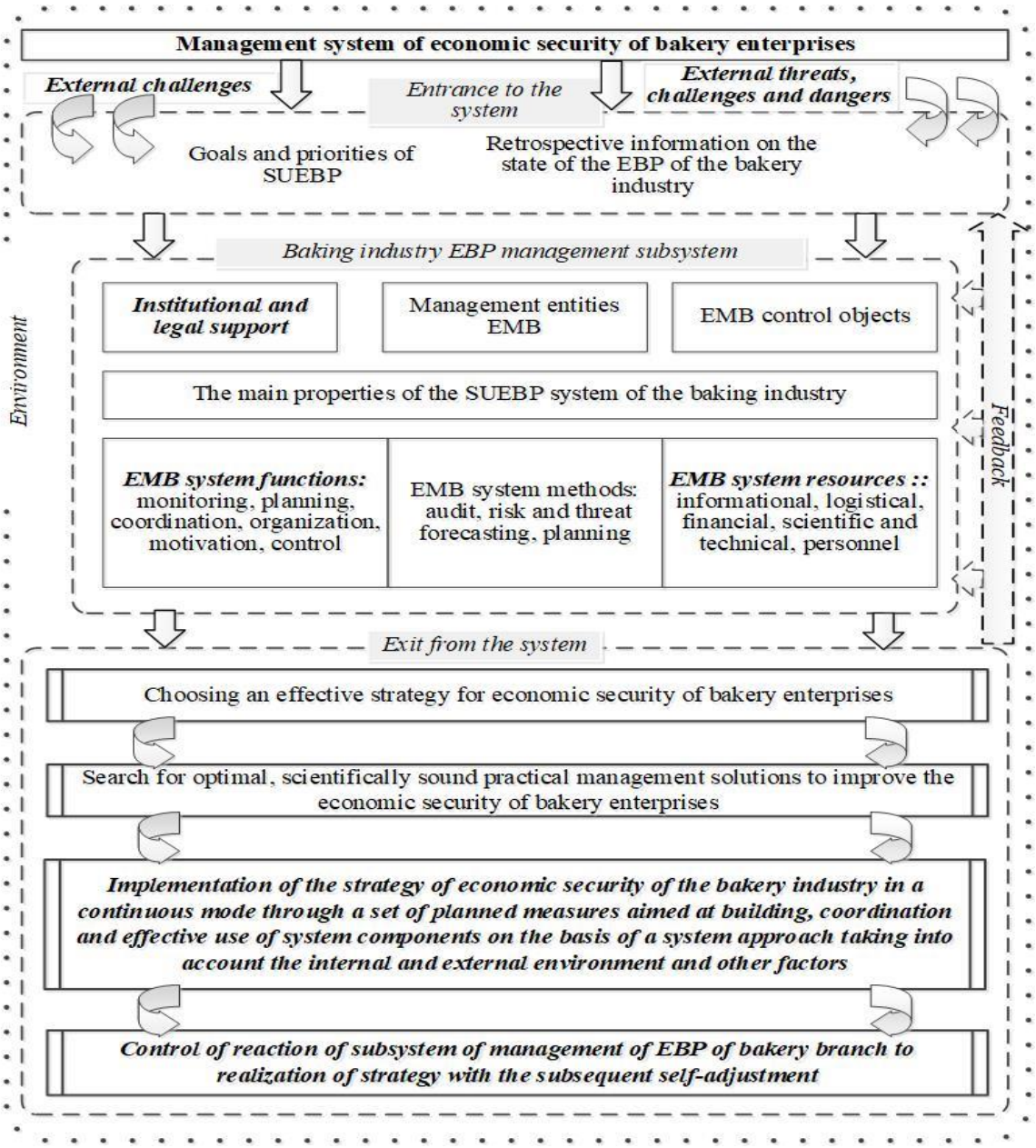
According to Figure 3, we can conclude that the system of economic security management of the bakery industry is determined by its composition. A clear division of the concepts of element, component and subsystem has a decisive influence on the process of systemic formation of economic security. Adequate and reasonable determination of the composition of components and subsystems makes it possible to reduce the complexity of the creation and operation of the system, which in the case of economic security is very relevant, as its methodological approaches are only at the stage of formation, and therefore the correct separation of elements, components and subsystems an important scientific task, the implementation of which depends on the formation of the overall security of the enterprise.

Figure 4 presents the author's development of the economic security management system of the bakery industry, which takes into account the theoretical and methodological studies of systems theory and systems analysis in the field of economic security, which are given above.

Figure 4 shows that the entry into the management system of economic security of enterprises (SUEBP) of the bakery industry consists of setting goals and priorities based on retrospective information on the state of general economic security in the face of internal and external challenges, threats, risks and dangers, directly and indirectly affect this system. You can identify the main goals and priorities as follows:

- development of plans and implementation of measures to comprehensively ensure the reliability of the economic security system of the bakery industry;
- formation, provision and development of special bodies of control over economic security of enterprises of the baking industry;
- restoration of protection facilities damaged as a result of illegal actions and development of measures to avoid ugly impact on these facilities, etc.

Figure 4. Management system of economic security of enterprises (SUEBP) of the baking industry



Source: developed by the author

Consider the elements of the subsystem of economic security management of bakery enterprises.

1. Institutional and legal support is a necessary and central element of the system, which is based on a comprehensive study and practical application of laws and regulations for the implementation and effective functioning of economic security in enterprises. Ukrainian legislation uses various means and mechanisms to regulate economic activity for the implementation of economic policy, implementation of targeted economic and other programs and programs of economic and social development, which is the basis for effective implementation of an effective system of economic security.

We can identify the key roles of government agencies in shaping the protection of bakery enterprises from various threats to their economic security, namely:

- formation of institutional and legal protection of entrepreneurship (protection of private property, legal regulation of economic relations, etc.) and property security;
- prevention of the creation of monopolies and avoidance of elements of abuse of monopoly position;
- fight against unfair and aggressive competition;
- price control (market security);

- legal regulation of protection of intellectual property and protection of trade secrets (intellectual, information and digital security);
- ensuring the inflationary stability of the national currency, the effective functioning of credit, stock, insurance and other financial markets;
- prevention of speculation in the securities market; protection of investors' rights, regulation of bankruptcy procedures; restoration of solvency and rehabilitation, state financial support of entrepreneurship, etc. (financial security);
- state support for exports and imports;
- protection of national producers from competition (especially foreign); prevention of exchange rate fluctuations (security of foreign economic activity);
- quality control of educational services, in particular in higher education, regulatory and legal support of labor activity (personnel security) (Ryabushka and Surkalo 2014).

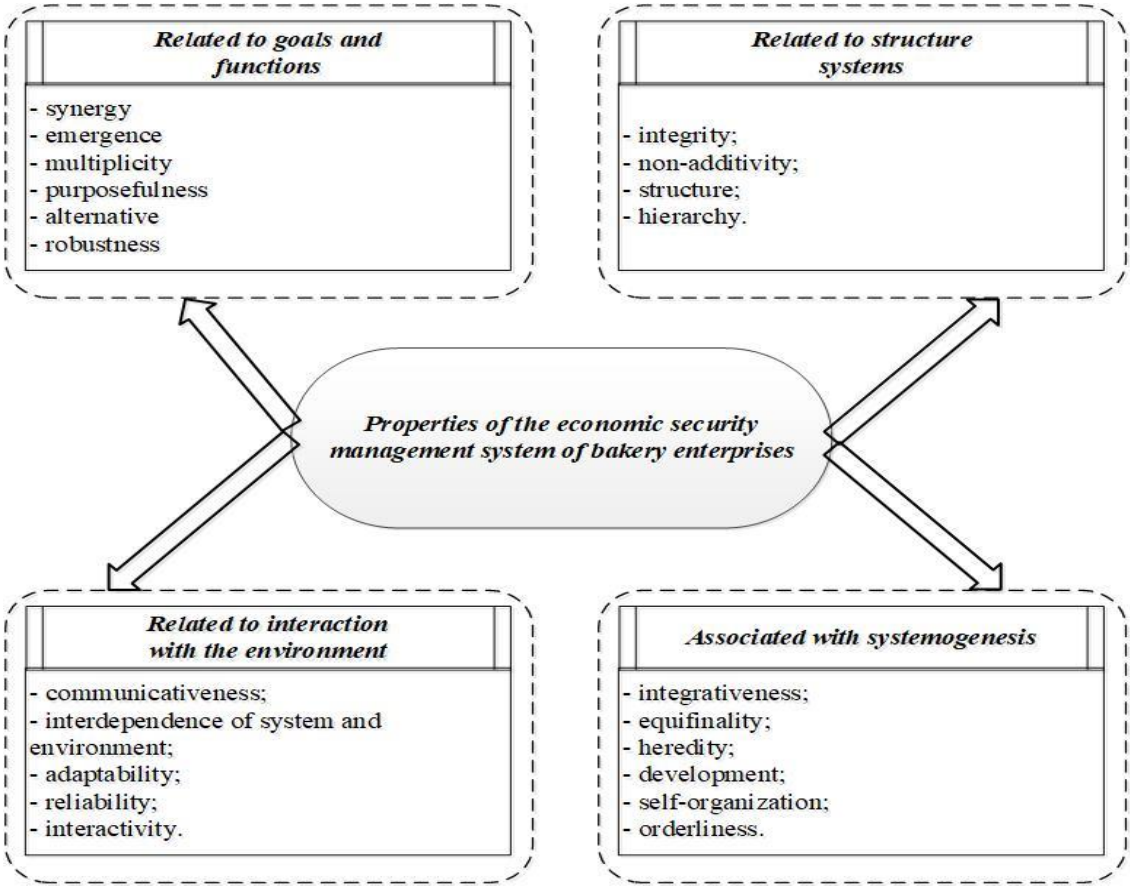
Thus, the mechanism of legislative activity of the state authorities of Ukraine is aimed at comprehensive and effective institutional and legal support of economic security of enterprises in the changing conditions of the internal and external environment.

2. The subjects of management of economic security of enterprises of the bakery industry are leaders, managers and specialists in economic and other areas of security of the enterprise. Their main function consists of making effective management decisions on all problematic issues that arise during the operation of the developed system.

3. The object of management is a system of relations and components in the field of economic security of the bakery industry.

4. The main properties of the economic security management system of the bakery industry can be summarized in Figure 5.

Figure 5. Properties of the economic security management system of the bakery industry



Source: developed by the author

5. The functions of the economic security management system of the bakery industry, namely: monitoring, planning, coordination, organization, motivation and control reflect the activities, the role of the entity within the

system. Among the main functions, monitoring deserves special attention, ie a set of actions that should be used to provide basic information on all aspects of digital security and the ability to build an effective system for its smooth operation in a digital economy (Andrenko, Mordovtsev, Mordovtsev 2020).

