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The Effect of Financial Innovation on Economic Growth in Transition Countries

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Abstract

This paper aims to explore the effect of financial innovation on economic growth in 28 transition countries from 2004 to 2021. Financial innovation is categorized based on the structure of the financial system, including commercial banks, non-commercial banks and financial markets. By applying difference GMM estimation, the research demonstrated a significant positive effect of financial innovation in commercial banks and non-commercial banks on economic growth. The results show that a greater number of financial innovations in terms of products and services, processes, technology and function in commercial banks and non-commercial banks would result in higher economic growth in transition countries. In contrast, financial innovation in financial markets indicates significantly negative effects on economic growth. Introducing complex products in stock and bond markets in underdeveloped financial markets probably lead to the volatility and fragility, reducing economic growth. The results of this research contribute to issuing crucial policies that employ financial innovation as an impulse for spurring economic growth in transition countries.

Keywords

Financial innovation, Commercial banks innovation, Non-commercial banks innovation, Financial markets innovation, Economic growth, Transition countries

JEL Classification

G10, G20, O11, O30, P20

Introduction

Economic growth has long been considered as a priority objective for the development of many countries in the world that improve living standards, create employment opportunities, reduce poverty and enhance social well-being (Balasubramanian et al., 2023; Danielli et al., 2020; Howarth & Kennedy, 2016). Thus, investigating drivers for economic growth has been attracting the attention of both researchers and policy makers. There are many factors affecting economic growth such as productivity and technology, human resource, inflation, foreign direct investment. Among these factors, the effect of financial innovation on economic growth is documented.

Financial innovation is defined as new or improved financial products, services, processes, technology and function innovation. A large body of previous studies performs different mechanisms on how financial innovation influences economic growth. On the one hand, the positive effect of financial innovation on economic growth presented by fostering the mobilizing saving, reducing the cost of transactions, and increasing the liquidity (Oyadeyi, 2023; Kotkova et al. 2020; Khraisha & Arthur, 2018; Merton, 1992). Also, financial innovation could enhance generating credit, offer investment opportunities and providing hedging for investors, creating more output in the economy and boosting economic growth (Agarwal et al., 2020; Merton, 1992). On the other hand, research also posited detrimental aspects of financial innovation which could channel negative effects on economic growth. By using new and complex financial products, credit expansion, and subprime securitization could lead to the fragility of the financial markets, affecting activities in the economy when financial crises occur and hindering economic growth (Naeem et al., 2023; Beck et al., 2016; Henderson & Pearson, 2011).

Empirically, the abundance of literatures demonstrated the linkage of financial innovation and economic growth in developed countries (Naeem et al., 2023; Bernier & Plouffe, 2019; Beck et al., 2016; Laeven et al., 2015). Also, previous studies documented this nexus in developing countries in Asia (Nazir et al., 2020; Qamruzzaman &

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Jianguo, 2018; Qamruzzaman & Jianguo, 2017), and African countries (Domeher et al., 2022; Satia & Okle, 2020; Bara et al., 2016; Bara & Mudzingiri, 2016; Adu-Asare Idun & Q.Q. Aboagye, 2014). However, investigating financial innovation and economic growth in transition countries has not received much attention.

Focusing on transition countries instead of other economies implicates more attentive reasons due to most transition countries are in the cohort of middle income and located in both the regions of Europe and Asia. Politically, some transition countries had changed their government's regime after wars and the ruination of the Soviet Union. Economically, transition countries transformed from government-based economies limited the involvement of the private sector into market-based economies (Halaskova et al., 2023; Dabrowski, 2022; Beck & Laeven, 2006). These characteristics in the history of politics, geographic and economic system determine their specific financial innovation compared to other parts of the world. While most of the available research is found in the scope of developed or developing countries, conducting research focused on transition countries would become interesting and yield meaningful contributions.