6. Methods of the economic security management system of the bakery industry, namely: audit, risk and threat forecasting, planning are a systematic set of steps that must be taken to meet the goals and priorities at the entrance to the system.

7. The basis for creating an effective system of economic security management of enterprises in the bakery industry can be allocated the following resources:

- information resources - is a set of information sources that are the main reliability of the created system. Without complete, reliable, timely, differentiated and potential information, it is impossible to implement an effective system of economic security. Also, it should be noted that information resources can be transposed into information potential, which is characterized by a promising component of the use of this resource;
- material and technical resources - all material means used to improve the economic security of the enterprise;
- financial resources - is the money that should be allocated by bakeries for economic security measures;
- scientific and technical resources allow to create and implement new technologies in the field of information and economic security;
- human resources should consist of highly qualified personnel with the desired education in the field of financial and economic security of the enterprise, which are able to qualitatively implement, improve and control all elements and components of the developed system of economic security management of bakery enterprises.

Thus, the output of the system developed in Figure 4 will be different options for developing a strategy for managing the economic security of the bakery industry, in which the central link will be the search for optimal, scientifically sound practical management solutions for continuous improvement of the system.

A key element of the developed system (Figure 4) is the implementation of the strategy of economic security of bakery enterprises in a continuous mode through a set of planned measures aimed at building, coordinating and effective use of system components based on system approaches taking into account internal and external environment and other factors. Of particular importance, as noted earlier, is the intellectual component that characterizes the ability of scientific and technical staff of the enterprise independently (without the involvement of outside experts) to qualitatively develop, implement and monitor the implementation of the entire economic security management system of the bakery industry.

Thus, the built system of management of economic security of the enterprises of bakery branch is the controlled, self-adjusting and managed system in real time which has the following functional possibilities:

- control of all processes and phenomena in the subsystem;
- the possibility of changing the parameters, according to the implemented mathematical models, in order to avoid excessive risk to economic security;
- availability of feedback to all components of the subsystem;
- timely change of plans and models depending on the external environment in which the bakery currently operates;
- the presence of automatic adjustment of parameters to ensure the implementation of basic tasks, a high level of accuracy, reliability, stability and ease of operation by a specialist in economic security;
- minimization of costs and optimization of their structure.

Conclusion

The article investigates the methods of improving the methodological approaches to the management of the economic security system of the bakery industry. Theoretical-methodical and practical results of the experiments were obtained, namely:

1. Generalized and systematized approaches to defining the concept of "economic security of the enterprise" and conclude that the essence of economic security of the enterprise can be considered as a function (process) and the result of the enterprise's response to external and internal factors of destabilization of its economic activity environment taking into account the norms of standardization and certification of basic production processes and quality of products.

2. On the basis of the defined research benchmarks within the framework of the system approach and the selected correlated components of the economic security management system of the bakery industry the author's vision of the economic security management system of the bakery industry was formed.

3 Within the developed system of economic security management of enterprises of the bakery industry, its main elements are studied and it is concluded that the system is universal and effective, which is expressed in the management of all processes and phenomena in the subsystem; the ability to change the parameters, according to the implemented mathematical models, in order to avoid excessive risk to economic security; availability of feedback to all components of the subsystem; carrying out timely change of plans and models depending on the external environment in which the enterprise of bakery branch works at present; the presence of automatic adjustment of parameters to ensure the performance of basic tasks, a high level of accuracy, reliability, stability and ease of operation by a specialist in economic security; minimizing costs and optimizing their structure.

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A MODEL WITH KNOWLEDGE EXTERNALITIES AND EDUCATIONAL POLICY

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Abstract:

We utilize a standard endogenous-growth model with knowledge spillovers (the "k-K" model). We characterize the optimal Balanced Growth Path (BGP), and compare it to path under market competition. In the presence of externalities, markets fail. One way to restore efficiency is to subsidize knowledge accumulation, and finance the subsidy by taxing final consumption.

Keywords: knowledge spillovers; externalities; educational subsidy.

JEL Classification: O31, O41.

Introduction

In this note we present a standard endogenous-growth model with knowledge externalities, as in Vasilev (2017). The main idea of such setups is that spillovers in knowledge are critical to accumulating growth. We derive the path that would be chosen by a Social Planner (SP), as then all external effects will be fully internalized, and hence the growth path is efficient. Then we proceed and decentralize the economy by allowing for market prices to determine allocations and compute the growth path under competitive equilibrium. We show that the growth rate is lower in a market economy, as compared to the rate chosen by the SP, since agents fail to incorporate the social effects into their individual optimization problems. A well-formulated policy, such as a subsidy to knowledge, will be then showed to improve upon allocations.

1. Model Setup

The model setup consists of preferences, technology and resources, which are described in turn.

Preferences: There is a representative household, which is infinitely lived and maximizes the stream of discounted utility

$$\sum_{t=0}^{\infty} \beta^t \ln(c_t), \quad 1.1$$

where $0 < \beta < 1$ is the discount factor, and c_t denotes consumption in period *t*.

Technology: the production technology is as follows: There are N>0 firms in the economy, and their number is held constant; k_{it} is knowledge (capital) of firm I in period t, $K_t = \sum_{i=1}^{N} k_{it}$ is aggregate knowledge (capital), and $K_{-it} = \sum_{j \neq i}^{N} k_{jt}$ is aggregate knowledge of all firms other than firm i.

Each firm uses a production function of the form

$$y_{it} = k_{it}^{\alpha} K_{-it}^{1-\alpha}, \quad 1.2$$

where the individual firm's ability to produce is influenced by the knowledge of others. In other words, there are positive complementarities (spillovers) between the two types of knowledge. Given that $0 < \alpha < 1$, there are decreasing returns to scale (DRS) in own knowledge, as the firm takes the knowledge of others as given. The production function is constant-returns-to-scale (CRS) in both inputs jointly.

Aggregate output is then
$Y_t = \sum_{i=1}^{N} y_{it},$ 1.3

And resource constraint is
$c_t + \sum_{i=1}^{N}\left[k_{i,t+1} - k_{it}\right] = Y_t,$ 1.4

where the second expression is aggregate investment; for simplicity we assume no depreciation of knowledge.

Knowledge is also assumed to be irreversible, or
$k_{i,t+1} \geq k_{it}$ 1.5

In other words, we cannot give up knowledge to gain additional consumption.

Each firm starts with an initial endowment of knowledge: $k_{i0} = k_0 > 0.$ 1.6

The Social Planner (SP) maximizes 1.1 s.t 1.2 – 1.6. Noting that in equilibrium the solution must be symmetric (as all individual firms use the same production function), the equilibrium condition produces the following balanced growth path (BGP):

$$\frac{1}{\beta}(1 + g^{SP}) = (N-1)\alpha(N-1)^{1-\alpha} + (1-\alpha)(N-1)^{-\alpha} + 1 \quad 1.7$$

Note that the SP understands that what firm N does, is good for everybody. When everybody accumulates more knowledge, it helps each individual firm. Note that N should be large, so that each firm is small (atomistic) relative to the aggregate. The result above will not hold if N=2, as then the two firms will be large relative to the aggregate, and thus there will be important strategic interactions and feedback effects.

With externalities, the competitive equilibrium (CE) allocation will not be equivalent to the Social Planner (SP) allocation – with externalities CE is not efficient, as the First Welfare Theorem (FWT) does not hold any more. We now turn now to the competitive equilibrium in the kK model.

1.Consumer Problem: The consumer now takes prices and firms' profit as given, and maximizes 1.1 s.t the budget constraint

$\sum_{t=0}^{\infty} p_t\, c_t = \sum_{t=0}^{\infty} p_t \sum_{i=1}^{N} \pi_{it},$ 1.8
Where π_{it} denotes firm I's profit.

2. Firm's problem: Each firm maximizes dynamic profit by taking prices, and others' knowledge as given, or

$\max \sum_{t=0}^{\infty} p_t \left[k_{it}^{\alpha} K_{-it}^{1-\alpha} - k_{it-1} + k_{it}\right]$ 1.9
s.t $k_{it+1} \geq k_{it}, k_{i0} > 0.$

3. Markets clear

In competitive equilibrium, the BGP is now: 1.10
$\frac{1}{\beta}(1 + g^{CE}) = (1-\alpha)(N-1)^{-\alpha} + 1$

Therefore, $g^{CE} \neq g^{SP}$. The firms fail to internalize the positive externality, as they consider only individual benefits, and ignore social benefits. This differs substantially from the SP case, where spillover effects are taken into consideration. In fact, we can show $g^{SP} > g^{CE}$ because of the positive externality (complementarity).

This result is an example of market failure, so there is room for government policies that could potentially improve upon allocative efficiency. One way to increase the growth rate is to subsidize knowledge accumulation at rate s. The way this subsidy is going to be financed is via consumption taxation, which is the way most of government expenditure is financed in Europe. The other alternative is to raise the funds through lump-sum taxation. As we will show below, both methods lead to the same outcome. The setup is now amended to

1. Consumer Problem: The consumer now takes prices and firms' profit as given, and maximizes 1.1 s.t the budget constraint

$$\sum_{t=0}^{\infty}(1+\tau^{c})p_t\, c_t = \sum_{t=0}^{\infty} p_t[\sum_{i=1}^{N}\pi_{it} - T_t], \qquad 1.11$$

where π_{it} denotes firm I's profit.

2. Firm's problem (same as before): Each firm maximizes dynamic profit by taking prices, and others' knowledge as given, or

$$\max \sum_{t=0}^{\infty} p_t \left[k_{it}^{\alpha} K_{-it}^{1-\alpha} - k_{it-1} + k_{it}\right] \qquad 1.9$$

s.t $k_{it+1} \geq k_{it}, k_{i0} > 0.$

3. Government

$$T_t + \tau^{c} p_t c_t = s\sum_{i=1}^{N}(k_{it+1} - k_{it})$$

4. Markets clear.

After some algebra, the BGP with the subsidy in place is now the same as the one in the SP setup:

$$\frac{1}{\beta}(1+g^{CE}) = (N-1)\alpha(N-1)^{1-\alpha} + (1-\alpha)(N-1)^{-\alpha} + 1$$

Therefore, we can raise the education subsidy to end up at the first-best (SP) solution.

Conclusions

Using a standard endogenous-growth model with knowledge spillovers as in Vasilev (2017), we show that the growth rate in a market economy is suboptimal, as individual agents fail to incorporate social gains in their decision-making. This proves that markets on their own do not always produce efficient outcomes, especially in the presence of knowledge externalities. This leaves room for government intervention as a way of improving allocative efficiency. We demonstrate that a well-targeted subsidy to knowledge accumulation can offset the effect of unexploited synergies, and an efficient growth rate in the economy can be achieved.

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AGE AND GENDER - SPECIFIC EXCESS MORTALITY DURING THE COVID-19 PANDEMIC IN HUNGARY IN 2020

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Abstract:

The excess mortality indicator is able to capture how an epidemic affects a country's mortality processes, taking into account direct and indirect, as well as possible effects in different directions. From the point of view of mortality processes in Hungary, the main feature of the first months of 2020 was that seasonal flu claimed fewer victims than in previous years, for this reason we examined last year's excess mortality for the period between weeks 12 and 52 related to the coronavirus epidemic using a stochastic mathematical model. According to our calculations, excess mortality related to the coronavirus epidemic in Hungary was 13,700 people in 2020, which means a 14% excess in the period under review. Eighty-six percent of those who died were over the age of 65, 10 percent were between the ages of 50 and 64, and the proportion of those aged 49 or younger was 4 percent. In almost all age groups, the excess mortality rate was nearly twice as high for men as for women. According to our calculations, excess mortality was roughly one and a half times the number of victims claimed by the epidemic in 2020 according to official statistics, and we also found a significant difference between the time course of the two indicators.

Keyword: COVID-19, excess mortality, demography, mortality, epidemics, Hungary.

JEL Classification: J11; I12; C49.

Introduction

The coronavirus epidemic appeared in Europe at the beginning of 2020 and has since been concentrated in successive waves in individual countries and regions.[3] Although the launch of the vaccine has brought the end of the epidemic within a foreseeable distance, it will be several years before we can get a relatively accurate picture of how the epidemiological crisis has affected Hungarian mortality processes in the short and long term. Accordingly, the study below cannot undertake to scrutinize the entire epidemic. Last year's closing, however, provides an opportunity to analyze the mortality processes in Hungary in 2020, and within this to identify the effects of the coronavirus.

The impact on mortality of an epidemic, virus, or any other event that significantly affects life expectancy should be measured via the development of excess mortality, which is often used in the literature of demographics. The essence of this indicator is to compare the actual mortality processes with a hypothetical (counterfactual) situation, based on the assumption of what would have happened if the event under study, in our case the coronavirus epidemic, had not occurred. It is important to stress that the indicator is the result of an estimate, as it requires a forecast of how many would have died in 2020 if mortality had been in line with previous years. Comparing this with last year's actual mortality data, we get the results for excess mortality.

[3] I am grateful to Lajos Bálint, who helped with both data collection and the display of the results.

One of the two important features of the indicator is that it aggregates all the effects that divert the development of mortality from its previous trajectory. In the case of the coronavirus epidemic, this means that it includes both direct and indirect, as well as positive and negative effects. Direct effects include cases where a death can be traced back to a coronavirus infection, that is, when someone dies due to the direct adverse health effects of the epidemic. The spectrum of indirect effects is much wider than this (Beaney *et al.* 2020). The overburdened health care system, psychological harms associated with the crisis, restrictions on hospital operations deemed as deferred, as well as postponed or permanently failed medical visits due to the risk of infection all substantially increase health risks. However, the impact of all these adverse consequences may be mitigated by increased funding for health care, stronger protection against flu due to the general use of masks, and restrictions on riskier (outdoor) activities from the point of view of various accidents. It is important to emphasize that the division line between direct and indirect effects is rather blurred, as it is not always clear, especially in the case of elderly and chronic patients who are most at risk, whether the coronavirus alone causes a death or other triggers also play a role in it. Moreover, the practice of individual countries is not uniform in how to categorize those who are infected but whose death can be traced back to another underlying disease.

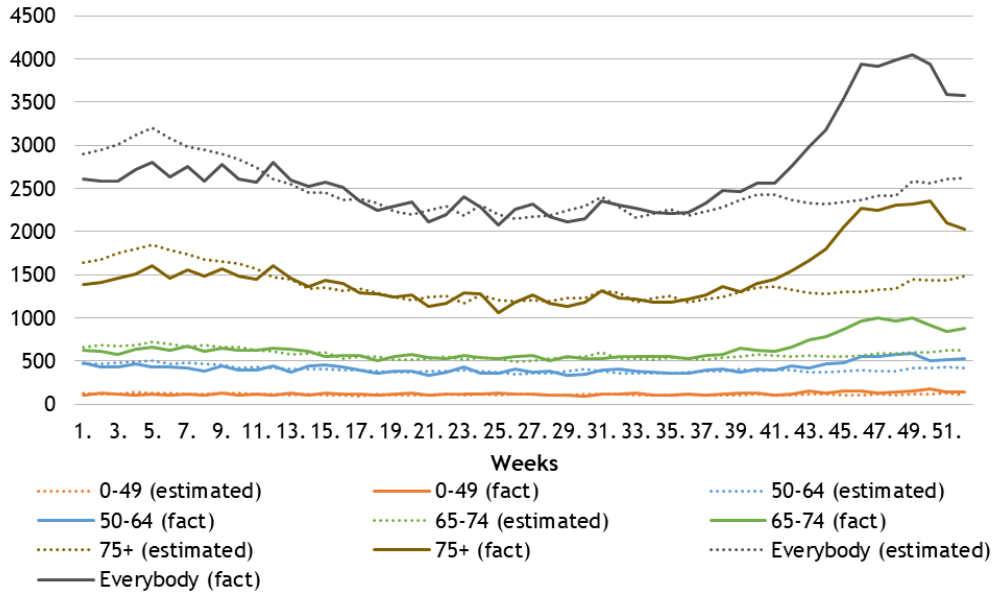
Another important feature of excess mortality as a measure is that, contrary to its name, it does not necessarily measure excess, but the balance in general. The indicator may also be negative in cases where the number of deaths in the year under review is lower than in previous years due to some reason, such as a milder than usual course of a flu epidemic, as it was the case in Hungary in the first months of the 2020, which is the subject of the study.

In order to calculate excess mortality related to the coronavirus in Hungary, we used a stochastic mathematical model published by Lee-Miller (2001) to make a prediction by age and gender using data from 2010–2019 on how mortality would have developed in 2020 (Tóth, 2021). This method has two important advantages over the simpler and therefore very widespread practice of comparing last year's deaths only with the mortality data of the preceding one or two years and with some sort of their average. On the one hand, this way we can consider the more or less continuous improvement of the mortality situation: life expectancy at birth in Hungary, for example, increased from 74.4 years to 76.2 years between 2010 and 2019. On the other hand, this method can also be used to manage the change in the number of people born in different years, which is especially significant for the age group around 65 due to the Ratkó era. For example, between 2019 and 2020, the number of people aged 60-64 fell from 695,000 to 651,000, that is, more than 6 percent, in one year. The improvement of mortality trends and the differences in the headcount of generations are the peculiarities of the Hungarian demographic processes that should be taken into account when analyzing excess mortality. 2020 consisted of 53 weeks, but the decade before that only had one such year (2015), so for the sake of comparability, we only considered the first 52 weeks throughout our calculations.

According to our model calculations, following the mortality processes of the last decade, 128,700 people would have died in Hungary in 52 weeks in 2020, if the coronavirus epidemic had not appeared. In contrast, there were actually 139,000 deaths last year. Annual excess mortality is accordingly 10,300 people. However, as we have already pointed out, our results are distorted by the fact that the flu epidemic, which claimed an average of 2-3 thousand victims per year (Pakot–Kovács 2020), was relatively mild in 2020, so our model overestimated expected mortality for this period. In order to exclude this from our calculation, in accordance with international practice, the Hungarian coronavirus-related excess mortality (hereinafter: excess mortality) is calculated from week 12, namely when the first victim of the coronavirus died in Hungary according to official statistics (16 March).

According to our calculations, excess mortality between week 12 and 52 was 13,700 people, in total, meaning that so many more people died since the appearance of the coronavirus until the end of the year, compared to the assumed situation if there had been no such epidemic in Hungary. Percentually, the excess mortality rate in Hungary was 18, 61 and 46 percent in the most intensive periods, that is October, November and December, respectively. Over the entire period under review, *i.e.* between March and December, the average monthly excess mortality (excluding negative months) was 14 percent. This is exactly the average of the 22 EU Member States in the relevant EUROSTAT statistical data. The indicator was above 20 percent in six countries (Spain, Poland, Slovenia, Belgium, the Czech Republic and Bulgaria) and below 6 per cent in four countries (Denmark, Finland, Latvia and Estonia).

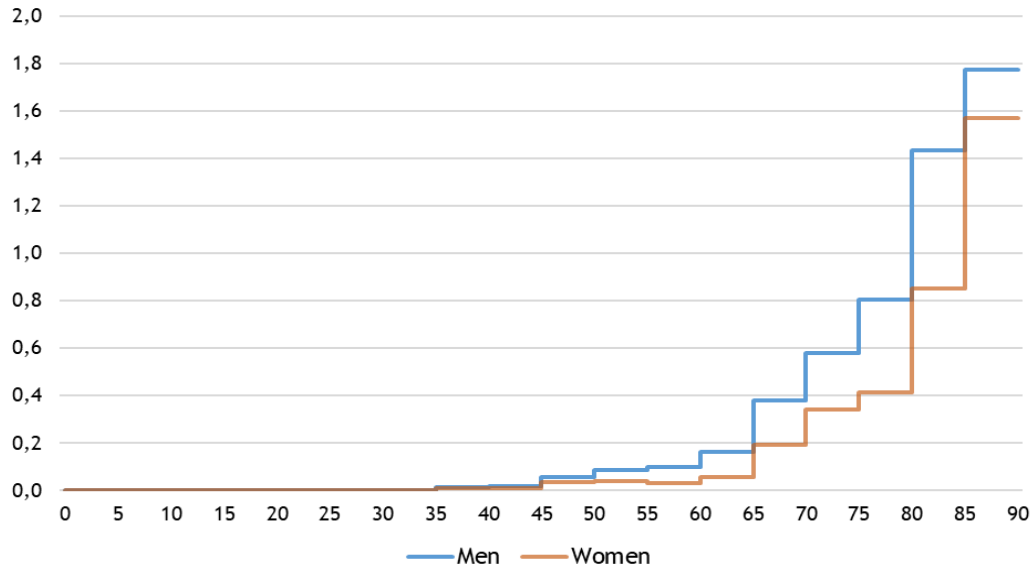
Figure 1. Estimated and actual mortality in 2020 by age groups (persons)



Source: Own calculation based on CSO data

Our estimate of excess mortality was 86 percent of deaths over the age of 65, 10 percent between the ages of 50 and 64, and 4 percent of 49 years of age or younger. The number of deceased women and men is roughly the same, which can be traced back to two processes with opposite effects. Men are generally at higher risk in terms of the coronavirus, but there are a lot more women than men in the older age groups. As women's life expectancy at birth in Hungary is more than six years more than that of men (Kovács–Bálint 2018), for example, the proportion of men over the age of 85 is only 27 percent. These processes are best captured by the age-specific mortality rate (Figure 2), which shows excess mortality as a percentage of the population in a given age group.