Despite the concept of financial innovation is documented in a considerable body of research, financial innovation is not sufficiently measured. Previous literatures use quite limited proxy for measuring financial innovation and do not categorize which part of financial innovation in the financial structure including commercial banks, non-commercial banks and financial markets. For example, previous researches using only private credit to the GDP (Qamruzzaman & Jianguo, 2017), banking sector credit to private sector credit (Bara & Mudzingiri, 2016; Bara et al.,2016; Laeven et al., 2015; Adu-Asare Idun & Aboagye, 2014), ratio of broad money to narrow money (M2/M1) (Qamruzzaman & Jianguo, 2017; Bara et al., 2016; Bara & Mudzingiri, 2016).

In order to fill the gap of previous studies, this research has two main contributions. Firstly, the study reshapes classification and measurement of financial innovation which capture directly financial innovation following the structure of the financial system including commercial banks, non-commercial banks and financial markets compared to previous researches which only capture on limited aspects of financial innovation. Secondly, while the majority of existing literature focuses on the case of developed or developing countries, the study fulfills this deficiency by conducting research on transition countries.

Accordingly, the objective of this research is to investigate the effect of financial innovation on economic growth using panel data of 28 transition countries from 2004 to 2021. This objective is explored by interpreting in the research questions whether financial innovation in commercial banks, non-commercial banks and financial markets can positively or negatively affect economic growth in transition countries.

This research applies the difference Generalized Method of Moments (difference-GMM) in estimating regression results. The empirical findings show that financial innovation in commercial banks and non-commercial banks positively affect economic growth while there is a negative effect of financial innovation in financial markets on economic growth.

The remainder of this paper is organised as follows: the next section will introduce a theoretical background and empirical literature. This is followed by a data and methodology, results and discussion section and conclusion.

Literature Review

Financial innovation definition

From previous research's definition (Horne, 1985; Tufano, 2003; Frame & White, 2012; Khraisha & Arthur, 2018), financial innovation is defined in four main aspects. Firstly, financial innovation is defined as introducing new financial products and services such as creating new derivative contracts, corporate securities or new forms of investment products (Horne, 1985; Tufano, 2003). Second, financial innovation is also defined as the innovation of financial process in which there is a development of the procedure that financial activities are conducted (Tufano, 2003; Horne, 1985). Third, financial innovation is identified as innovations in terms of new technology that could be carried out by not only financial institutions but also non-financial institutions (Khraisha & Arthur, 2018). Fourth, financial innovation can be defined in the function perspective which plays a crucial role in reducing risk, transition cost, making the financial market more efficient, mobilizing saving and generating credit and equity (Frame & White, 2012; Merton, 1995). In conclusion, this research generally defines financial innovation as new or improved innovations in the financial system that embrace products and services, processes, technology and function innovations.

The effect of financial innovation on economic growth

Conceptually, a considerable body of research positively explicated the contributions of financial innovation on economic growth. Financial innovation in commercial banks presents by the appearance of new financial products and services which function in reducing the cost of transaction, enhancing the liquidity of capital flow, fostering the mobilizing process of households' savings (Mishra, 2008). Also, Carbó Valverde et al. (2007) stated that financial innovations deliver lower the cost of financial transactions and could improve the processes in capital markets more productive, driving positive influences to investment and gross savings growth and stimulate higher stages of economic growth. Furthermore, innovation in terms of technology could facilitate in processing intertemporal or

spatial transfers increases the liquidity and reduces agency costs (Merton, 1992). Regarding non-commercial banks, the advent of new financial institutions such as mutual funds, pension funds, venture capital, microfinance organizations bring opportunities for investors to diversify their portfolios, smoothly mobilize savings and generate a variety of credit resources. Also, innovation related to functions of institutions such as insurance, investment funds provide a greater choice for firms and individuals in protecting financial transactions and business activities of individuals and firms. In addition, through investing to productive investments such as stock and government securities, these kinds of innovation generate capital resources for expanding production, creating employment and development (Merton & Bodie, 1995; Kumari, 2016; Asongu & Odhiambo, 2019). On the side of the financial markets, innovation in the process of electronic record-keeping, distributing securities, conducting and valuing transactions could help the liquidity of capital flow more conveniently (Tufano, 2003; Frame & White, 2004). These kinds of innovation bridge the demands of investors to complete the markets for risk-sharing and hedging (Merton, 1992). Furthermore, financial innovation by risk-sharing the portfolios and fulfilling the liquidity requirements which positively functions activities in the financial system. Consequently, a well- improved financial system enables in boosting economic growth through offering high-return investments for participants, generating variety credit and equity sources in the economy (Saint-Paul, 1992; Merton, 1992).

On the contrary, financial innovation can lead to negative effects on economic growth. Allen (2012) stated that financial innovation which creates new and complex products such as credit default swaps may lead to possible serial of default risk and crises in the long term. Additionally, credit expansion from non-bank institutions can possibly cause the financial crisis and lowering economic growth. Financial innovation in financial markets such as securitization, new derivative securities, and subprime securitization which reduce the standard of lending. In this situation, the financial markets would be higher systemic risk, exerted the complexity and fragility of, affecting activities in the economy when financial crises occur (Henderson & Pearson, 2011). Consequently, that would lead to economic downturn and hindering economic growth in crisis periods.

For the empirical study, several literatures demonstrated the effect of financial innovation on economic growth. Laeven et al. (2015) demonstrated the positive effect of financial innovation on economic growth of 77 countries by using first-difference GMM. This research found that this effect is higher for countries whose economic growth is lower than the average sample. Focusing on developed countries, Bernier and Plouffe (2019) applied fixed effect regressions and confirmed that financial innovation is positively associated with economic growth of OECD countries. Considering developing countries in Asia, Nazir et al. (2020), Qamruzzaman and Jianguo (2017) documented a strong significant and positive effect of financial innovation on economic growth in Bangladesh, China, India and Pakistan through employing the ARDL bonding tests. Similarly, Bara et al. (2016) also pointed out a positive effect of financial innovation on economic growth in the long run for the data of 15 SADC countries. Investigating the effect of financial innovation on economic growth of both high-income and upper-income economies, Mollaahmetoğlu and Akçalı (2019) supported the positive linkage. In the context of regional growth, Carbó Valverde et al. (2007) and Wang et al. (2022) used fixed effect models and explored that financial innovation positively affects regional GDP, investment and gross saving growth in Spain and 31 provinces and cities in China.

However, Beck at el. (2016) examine the effect of financial innovation on the growth in OECD countries by OLS estimations and stated that advanced financial products could intensify the moral hazard, information asymmetric problems, reducing economic growth. Qamruzzaman and Jianguo (2018) applied ARDL bounds test also documented the negative effect of financial innovation on the long-run economic growth of Sri Lanka. Similarly, Adu-Asare Idun and Q.Q. Aboagye (2014) stressed that in the long run, financial innovation is negatively associated with economic growth of Ghana over the period 1990 - 2009. This is due to the innovative products available in Ghana tend to encourage the number of withdrawals more than deposits in the long run.

Also, many empirical studies mentioned the complex nexus of financial innovation and the economic growth which has both positive and negative effects on economic growth in developed countries (Bernier & Plouffe, 2019; Laeven et al., 2015). Some studies conducted for developing and lower-middle-income countries also exhibited a more nuanced view on the contribution of financial innovation to economic growth such as the bi-directional causality or no significant nexus (Bara & Mudzingiri, 2016; Qamruzzaman & Jianguo, 2018; Satia & Okle, 2020).

In conclusion, reviewing previous literature displays multifaceted aspects in the linkage between financial innovation and economic growth. Besides, indicators measuring financial innovation such as gross capital formation (Bernier & Plouffe, 2019), private credit to the GDP (Laeven et al., 2015; Qamruzzaman & Jianguo, 2017), ratio of broad money to narrow money (M2/M1) (Qamruzzaman & Jianguo, 2017; Bara et al., 2016; Bara & Mudzingiri, 2016), banking sector credit to private sector credit (Bara & Mudzingiri, 2016; Bara et al.,2016; Laeven et al., 2015; Adu-Asare Idun & Aboagye, 2014) are limited and do not well-represent for financial innovation. Furthermore, previous authors mainly paid attention to developed, developing, and low-income countries while there is a shortage of study focused on transition countries. In terms of econometrics techniques, previous research mainly used OLS, fixed effect and ARDL (Beck at el., 2016; Carbó Valverde et al., 2007; Bernier & Plouffe, 2019; Qamruzzaman & Jianguo, 2017). These methods present limitations due to not controlling for autocorrelation and endogeneity.