Figure 2. Age-specific mortality rate (percentage, for five-year age groups)



Source: Own calculation based on CSO data

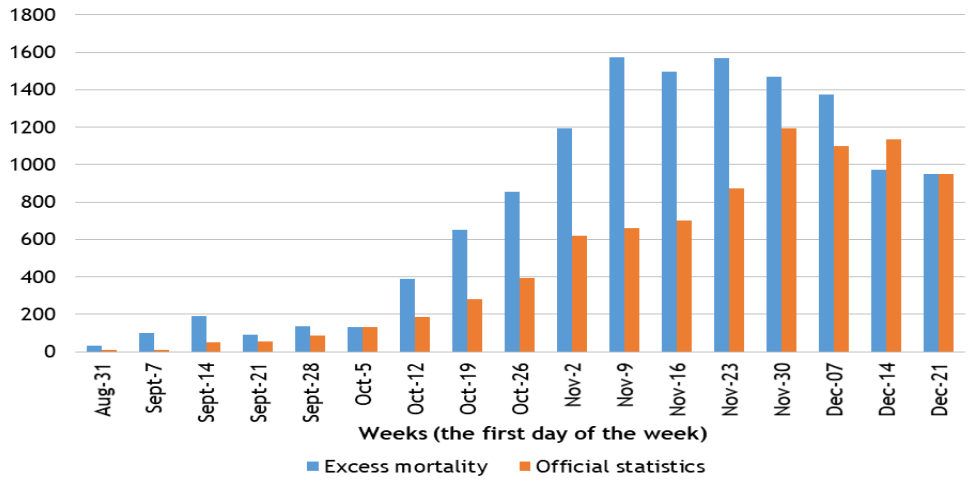
This reveals that the mortality rate for men between the ages of 55 and 59 reached 0.1 percent, so roughly one in a thousand men in this age group fell victim directly or indirectly to the coronavirus, according to the excess mortality we calculated between week 12 and 52. The rate rises sharply from here, with a coronavirus-related (excess) mortality rate of 0.4 per cent between the ages of 65 and 70, 0.8 per cent between 75 and 80 years, and 1.8 per cent over the age of 85. The indicator is just over half that among women in almost all groups: 0.2 percent for those aged 65-70, 0.4 percent for those aged 75-79, and rose to 1.6 for women over 85, approaching the age-

specific mortality rate of men. The significant difference between the excess mortality rates of men and women in the same age group is consistent with the experience of other countries, for example Kontopalis *et al.* (2020) found similar proportions when examining the experiences of the first wave of the epidemic in England and Wales.

The excess mortality we estimate is roughly one and a half times the number of deaths that official statistics directly related to the coronavirus in 2020. Although there is very little research so far that would allow us to compare the Hungarian undercount rate of 1.5 with data from other countries, based on a recent study, Hungarian practice can be considered to be average. Karlinsky and Kobak (2021) used aggregated national data for the modeling without a breakdown by age and gender, so this may presumably explain that in the case of Hungary, researchers received a value that is a few tenths less. At the same time, their analysis, extended to more than fifty countries, shows that although there were EU Member States with undercount rates below 1 and those with undercount rates above 2, the indicator varied between 1 and 1.7 in most EU countries, and the Community average was 1.5.

The time course of excess mortality shows a different picture of the evolution of the epidemic intensity than what can be read in official statistics (Figure 3). The latter indicates that after the onset of the second wave in mid-September, the effect of the virus was most intense in Hungary in early December, and only then did a slight moderation begin. This is in line with views according to which the beneficial effects of the strict restrictions introduced from 11 November (night curfew, shop closures, compulsory mask-wearing regulations, closure of secondary schools) show a more favorable evolution of mortality data in roughly 4-5 weeks.

Figure 3. Weekly trends in excess mortality and official coronavirus deaths in the last four months of 2020 (persons)



Source: Own calculation based on CSO data

In contrast, our calculations suggest that the surge in excess mortality also began in mid-September, but it peaked in early-mid-November, practically the week the austerity measures came into effect. After this, weekly excess mortality stagnated at a high level for nearly another month, before declining significantly by almost half by the end of the year. The result of the different trends is also that while weekly excess mortality in October and November significantly exceeded the official data, this difference completely disappeared by the end of the year.

There may be a number of reasons for the early peak of excess mortality compared to official statistics. Interpretation also depends in part on what is behind the difference between the two sets of data. If we look at the difference as covering indirect deaths, it is presumably worth looking for an answer by referring to the shrinking capacity of the health system, as it is conceivable that extreme system overload may have caused mortality beyond official statistics for a few weeks. If the difference is due to the difficulty of uniformly recording causes of death and, in fact, excess mortality largely measures direct mortality – but more accurately than official statistics - then early peaking can be explained, among other things, by developments in healing practices or by the deadly victims of the epidemic losing their lives in a shorter time than the 4-5 weeks previously observed.

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COVID-19: BEHAVIOR OF PUBLIC FINANCES TOOLS IN DEMOCRATIC REPUBLIC OF CONGO. ECONOMIC SITUATION AND PERSPECTIVES

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Abstract:

Observation of economic life over a long period portrays a succession of phases in which the economic activity is somehow important or decreasing. This succession can either be caused by an endogenous or exogenous sector shock.
This health shock, due to Covid-19, has compromised the macroeconomic stability as well as the economic growth in DRC, even across the world, according to their impact. Additionally, it is the cause of a reduction of the economic activity and has resulted in a huge instability of the global supply and demand. Congolese economy has not experienced satisfactory outcomes, thereby, a conjectural analysis of public finance macroeconomic aggregates enabled to comprehend this situation.
Regarding the hypothesis's verification, there are variables of income and outlay of independent samples, variables whose variances and means are equal both in the presence or the absence of Covid-19. In the same way, other variables and means are considerably different one another.

Keywords: presence of covid-19, absence of covid-19, publics finances

JEL Classification: C12, C46, C49, E69, H15, H59.

1. Introduction

1.1. Revue de la littérature

Le choc est la modification exogène d'une relation économique, telle que la courbe d'offre ou de la demande agrégée (Ntungila F. 2019). Les chocs sanitaires peuvent compromettre la stabilité macroéconomique et la bonne évolution de l'activité économique au niveau interne ou externe.

Pour les keynésiens, l'économie est fondamentalement instable. Selon ces derniers, l'économie enregistre fréquemment des chocs d'offre ou de la demande. Le choc induit des fluctuations (de la consommation, la production, de l'emploi et de l'inflation). Et, la crise économique survient lors que l'activité économique cesse de progresser (John K. 1955).

Pour Jonas K., la crise de la COVID-19 et les mesures de riposte qu'elle implique (distanciation sociale, confinement) ont entrainé: la réduction de la production, la baisse des recettes fiscales, l'accroissement des dépenses (dépistage, soins de santé, etc.) et l'accroissement des aides aux ménages (transferts, allocations-

chômages, subventions salariales, report de paiements d'impôts, etc.) et aux entreprises (fourniture de liquidités, exonérations fiscales, etc.) les plus touchés pour les protéger contre la perte de revenus, le chômage et les faillites (Weder M. 2020; Boone L. *et al.* 2020; McKibbin W. et Fernando R. 2020; Arezki R. et Nguyen H. 2020; Baldwin R. et Tomiura E. 2020; Beck T. 2020; Cecchetti G. et Schoenholtz L. 2020; Mann C. 2020; Meninno R. et Wolff G. 2020; Voth J. 2020; Cochrane J. 2020; Wren-Lewis S. 2020; Wyplosz C. 2020; Baker S. *et al*. 2020; Tobias A. et Aditya N. 2020; Albulescu C. 2020a, 2020b et 2020c; FMI, 2020b).

Et cela a dégradé les soldes budgétaires (aggravation de déficits budgétaires) de la plupart de pays dans le monde et augmenté les ratios d'endettement public de certains (en 2019, la dette publique représentait 83% du PIB mondial), comme le soutient le FMI (2020) dans son rapport sur les effets de la COVID-19 sur les finances publiques dans le monde, paru en avril 2020.

Selon Pinshi C., les pays à faible revenu comme ailleurs, qu'il soit total ou partiel, le confinement décrété pour freiner la propagation de la COVID-19 a eu des effets dévastateurs sur les entreprises et les travailleurs. Les heures de travail perdues dans chaque catégorie de pays représentent 255 millions d'emplois à temps plein et environ quatre fois plus que lors de la crise financière internationale de 2009.

Il explique également, que la baisse du revenu du travail mondial s'élève à 3,7 billions usd, soit 4,4% du PIB mondial. Les pertes d'emplois en 2020 ont principalement entraîné une augmentation de l'inactivité plutôt que du chômage. Représentant 71% des suppressions d'emplois dans le monde, l'inactivité a augmenté de 81 millions, entraînant une réduction du taux d'activité mondial de 2,2 points de pourcentage en 2020 à 58,4%. Ces chiffres en disent long sur les conséquences désastreuses de la pandémie de COVID-19 sur le marché du travail.

Le Confinement a sauvé des vies, mais il a également saisi les économies derrière une récession souhaitée, ce que nous appelons le Gâchis du confinement, l'effet selon lequel le confinement réduit les facteurs d'accumulation de la production et accélère considérablement une récession auto-infligée (Pinshi 2020).

Outre ces effets sectoriels, une détérioration de la confiance des consommateurs et des entreprises peut conduire les entreprises à s'appuyer sur une demande plus faible et, par conséquent, réduire les dépenses et les investissements. Cela aggraverait les fermetures d'entreprises et les pertes d'emplois (Gopinath 2020), qui du reste a impacté les finances publiques.

1.2. Problématique

Depuis la fin de l'année 2019 et le début 2020, le monde fait face à la pandémie de la COVID-19 qui s'est déclenchée à Wuhan en République Populaire de Chine et qui, aujourd'hui, a atteint presque tous les pays. Au-delà de ses effets sur la santé publique, la COVID-19 a fortement impacté l'économie mondiale. L'expansion rapide de la pandémie sur les cinq continents, vers la fin du premier trimestre de l'année 2020, a engendré de fortes perturbations de l'activité économique au niveau mondial. La quasi-totalité des pays du monde a été touché. Les problèmes observés dans les circuits de production, d'approvisionnement, des échanges nationaux qu'internationaux ainsi que les disfonctionnements dans le secteur monétaire et financier ont révélé une réalité à laquelle les théories économiques n'accordaient pas assez d'attention (Mujani J. 2020).

L'observation de la vie économique sur une longue période met en évidence une succession de phases où l'activité économique est plus ou moins importante ou dégradante, laquelle succession peut être causée par un choc endogène ou exogène sectoriel.

Le choc sanitaire à COVID-19 a compromis la stabilité macroéconomique et la croissance économique de la RDC voire à l'international, selon leur l'ampleur. Elle est également à la base d'un ralentissement de l'activité économique et a créé un profond déséquilibre de l'offre et de la demande globale. L'économie congolaise n'ayant connue des sorts enviables, il est à cet effet important de conduire une analyse conjoncturelle en analysant les agrégats macroéconomiques des finances publiques afin de mieux cerner la situation.

Les objectifs que poursuis cette étude sont: (i) dresser un état de lieux de ces outils relativement aux périodes «de la présence et de l'absence COVID-19» le choc sanitaire négatif, et (ii) établir une analyse comparative du comportement de ces outils des finances publiques au cours de ces différentes périodes.

L'étude s'interroge spécifiquement sur les effets de la crise sanitaire à COVID -19 sur le comportement des outils des finances publiques de la RDC. Et, elle se fixe à cet effet l'hypothèse ci-après: la pandémie de la COVID-19 à la base de la modification négative des outils des finances publiques de la RDC.

2. Démarche méthodologique

La méthode analytique et descriptive a été adoptée pour mener cette réflexion, associée à la technique documentaire et l'analyse économétrique, qui consiste à établir une comparaison des moyennes et variances des variables des finances publiques sous analyse, entre 2019 et 2020 afin de tester leur significativité.

2.1. Démarche théoriques

2.1.1. Aperçu des indicateurs macroéconomiques en RDC 2019 – 2020

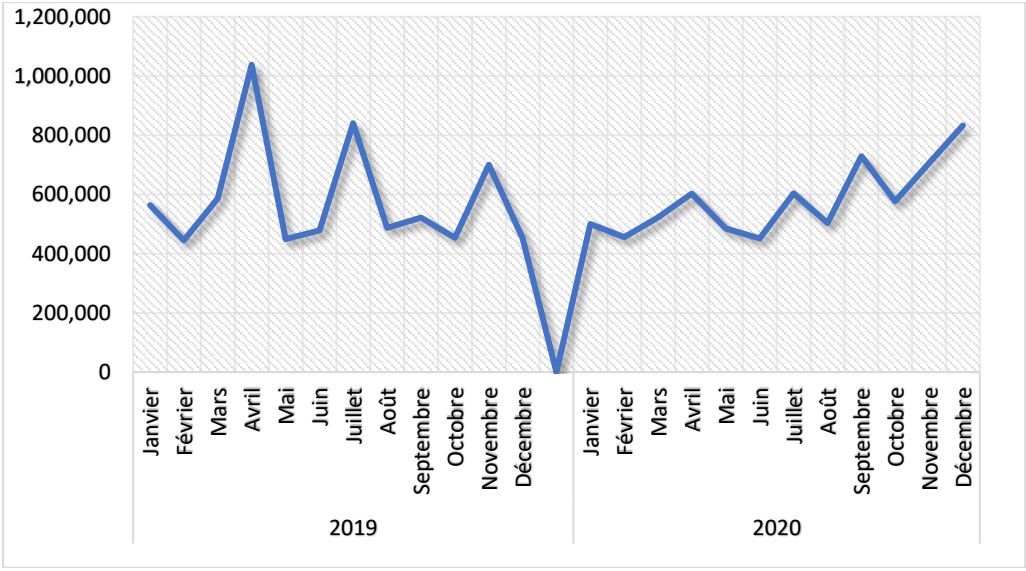
Le FMI, au travers la sélection de quelques indicateurs, fait un aperçu de la situation macroéconomique de la RDC en 2019 et 2020. En 2019, elle réalise 4,3% du PIB, l'IPC à 5,5%, les recettes publiques associées aux dons s'élèvent à 10,8% du PIB, dont 9,5% des recettes fiscales et non fiscales à 1,3% des Dons et Legs. Les dépenses publiques représentent 10,9% du PIB, spécifiquement 2,1% en capital. Deux déficits observables en 2019, respectivement le solde budgétaire de -0,2% et du solde de la balance courante de -3,5%. La RDC enregistre ce pendant 3,7% du PIB des réserves officielles nettes et 13,3% des dettes publiques extérieures.

Comparativement à l'année précédente, l'année 2020 est marquée par des fluctuations descendantes et ascendantes, pour certains indicateurs identifiés en 2019. La production intérieure brute connait une baisse de 4,3% en 2019 contre 3,9% en 2020. On note, respectivement, une légère baisse de l'IPC à 5,0% et des recettes publiques et Dons, à 10,6% globalement, dont 9,1% des recettes fiscales et non fiscales, particulièrement une légère hausse à 1,5% des Dons et Legs contre 1,3% en 2019. Les dépenses publiques globalement en baisse à 10,8% ; une légère augmentation des dépenses en capital qui se traduit par effets d'interventions publiques dans le secteur de la santé due à la crise sanitaire de la COVID-19. Solde budgétaire déficitaire à -0,1% du PIB qui, du reste, est une augmentation, comparativement à -0,2% en 2019. Le solde compte courant, également déficitaire de -4,2%, sensiblement en baisse par rapport en 2019. Augmentation des réserves officielles de 3,9% du PIB et les dettes publiques extérieures baissent également à 12,7% contre 13,3% en 2019.

2.1.2. Approche comparative et evolution des finances publiques en RDC de 2019 à 2020

Elle correspond, respectivement à la période pré et pendant la COVID - 19, qui s'aperçoit sur l'évolution des finances publiques au travers les quelques variables ci-dessous indiquées.

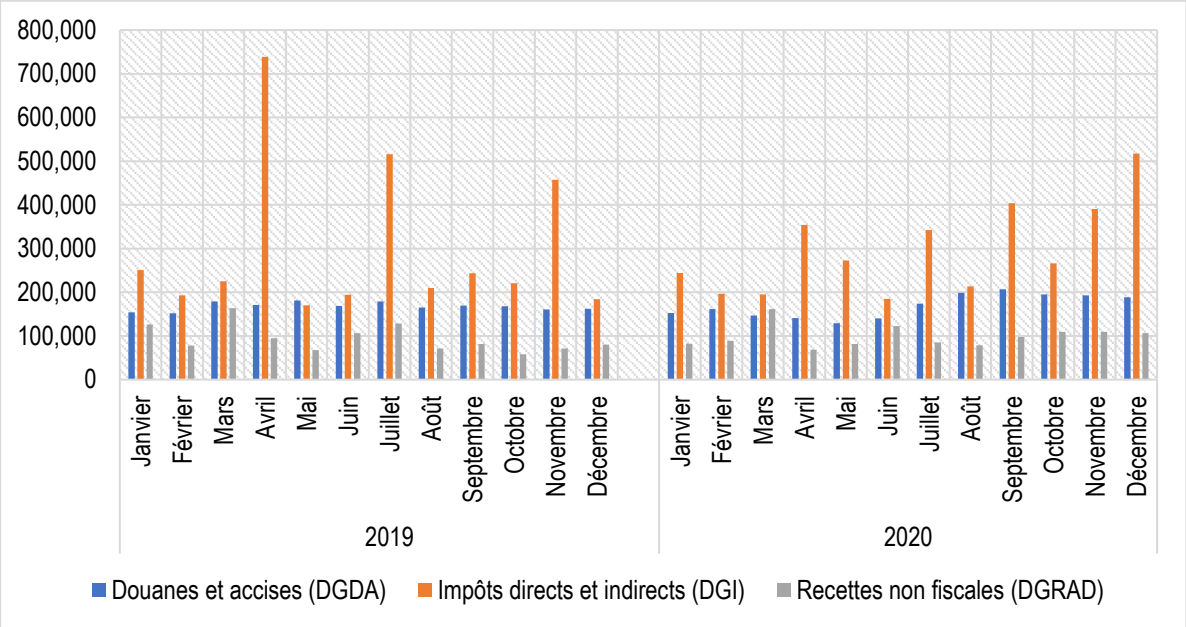
Figure 1. Recettes publiques 2019 et 2020 *(en millions de Francs congolais)*.



Source: Elaboré par l'auteur sur base des données BCC, 2020

Le graphique, ci-dessus renseigne l'évolution fluctuante des recettes publiques en 2019 et 2020. Globalement, la courbe indique une tendance baissière des recettes publiques en 2020, une baisse moyenne de 600 à 800 millions de CDF, allant du mois de janvier au septembre. On note, cependant, la reprise de l'activité pour le mois d'octobre et décembre 2020, qui se situe entre 800 millions et 1.000 000 000 de CDF. Cette période est marquée par la levée de l'état d'urgence sanitaire ainsi que les festivités de fin d'année. La crise sanitaire de la COVID-19 constitue les mobiles occasionnant la baisse significative des recettes publiques, Comparativement aux recettes de 2019 dont le niveau maximal se situe entre 1.000 000 000 et 1.200 000 000 CDF. Ces recettes publiques comprennent les recettes (fiscales et non fiscales) mobilisées.

Figure 2. Recettes publiques par Régies financières (DGDA, DGI et DGRAD) 2019 et 2020



Source: Elaboré par l'auteur sur base des données BCC, 2020.

Ces régies financières restent les principales sources à part importante d'alimentation du trésor public de la RDC. En comparant les recettes publiques des années sous-analyses, on note des sensibles fluctuations entre ces années, marquées par une tendance baissière de la mobilisation des recettes en moyenne annuelle pour certaines régies en 2020, par rapport en 2019. La DGDA baisse légèrement de 168.311 millions en 2019 à 167.090 millions en 2020, la DGI baisse sensiblement ses recettes à 278.396 millions en 2020 contre 316.801 millions en 2019. Cependant, une légère hausse des recettes de la DGRAD de 96.670 millions à 98.666 millions, respectivement en 2019 et 2020.

a. Considération sur l'épargne et l'investissement (notes d'économie politique, en ligne 2020).