Data and Methodology

Data

This study uses panel data of 28 transition countries[1] during the period 2004–2021. Economic growth represented by the real GDP per capita is collected from the World Bank.

Table 1. Data description.

Type of variable	Variable	Symbol	Sources
Dependent variable	GDP per capita ($US)	EG	World Bank
Financial innovation in commercial banks	Number of debit cards (unit)	DB	Financial Access Survey (IMF), World Bank and Annual report of each country
	Number of credit cards (unit)	CRE	
	Number of commercial bank branches (unit)	BBR	
	Number of ATMs (unit)	ATM	
	Number of POS terminal (unit)	POS	
	Number of mobile and internet banking transactions (unit)	MIB	
	Private sector credit to GDP (%)	PC	
	Bank deposit to GDP (%)	BD	
Financial innovation in non-commercial banks	Number of life insurance policies	LIPO	
	Number of non-life insurance policies	NLIPO	
	Pension fund assets to GDP (%)	PENA	
	Mutual fund assets to GDP (%)	MULA	
	Non-bank institution assets to GDP (%)	NBA	
Financial innovation in financial markets	Stock market capitalization to GDP (%)	SMCAP	
	Stock market value traded to GDP (%)	SMVTD	
	International debt securities to GDP (%)	INDEBT	
	Corporate bond issuance to GDP (%)	CORBD	
Control variables	Inflation rate (%)	INF	World Bank
	Labor force participation (% of ages 15+/total population)	LABOR	
	Gross domestic investment to GDP (%)	INV	
	Government expenditure to GDP (%)	GEX	
	Household expenditure to GDP (%)	HCE	
	Trade openness (% of the total exports and imports/GDP)	TO	

Concerning the classification of financial innovation, this study will divide financial innovation indicators based on the structure of the financial system including commercial banks, non-commercial banks and financial markets. This classification will fill the gap of previous measurements which measured financial innovation by quite limited indicators and do not present the structure of the financial system. Indicators in this study also capture financial innovation in terms of new products and services (debit cards, credit cards, commercial bank branches, ATMs, life and non-life insurance policies), processes (debit cards, credit cards, commercial bank branches, ATMs, POS terminal, stock market capitalization, stock market value traded, international debt securities and corporate bond issuance), technology (ATMs, POS terminal, mobile and internet banking transactions), and function innovation such as reducing transaction cost, enhancing liquidity, transferring risk, mobilizing more savings, credit-generating and equity-generating. These indicators are collected from World Bank, the International Monetary Fund (IMF) and Annual report of each country. Also, the data of control variables added to the empirical model is collected from World Bank. The data description used in this study shown in table 1 and the summary statistics shows in table 2.

[1] These countries are selected based on the categories of the International Monetary Fund and the availability of data. A sample of transition countries includes Albania, Armenia, Azerbaijan, Belarus, Bulgaria, Cambodia, China, Croatia, Czech Republic, Estonia, Georgia, Hungary, Kazakhstan, Kyrgyz Republic, Laos, Latvia, Lithuania, Moldova, North Macedonia, Poland, Romania, Russia, Slovak Republic, Slovenia, Tajikistan, Ukraine, Uzbekistan and Vietnam.

Table 2. Summary descriptive statistics.

Variable	Obs.	Mean	Std. Dev.	Min	Max
EG	504	8,273.867	6,793.064	311.627	29,200.82
DB	504	157,236,996	887,285,023	2924.000	8,450,000,000
CRE	504	21,786,507	105,276,087	806.000	800,000,000
BBR	504	6,059.25	17,418.35	47.000	101,883
ATM	504	28,905.07	126,705.1	1.000	1,110,800
POS	444	752,783	4,119,029	155.000	36,914,349
MIB	436	29,455.5	41,990.61	35.586	321,204
PC	504	45.854	30.119	3.161	182.433
BD	504	38.932	19.176	4.158	130.616
LIPO	217	219.748	415.252	1.000	2,134.928
NLIPO	239	1,316.516	2,642.984	4.114	16,989.52
PENA	504	4.111	5.694	0.004	36.194
MULA	486	2.744	3.605	0.005	18.756
NBIA	162	5.586	5.804	0.074	33.606
SMCAP	448	19.662	33.781	0.166	392.957
SMVTD	436	9.619	29.413	0.001	355.52
INDEBT	441	10.251	8.335	0.002	41.068
CORBD	400	1.404	2.152	0.001	20.541
INF	504	5.375	5.863	-1.545	59.219
LABOR	504	59.429	7.483	40.320	77.200
INV	504	26.944	6.893	8.932	57.990
GEX	504	15.671	4.107	3.460	24.016
HCE	504	63.639	14.692	33.401	116.618
TO	504	104.256	35.501	29.192	189.804

Empirical model

The empirical model used in this study is as follow:

$$EG_{i,t} = \alpha + \beta_1 EG_{i,t-1} + \beta_2 Inno_{i,t} + \beta_3 INF_{i,t} + \beta_4 Labor_{i,t} + \beta_5 INV_{i,t} + \beta_6 GEX_{i,t} + \beta_7 HCE_{i,t} + \beta_8 TO_{i,t} + \varepsilon_{i,t}$$

where

i represents each transition country (1, 2, 3, …, N);
t is the time period (1, 2, 3, …, T);
$EG_{i,t}$ denotes economic growth represented by the real GDP per capita. This variable is widely used in the studies observed economic growth (Bernier & Plouffe, 2019; Beck et al., 2016; Qamruzzaman& Jianguo, 2017; Bara et al., 2016; Bara & Mudzingiri, 2016);
$Inno_{i,t}$ are the financial innovation indicators mentioned previously in table 1;
$\varepsilon_{i,t}$ is error term.

In this case, the model will estimate separately the effect of each indicator on economic growth. For financial innovation in commercial banks, indicators such as the number of debit cards (DB) and credit cards (CRE) show financial innovation in terms of products, services, and processes which facilitate end-users in conducting their transactions and making payment with a low transaction cost. In addition, credit cards also serve a credit-generating function by offering unsecured loans in the short run, which smoothly supports household consumption. The number of commercial bank branches (BBR) presents innovation in terms of financial services, processes and function. Spreading out of traditional commercial bank branches provides services more popularly with end-users, process to borrowers and saver more conveniently and creates larger credit availability. Also, the number of ATMs (ATM), POS terminal (POS) and mobile and internet banking (MIB) present technology innovation which facilitates financial transactions and payment using cards and banking applications that serves function innovation in terms of liquidity enhancing and cost-reducing. Private sector credit to GDP (PC) and bank deposit to GDP (BD) present

function innovation in terms of credit-generating and saving-mobilizing.

For financial innovation in non-commercial banks, the number of life insurance policies (LIPO) and non-life insurance policies (NLIPO) show product innovation and risk-transferring function innovation by providing greater choices for firms and individuals in hedging their financial transactions and business activities from risk and could generate more capital resources. Indicators such as pension fund asset to GDP (PENA), mutual fund asset to GDP (MULA), and nonbank financial institutions' assets to GDP (NBIA) express function innovation in terms of mobilizing capital, enhancing liquidity and generating equity functions.

For financial innovation in financial markets, indicators present financial innovation in stock markets are stock market capitalization to GDP (SMCAP) and stock market value traded to GDP (SMVTD) show process innovation in the stock market by allowing shareholders to sell their equity quickly as well as mobilizing equity capital more conveniently. Financial innovation in bond markets is presented by outstanding total international debt securities to GDP (INDEBT) and corporate bond issuance volume to GDP (CORBD) which show creating a variety of debt securities which makes channelling savings to fund long-term borrowers more efficient. Also, all of indicators measured financial innovation in financial markets presents function innovation in terms of reducing the liquidity risks, mobilizing savings and investment, generating credit and equity capital.

Based on the conceptual framework mentioned in the literatures, the expected sign of effect of all indicators measured financial innovation in commercial banks, financial innovation in non-commercial banks, and financial innovation in financial markets can be positive or negative.