➢ **Considérons l'investissement**

Nous savons que le PIB correspond au revenu total de l'économie ainsi qu'aux dépenses totales d'une économie;

$$PIB = Y = C + I + G + XN \quad (2.1)$$

Où:
PIB: Produit intérieur brut;
C: Consommation;
I: Investissement;
G: Dépense publique;
XN: Exportation nette;
Supposons en économie fermée ;

$$Y = C + I + G \quad (2.2)$$

De l'équation 2.2 on tire l'investissement

$$I = Y - C - G \quad (2.3)$$

➢ **Considérons l'Epargne**

Deux composantes de l'épargne nationale;
Soit « T » les recettes fiscales du gouvernement (nettes de transferts);

$$S = Y - C - G\ (+T - T) \quad (2.4)$$

Ou encore ;

$$S = (Y - T - C) + (T - G) \quad 2.4/$$

Notons ;

$$Sp = Y - T - C \quad 2.5$$

où:
Sp: épargne privée;

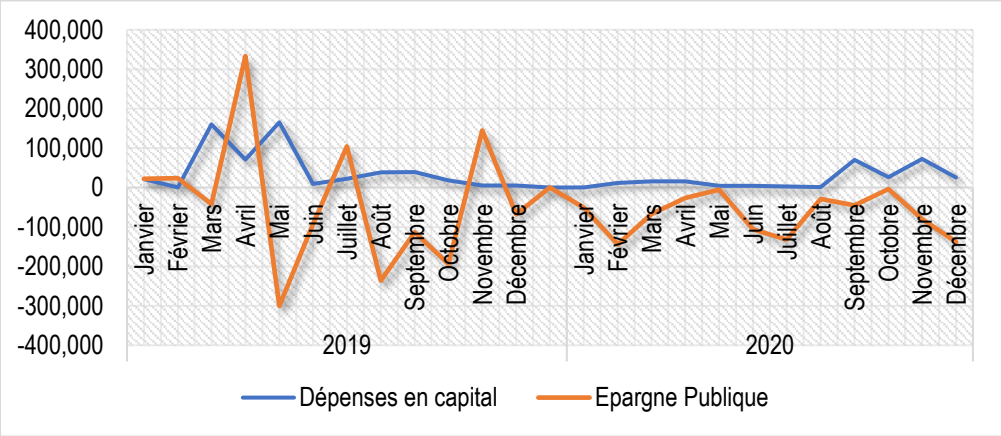
$$Sg = T - G \quad 2.6$$

Sg: épargne publique
Or,
S = Sg + Sp (épargne nationale),

$$S = I = Y - C - G \quad 2.7$$

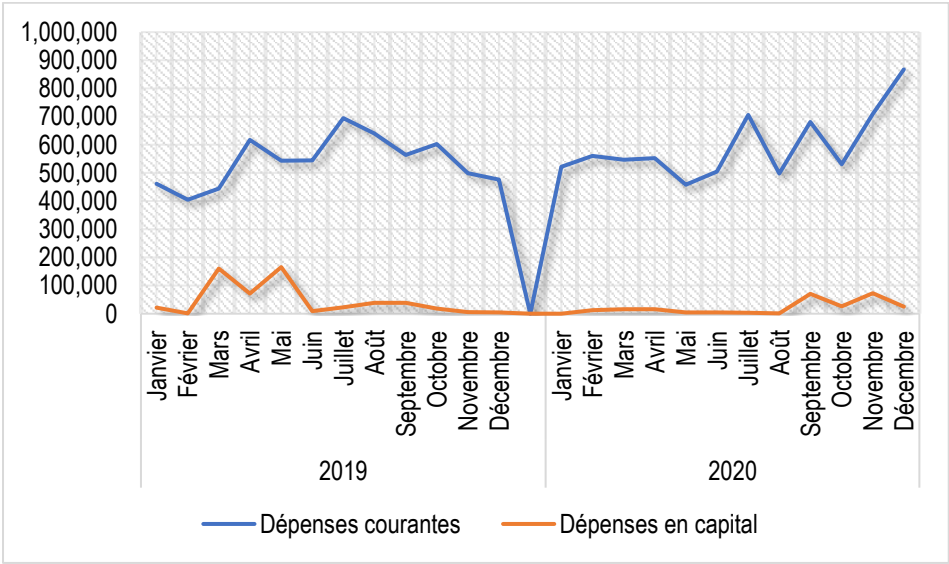
$$I = S \quad 2.8$$

Figure 3. Investissements publics et épargnes publiques 2019 et 2020



Source: Elaboré par l'auteur sur base des données BCC, 2020

Figure 4. Dépenses publiques (courantes et en capital) 2019 et 2020



Source: Elaboré par l'auteur sur base des données BCC, 2020

L'évolution de ces courbes renseigne la part des ressources consacrées à l'investissement et à l'épargne. Les dépenses consacrées à l'investissement (dépenses en capital) restent très faibles au cours de la période sous-observation, comparativement entre ces deux périodes 2019 et 2020, et dont

le niveau maximal se situe entre 100 millions et 200 millions de CDF. Une tendance à la baisse et linéaire de Novembre 2019 à Août 2020.

Globalement, l'épargne publique est presque inexistante pendant ces deux années, à l'exception des fluctuations à tendance haussière observées pour le mois d'Avril, Juillet et Novembre 2019. Elle est également pour l'année 2020, et atteint même le niveau négatif, défavorable à l'économie étant donné que l'épargne publique doit être susceptible d'influencer l'investissement public.

- Sg – Ig < 0 ; l'économie congolaise en besoin de financement.

Il existe, en RDC, un écart très considérable entre les dépenses courantes et celles en capital (dépenses d'investissements). Une tendance linéaire des dépenses en capital de juin 2019 à août 2020. Cette situation est tributaire au choc sanitaire de la COVID-19.

2.2. Démarche empirique

2.2.1. Présentation des résultats et commentaires

L'analyse empirique a porté sur les tests d'échantillonnage indépendant de Test de Student (T-Student), en faisant la comparaison des moyennes des variables sous analyse, et tester la significativité de ces écarts.

a. Tests d'échantillonnage indépendant

Tableau 1. Statistique de groupe

Covid-19		N	Moyenne	Ecart-type	Erreur standard moyenne
Total des recettes fiscales et non fiscales	Absence	janvier à décembre 2019	584932,9167	186239,84443	53762,81216
	Présence	janvier à décembre 2020	580743,7500	120537,64560	34796,22107
Douanes et accises (DGDA)	Absence	janvier à décembre 2019	167447,9167	9485,40184	2738,19965
	Présence	janvier à décembre 2020	168863,7500	27023,02848	7800,87638
Impôts directs et indirects (DGI)	Absence	janvier à décembre 2019	300198,5000	176439,92571	50933,81930
	Présence	janvier à décembre 2020	298320,0000	103825,91367	29971,95960
Recettes non fiscales (DGRAD)	Absence	janvier à décembre 2019	94048,7500	31346,16558	9048,85857
	Présence	janvier à décembre 2020	99307,7500	25172,53403	7266,68465
Total des dépenses	Absence	janvier à décembre 2019	619754,6667	100413,66291	28986,92766
	Présence	janvier à décembre 2020	649679,9167	139216,34586	40188,29738
Dépenses courantes	Absence	janvier à décembre 2019	540804,0000	87330,25960	25210,07444
	Présence	janvier à décembre 2020	594737,6667	119914,46476	34616,32425
Dépenses en capital	Absence	janvier à décembre 2019	46351,0000	57749,32153	16670,79317
	Présence	janvier à décembre 2020	20912,6667	25172,80867	7266,76393
Epargne Publique	Absence	janvier à décembre 2019	-34821,7500	175890,55246	50775,22890
	Présence	janvier à décembre 2020	-68936,1667	50786,09473	14660,68273

Source: Auteur, à l'aide du logiciel SPSS

Les comparaisons de ces moyennes, pour un échantillon indépendant, concernent: (i) les séries normalement distribuées dont le Test de Z pour un échantillon «n» supérieure ou égale à 30 observations ($n \geq 30$) et le Test de T (Student) pour un échantillon «n» inférieure à 30 observations ($n < 30$), et aussi (ii) la série par rapport à l'absence de la normalité, dont le Test W (Test de Wilson ou de rang) qui permet de tester la significativité des variables.

Il ressort de cette analyse empirique de nos variables des échantillons indépendants, et après la comparaison des moyennes des échantillons, des écarts à tendances haussière ou baissière pour certaines variables en **absence** ou **présence** Covid-19. Notamment, le total des recettes, spécifiquement les recettes de la DGDA et de la DGRAD dont les moyennes annuelles en présence COVID-19 sont supérieures en absence covid-19. Se révèlent contraires aux observations théoriques.

Pour les dépenses, des tendances haussières par rapport aux moyennes des dépenses totales et courantes en présence de la COVID-19 par rapport en l'absence COVID-19.

- **Tests d'échantillonnage indépendant**

Les tableaux ci-dessous, permettent de statuer sur la significativité de ces écarts au seuil de 5% (0,05).

- **Par rapport aux recettes**

Tableau 2. Test de Levene sur l'égalité des variances au seuil de 5% (0,05)

	Test de Levene sur l'égalité des variances		Choix des hypothèses
	F	Sig.	
Total des recettes fiscales et non fiscales	1,157	,294	**H_0 accepté.** La variance des recettes totales en absence Covid-19 est égale à la variance des recettes totales en présence COVID-19.
Douanes et accises (DGDA)	22,241	,000	**H_0 rejeté.** La variance des recettes de la DGDA en absence Covid-19 est significativement différente à la variance des recettes de la DGDA en présence COVID-19.
Impôts directs et indirects (DGI)	2,089	,162	**H_0 accepté.** La variance des recettes de la DGI en absence Covid-19 est égale à la variance des recettes DGI en présence COVID-19.
Recettes non fiscales (DGRAD)	,808	,378	**H_0 accepté.** La variance des recettes de la DGRAD en absence COVID-19 est égale à la variance des recettes de la DGI en présence COVID-19. .