Beside financial innovation, our models also take into account the effect of other factors on economic growth. We included six essential macroeconomic elements including inflation ($INF_{i,t}$), labor force participation rate ($Labor_{i,t}$), domestic investment ($INV_{i,t}$), government expenditure ($GEX_{i,t}$), household consumption ($HCE_{i,t}$) and trade openness ($TO_{i,t}$) as control variables which are documented in the research of Barro and Sala-i-Martin (2003). This research expects that domestic investment, government expenditure, household consumption, trade openness, and labor force participation rate have positive effects on economic growth while inflation can have both positive or negative effect.

In order to capture the dynamic model and handle the presence of autocorrelation and endogeneity, this study employs first-difference GMM technique to estimate the empirical results[2].

Empirical Results and Discussion

The results of the effect of financial innovation on economic growth are divided based on the structure of the financial system including the effect of financial innovation in commercial banks, non-commercial banks and financial markets on economic growth shown by table 3, table 4, and table 5, respectively.

The results from table 3, columns 1 to 8 demonstrated that all indicators measuring financial innovation in commercial banks have significantly positive effects on economic growth which is consistent with the expectation and previous studies (Bara et al., 2016; Satia & Okle, 2020; Wong et al., 2020).

In particular, the significantly positive coefficient of debit cards (DB) and credit cards (CRE) in column 1 and 2 pointed out that the higher number of debit cards and credit cards lead to the greater growth rate of the economy. As financial innovation in terms of products, debit cards and credit cards create new payment methods which facilitate conducting financial transactions with lower cost and more convenience (Laradi et al., 2023; Tee & Ong, 2016). In particular, the significantly positive coefficient of debit cards (DB) and credit cards (CRE) in column 1 and 2 pointed out that the higher number of debit cards and credit cards lead to the greater growth rate of the economy. As financial innovation in terms of products, debit cards and credit cards create new payment methods which facilitate conducting financial transactions with lower cost and more convenience (Tee & Ong, 2016). In terms of process innovation, using debit cards and credit cards for the payment replace the channel of paper-based transactions. That reduces not only the cost of transaction for end-users but also lower operating costs for payment service suppliers. Thereby, the process of transaction is faster, increasing the efficiency of economies of scale, leading to the expansion of business activities and higher investment in the economy, accelerating economic growth (Hasan et al., 2012). Also, credit cards have the function innovation in terms of credit-generating through providing loans in the short term as it offers immediate credit within the limit to customers used in making purchases or withdrawing cash. That increases individuals' consumption and capital resources in the market, enhancing economic growth (Wong et al., 2020).

Similarly, the result in column 3 supports a significant positive effect of commercial bank branches (BBR) on economic growth. Expanding more commercial bank branches could capture a broader spectrum of customers because they can save commuting time and cost of transportation (Maity & Sahu, 2023). A wider branch network shows process innovation, saving-mobilizing and credit-generating function innovation that have more connection

[2] The system GMM technique is also use for the robustness check and the result confirms similar findings compared to the first difference GMM.

with borrowers and savers thus creating larger credit availability for the local population and providing capital for business activities, resulting in higher economic growth (Chu, 2010).

Table 3. The effect of financial innovation in commercial banks on economic growth.