Source: Auteur, à l'aide du logiciel SPSS

Tableau 3. Test-t pour égalité des moyennes au seuil de 5% (0,05)

	T	Ddl	Sig. (bilatérale)	Différence moyenne	Différence écart-type	Intervalle de confiance 95% de la différence	
						Inférieure	Supérieure
Total des recettes fiscales et non fiscales	,065	22	,948	4189,16667	64040,74462	-128623,20885	137001,54219
Douanes et accises (DGDA)	-,171	22	,866	-1415,83333	8267,49114	-18561,56054	15729,89388
Impôts directs et indirects (DGI)	,032	22	,975	1878,50000	59097,98906	-120683,22789	124440,22789
Recettes non fiscales (DGRAD)	-,453	22	,655	-5259,00000	11605,45334	-29327,23712	18809,23712

Source: Auteur, à l'aide du logiciel SPSS

- **Par rapport aux dépenses**

Tableau 4. Test de Levene sur l'égalité des variances au seuil de 5% (0,05)

	Test de Levene sur l'égalité des variances		Choix des hypothèses
	F	Sig.	
Dépenses courantes	1,434	,244	H_0 accepté. La variance des dépenses courantes en absence de la COVID-19 est égale à la variance des dépenses courantes en présence de la COVID-19.
Dépenses en capital	4,514	,045	**H_0 rejeté.** La variance des dépenses en capital en absence COVID-19 est significativement différente à la variance des dépenses en capital en présence de la Covid-19.
Epargne Publique	8,257	,009	**H_0 rejeté**. La variance d'épargne publique en absence COVID-19 est significativement différente à la variance d'épargne publique en présence de la Covid-19.

Source: Auteur, à l'aide du logiciel SPSS

A l'issue de la comparaison des moyennes des variables sous analyse (la mobilisation des recettes totales, des recettes de la DGDA, des recettes de la DGI ainsi que celles de la DGRAD),

nous acceptons H_0 pour l'ensemble de ces variables au seuil de 5% (soit 0,05). Les moyennes des variables en absence COVID-19 sont égales aux moyennes des variables en présence COVID-19.

Tableau 5. Test-t pour égalité des moyennes au seuil de 5% (0,05)

	T	ddl	Sig. (bilatérale)	Différence moyenne	Différence écart-type	Intervalle de confiance 95% de la différence	
						Inférieure	Supérieure
Total des dépenses	-,604	22	,552	-29925,25000	49551,39979	-132688,56350	72838,06350
Dépenses courantes	-1,259	22	,221	-53933,66667	42823,33194	-142743,82145	34876,48812
Dépenses en capital	1,399	22	,176	25438,33333	18185,74174	-12276,58669	63153,25336
Epargne Publique	,646	22	,525	34114,41667	52849,40386	-75488,53866	143717,37199

Source: Auteur, à l'aide du logiciel SPSS

En comparant les moyennes des variables sous analyse (dépense totale, dépenses courantes, dépense en capital et épargne publique), on accepte H_0 pour l'ensemble de ces variables au seuil de 5% (soit 0,05). Leurs moyennes, en absence COVID-19, sont égales aux moyennes des variables en présence COVID-19.

En conclusion

Il ressort, des observations théoriques et empiriques, que les indicateurs des finances publiques autours desquels est centrée cette réflexion se sont révélés fragiles et peu résilients, en comparant l'année 2019 et 2020. Leurs évolutions sont marquées globalement par des tendances baissières pendant plusieurs mois au cours des années en étude, sinon de légères fluctuations à très courte durée. La baisse de recettes de certaines régies financières et la baisse de l'épargne publique, qui atteint le niveau négatif et qui est défavorable à l'économie et affecte les dépenses en capital (investissement).

Il ressort, des analyses empiriques de nos variables considérant les échantillons indépendants, et après la comparaison des moyennes des échantillons. Les écarts à tendances haussière ou baissière pour certaines variables en **absence** ou **présence** de la COVID-19. Notamment le total des recettes, spécifiquement les recettes de la DGDA et de la DGRAD dont les moyennes annuelles en présence de la COVID-19 sont supérieures en absence de la COVID-19. C'est -à- dire, par rapport à la moyenne et la variance des recettes, la COVID-19 et dépenses, la présence de la COVID-19 n'a pas influencé significativement, de manière négative toutes les régies financières. Par rapport aux dépenses, la présence de la COVID-19 n'a pas aussi influencé toutes les natures des dépenses.

Au regard de la vérification des hypothèses, il existe des variables des recettes et des dépenses des échantillons indépendants, des variables dont les variances et les moyennes sont égales en **présence** et en l'**absence** COVID-19. Mais également, d'autres variables dont les variances et les moyennes sont significativement différentes.

Etant donné le caractère sélectif de la crise sanitaire à COVID -19 sur les outils des finances publiques, nous recommandons aux pouvoirs publics : (i) renforcer les mesures de lutte contre le coulage des recettes et renforcer la mobilisation des recettes publiques, et (ii) de renforcer les mesures de résilience des finances publiques.

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Liste des sigles

- BCC: Banque Centrale du Congo
- CDF: Franc Congolais
- CES: Conseil Economique et Social
- Covid-19: Coronavirus 2019 (nom complet)
- CR: Cellule de Recherches
- DGDA: Direction Générale des Douanes et Accises
- DGI: Direction Générale des Impôts
- DGRAD: Direction Générale des Recettes Administratives et Domaniales
- ECOPOL: Economie politique
- FASEG: Faculté des Sciences Economiques et de Gestion
- FMI: Fonds monétaire international
- H_0: Hypothèse nulle
- H_1: Hypothèse alternative

- IPC: Indice des prix à la consommation
- IRES: Institut de Recherches Economiques et Sociales
- OMS: Organisation mondiale de la santé
- PED: Pays en développement
- PIB: Produit intérieur brut
- PMUAIC-19: Programme multisectoriel d'urgence d'atténuation des impacts de la Covid-19
- RDC: République Démocratique du Congo
- TVA: Taxe sur la valeur ajoutée
- UNIKIN: Université de Kinshasa
- USD: Dollar américain

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A NOTE ON *GENSYS'* MINIMALITY

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Abstract:

Gensys'non-minimality is shown analytically and necessary and sufficient conditions for vector autoregression representations of states in outputs are presented.

Keywords: gensys; minimality; state space.

JEL Classification: C02; C32.

Introduction

Sims' (2001) Matlab solution algorithm to linear rational expectation models is called gensys. Does it deliver minimal linear time invariant state space representations? Namely, is gensys sufficient for minimal linear time invariant state space representations? The example produced by Komunjer and Ng (2011) shows that the answer is negative: $G \not\longrightarrow MR$, since $\exists x \in U$ such that $G \times\wedge \neg MRx$in which $G \equiv$gensys, $MR \equiv$Minimal representation, $X \equiv$counterexample and $U \equiv$universe (*i.e.* domain of discourse). This note shows such analytically, presenting necessary and sufficient conditions for vector autoregression representations of states in outputs.

1. Gensys State Space, Minimality and VAR

Gensys gives rise to the unique and stable solution $[x_{1t}\, x_{2t}]^{\top} = [(A_{11} 0)(0\, 0)]^{\top}[x_{1t-1}\, x_{2t-1}]^{\top} + [B_{11} B_{21}]^{\top} u_t, \forall t \in \mathbb{Z}, x_{1t} \in \mathbb{R}^{n_{x_1}}, x_{2t} \in \mathbb{R}^{n_{x_2}}, u_t \in \mathbb{R}^{n_u}, A_{11} \in \mathbb{R}^{n_{x_1} \times n_{x_u}}, B_{11} \in \mathbb{R}^{n_{x_1} \times n_{x_u}}$ and $B_{21} \in \mathbb{R}^{n_{x_1} \times n_{x_u}}$; x_{1t} is a vector of non-expectational variables, X_{2t} is a vector of expectational variables and is a vector of inputs (i.e.shocks). Such a solution is the transition equation of a linear time invariant state space representation in discrete time: $[x_{1t}\, x_{2t}]^{\top} = [(A_{11}\, 0)\ (0\, 0)]^{\top}[x_{1t-1}\, x_{2t-1}]^{\top} + [B_{11}\ B_{21}]^{\top} u_t \longleftrightarrow x_t = Ax_{t-1} + Bu_t$, $\forall x_t \in \mathbb{R}^{n_x}$, $A \in \mathbb{R}^{n_x \times n_x}$ and $B \in \mathbb{R}^{n_x \times n_u}$; x_t is a vector states such that $n_x = n_{x_1} + n_{x_2}$.

Let $M \in \mathbb{R}^{n_y \times n_x}$ give rise to $Mx_t = MAx_{t-1} + MBu_t \longleftrightarrow y_t = Cx_{t-1} + Du_t$, $\forall y_t \in \mathbb{R}^{n_y}$, $C \in \mathbb{R}^{n_y \times n_x}$ and $D \in \mathbb{R}^{n_y \times n_u}$. It is the measurement equation of a linear time invariant state space representation in discrete time, in which y_t is a vector of outputs; M is called measurement matrix.

Linear time invariant state space representations are minimal *if and only if* rank $r_C = r_O = n_x$ for controllability matrix $C = [\cdots\ A^{n_x-1}B]$ and observability matrix $O = [\cdots\ CA^{n_x-1}]^{\top}$. Non-minimal representations can be reduced to minimal ones by the Kalman decomposition: the economic interpretation is invariant (see Franchi (2013)). Assume that the representation be minimal: $x_{mt} = A_m x_{mt-1} + B_m u_t$ and $y_t = C_m x_{mt-1} + Du_t$.

Assume that D be non-singular and thus square: $n_y = n_u$. Solve the measurement equation for u_t and plug it into the transition equation:

$x_{mt} = (A_m - B_m D^{-1} C_m)\, x_{mt-1} + B_m D^{-1} y_t = F_m x_{mt-1} + B_m D^{-1} y_t;$ notice that $F_m \equiv A_m - B_m D^{-1} C_m$. Solve it backwards, satisfying causality: $x_{mt} = \sum_{j=0}^{\infty} F_m^j B_m D^{-1} y_{t-j}$ *if and only if* F_m is stable, namely, F_m's characteristic polynomial eigenvalues are less than one in modulus, $|\lambda_{F_m(\lambda)}| < 1$ for $F_m(\lambda) = F_m - \lambda I$ in $\det[F_m(\lambda)] = 0.$ Plug this into the measurement equation: $y_t = \sum_{j=0}^{\infty} F_m^j B_m D^{-1} y_{t-j-1} + D u_t.$

Thus: there exists a vector autoregression of infinite order $\mathrm{VAR}(\infty)$ *if and only if* F_m is stable; there exists a vector autoregression of finite order $\mathrm{VAR}(k)$ for $k<\infty$ *if and only if* F_m is nilpotent, namely, F_m's characteristic polynomial eigenvalues are zero, $\lambda_{F_m(\lambda)} = 0.$ See Franchi (2013), Franchi and Paruolo (2014), Fernández-Villaverde *et al.* (2007), Ravenna (2007) and Franchi and Vidotto (2013) for further detail.

2. Symmetric Case

Let x_{1t} be symmetrically semi-measurable, namely, let half of its rows be measurable: $x_t = [x_{M1t}\ x_{N1t}\ x_{2t}]^\top$ such that $n_{x_{M1}} = n_{x_{N1}}$, $A = [(A_{11_{11}}\ A_{11_{12}}\ 0)\ (A_{11_{21}}\ A_{11_{22}}\ 0)\ (0\ 0\ 0)]^\top$, $B = [B_{11_{11}}\ B_{11_{21}}\ B_{21}]^\top$, $M=[1\ 0\ 0]$, $y_t = x_{m1t}$, $C = [A_{11_{11}}\ A_{11_{12}}\ 0]$ and $D=B_{11_{11}}$. Record $r_{\mathcal{C}}$ for C and $r_{\mathcal{O}}$ for O: $n_x = r_{\mathcal{C}} = 3 > r_{\mathcal{O}} = 2,$ thus, the representation is controllable, non-observable and therefrom non-minimal.

Reduce the representation to minimality by the Kalman decomposition: construct similarity transformation matrix $T=[\mathcal{O}_{r_{\mathcal{O}}}\ v_{n_x - r_{\mathcal{O}}}]^\top$ such that $\bar{x}_{co\bar{o}t} = \mathcal{T}^{-1} x_t$, $\bar{A}_{co\bar{o}} = \mathcal{T}^{-1} A \mathcal{T}$, $\bar{B}_{co\bar{o}} = \mathcal{T}^{-1} B$, $\bar{C}_{co\bar{o}} = C\mathcal{T}$, $\bar{\mathcal{C}}_{co\bar{o}} = \mathcal{T}^{-1}\mathcal{C}$ and $\bar{\mathcal{O}}_{co\bar{o}} = \mathcal{O}\mathcal{T}$; select the first $r_{\mathcal{O}} = 2$ states such that $\bar{x}_{cot} = x_{mt}$, $\bar{A}_{co} = A_m$, $\bar{B}_{co} = B_m$, $\bar{C}_{co} = C_m$, $\bar{\mathcal{C}}_{co} = \mathcal{C}_m$ and $\bar{\mathcal{O}}_{co} = \mathcal{O}_m$.

Computing F_m, $F_m(\lambda)$ and $|\lambda_{F_m(\lambda)}|$, F_m first eigenvalue matrix $\Lambda_1 \equiv \lambda_{1Fm(\lambda)} = -[A_{11_{12}} B_{11_{21}} - A_{11_{22}} B_{11_{11}}]\, B_{11_{11}}^{-1}$ and F_m second eigenvalue matrix $\Lambda_2 \equiv \lambda_{2Fm(\lambda)} = \mathbf{0}$; notice that $A_{11_{12}} \in \mathbb{R}^{n_{x_{M1}} \times n_{x_{N1}}}$, $B_{11_{21}} \in \mathbb{R}^{n_{x_{N1}} \times n_u}$, $A_{11_{22}} \in \mathbb{R}^{n_{x_{N1}} \times n_{x_{N1}}}$, $B_{11_{11}} \in \mathbb{R}^{n_{x_{M1}} \times n_u}$. Thus, there exists a $\mathrm{VAR}(k)$, $\forall k \leq \infty$, of x_t in y_t *if and only if* $|\lambda_{\Lambda_1(\lambda)}| \in [0,\ 1)$ for $\Lambda_1(\lambda) = \Lambda_1 - \lambda I$ in $\det[\Lambda_1(\lambda)] = 0.$

Such a **gensys** condition is necessary and sufficient for a vector autoregression representation of the states in the outputs in the symmetric case, furthering $|\lambda_{F_m(\lambda)}| \in [0,\ 1)$ and acting as the analytical *counterexample* to the syntactic implication 'Minimal linear time invariant state space representations *if* **gensys'.**

3. Complete and Asymmetric Case

Let x_{1t} be fully measurable, namely, let all of its rows be measurable: $M=[1\ 0]$, $y_t = x_{1t}$, $C = [A_{11}\ 0]$ and $D=B_{11}$. Record $r_{\mathcal{C}}$ for C and $r_{\mathcal{O}}$ for O: $n_x = r_{\mathcal{C}} = 2 > r_{\mathcal{O}} = 1,$ thus, the representation is controllable, non-observable and therefrom non-minimal.

Reduce the representation to minimality by the Kalman decomposition: construct $T=[\mathcal{O}_{r_{\mathcal{O}}}\ v_{n_x - r_{\mathcal{O}}}]^\top = [(A_{11}\ 0)\ (0\ 1)]^\top$ and proceed as before, selecting the first $r_{\mathcal{O}} = 1$ states, so that

$$[x_{mt}\ y_t]^\top = [A_m\ C_m]^\top x_{mt-1} + [B_m\ D]^\top u_t \longleftrightarrow \left[A_{11}^{-1} x_{1t}\ x_{1t}\right]^\top = \left[A_{11}\ A_{11}^2\right]^\top A_{11}^{-1} x_{1t-1} + \left[A_{11}^{-1} B_{11}\ B_{11}\right]^\top u_t.$$

Computing F_m, $F_m(\lambda)$ and $|\lambda_{F_m(\lambda)}|$, $\lambda_{F_m(\lambda)} = F_m = A_{11} - A_{11}^{-1} B_{11} B_{11}^{-1} A_{11}^2 = \mathbf{0}.$ Thus, there exists a $\mathrm{VAR}(k)$, $\forall k < \infty,$ of x_t in y_t.

The scenario of x_{1t} asymmetric semi-measurability, namely, $n_{x_{M1}} \neq n_{x_{N1}}$, is best studied case by case.

Conclusion

This note's conclusion prescribes the reduction of **gensys'**representation to minimality as hereby shown.

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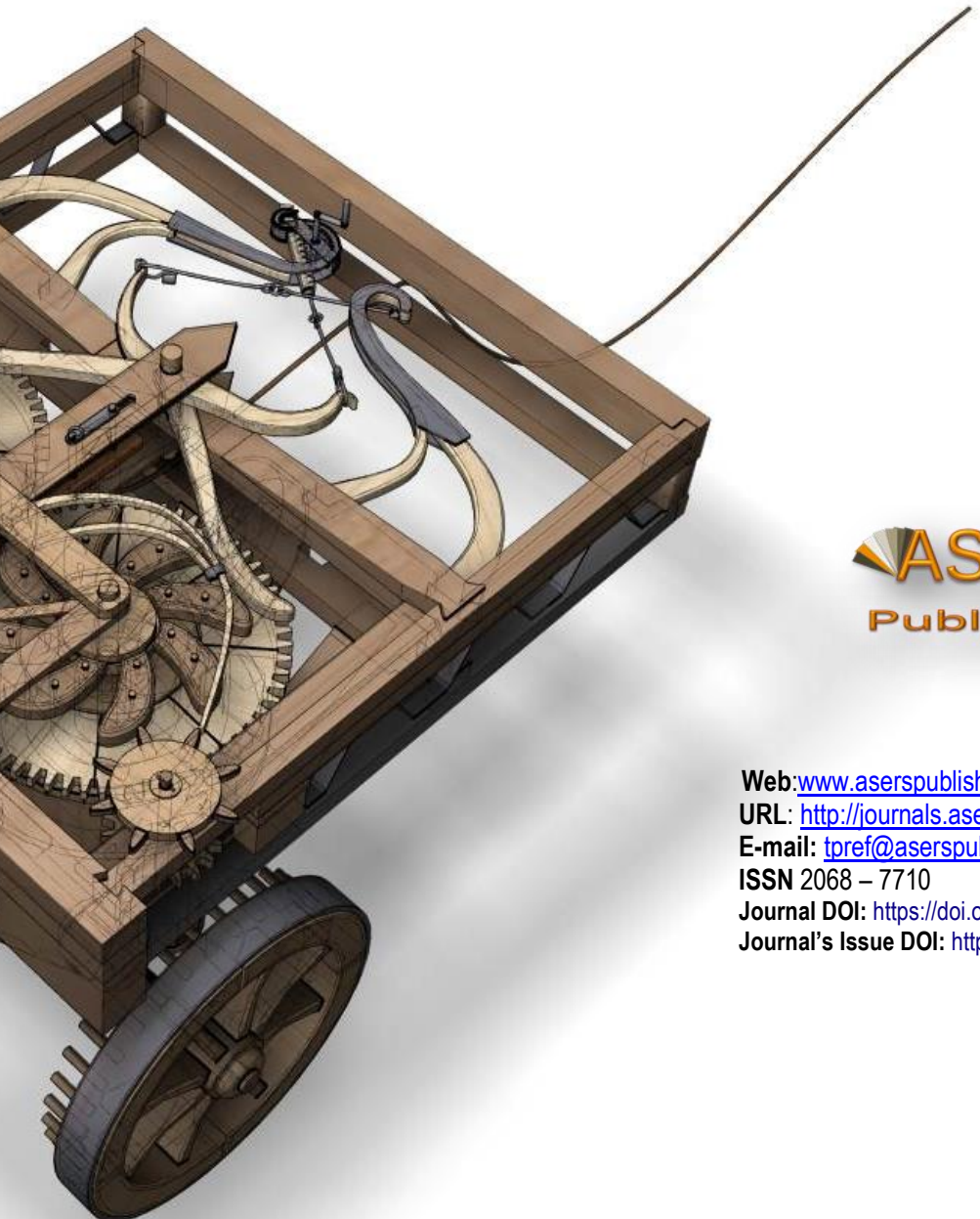
Appendix

*Matlab*commands for symmetric case.

```
% gensys state space (symmetric case)
syms a1111 a1112 a1121 a1122 b1111 b1121 b21
A=[a1111 a1112 0; a1121 a1122 0; zeros(1, 3)];
B=[b1111; b1121; b21];
M=[1 0 0]; C=M*A; D=M*B;
% Controllability and observability
Con=[B A*B A*A*B];
fprintf('Controllability matrix rank')
rc=rank(Con)
Obs=[C; C*A; C*A*A];
fprintf('Observability matrix rank')
ro=rank(Obs)
% Similarity transformation
v=[0 0 1];
T=[Obs(1:2, 1:3); v];
invT=inv(T);
% Canonical and minimal decomposition
Ad = invT*A*T;
Bd = invT*B;
Cd = C*T;
Am = [Ad(1:2, 1:2)];
Bm = [Bd(1:2, 1:1)];
Cm = Cd(1:1, 1:2);
% Minimal controllability and observability
Conm=[Bm Am*Bm];
fprintf('Minimal controllability matrix rank')
rcm=rank(Conm)
Obsm=[Cm; Cm*Am];
fprintf('Minimal observability matrix rank')
rom=rank(Obsm)
% Minimal VAR representation
Fm=Am-Bm*inv(D)*Cm;
fprintf('Minimal VAR representation condition eigenvalues')
lambdas_Fm=eig(Fm)
```

ASERS



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