Variables	DB	CRE	BBR	ATM	POS	MIB	PC	BD
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GDP_{t-1}	0.668***	1.025***	0.364***	0.504***	0.824***	0.424***	0.559	0.469***
	(0.062)	(0.046)	(0.098)	(0.099)	(0.209)	(0.073)	(0.388)	(0.113)
$Inno_{i,t}$	0.166***	0.279***	0.191**	0.258***	0.001***	0.001***	0.035*	0.017**
	(0.063)	(0.037)	(0.051)	(0.091)	(0.000)	(0.000)	(0.021)	(0.008)
$INF_{i,t}$	-0.001**	-0.011**	-0.006*	-0.001*	-0.013***	0.001	-0.010*	-0.001*
	(0.003)	(0.005)	(0.003)	(0.000)	(0.004)	(0.002)	(0.006)	(0.000)
$Labor_{i,t}$	-0.028	-0.011	-0.034**	-0.030	-0.019***	0.001	-0.014	-0.016
	(0.034)	(0.645)	(0.017)	(0.039)	(0.014)	(0.008)	(0.036)	(0.017)
$INV_{i,t}$	0.021***	0.029***	0.013	0.025**	-0.010	0.014***	0.023*	0.027***
	(0.005)	(0.004)	(0.011)	(0.064)	(0.007)	(0.004)	(0.015)	(0.010)
$GEX_{i,t}$	-0.019	0.052***	0.069**	0.026	-0.122***	-0.019	-0.069	-0.028
	(0.017)	(0.003)	(0.031)	(0.026)	(0.524)	(0.017)	(0.077)	(0.036)
$HCE_{i,t}$	0.001*	0.008**	-0.008	-0.001	-0.065	0.023***	0.009*	0.031*
	(0.000)	(0.003)	(0.019)	(0.005)	(0.046)	(0.008)	(0.004)	(0.019)
$TO_{i,t}$	0.005**	0.021***	0.018***	0.008***	0.011**	0.004***	0.023**	0.008**
	(0.002)	(0.002)	(0.004)	(0.003)	(0.005)	(0.001)	(0.011)	(0.004)
AR(1)	0.100	0.632	0.321	0.941	0.464	0.873	0.232	0.986
AR(2)	0.198	0.979	0.935	0.254	0.348	0.394	0.508	0.314
Hansen test	0.277	0.147	0.136	0.288	0.280	0.182	0.169	0.155

Note: The abbreviations in the columns 1 to 8 are explained as follows: DB denotes the number of debit cards; CRE is the number of credit cards; BBR is the number of commercial bank branches; ATM is the number of automated teller machines; POS is the number of points of sale; MIB is the number of mobile and internet banking transaction; PC denotes private sector credit to GDP; and BD is bank deposit to GDP. Robust standard errors reported in parenthesis. ***, **, *, significant at the 1%, 5%, and 10% levels respectively. The results of AR(1), AR(2) and Hansen test are presented in P-value.

For the number of ATMs (ATM) in column 4, we find that there is a significantly positive effect on economic growth. This result shows that a greater number of ATMs increases the growth rate of GDP per capita due to ATMs brings more convenient services to customers and reduces labor cost for the banking system (Markose & Loke, 2003; Ogbuji et al., 2012). ATMs also present liquidity-enhancing and transaction cost-reducing function innovation that facilitates business transactions and individuals' demand, increasing the capital flow in the economy and contributing significantly to economic development.

The result of financial innovation measured by the number of POS (POS) terminals is shown in column 5 which indicates a significantly positive effect on economic growth. Similar to the expectation, a rise in the number of POS terminals will lead to an improvement in the process innovation for making payment for goods and services which facilitates business activities, increasing consumption, and hence rising economic growth. Also, a wide adoption of POS terminals represents technology innovation in connection between commercial banks, sellers and customers and present an innovation function in terms of reducing the cost of transaction, enhancing the liquidity and transferring risk, consequently increasing an economic growth.

Regarding the effect of mobile and internet banking transactions (MIB), the results in column 6 shows a significant positive effect on economic growth. This is due to internet banking and mobile banking allow customers themselves conduct basic financial transactions in real-time without commuting to a physical bank branch. That facilitate financial transactions of businessmen, companies or individuals more quickly and conveniently (Chen et al., 2017). Moreover, this indicator shows function innovation in terms of reducing the cost of transaction and enhancing the liquidity of capital flow, resulting in greater economic growth.

In column 7 and 8, the model documented the positive effect of the private sector credit (PC) and bank deposit (BD) to GDP on economic growth, respectively. This result shows that a rise in bank deposits and private sector credit result in higher capital economic growth. As these indicators show function innovations in terms of credit-generating in which creatable more credit availability and capital resources for the private sector support business activities of individuals, households, and firms, accelerating economic growth (Beck et al., 2009; Čihák et al., 2012).

In terms of the effect of financial innovation in non-commercial banks on economic growth, the result in table 4, columns 1 to 5 exhibited that each indicator shows statistical significance and positive effects on economic growth

that is in line with the expectation (Beck at al., 2016; Qaruzzaman & Jianguo, 2017; Bernier & Plouffe, 2019; Nazir et al., 2020).

Table 4. The effect of financial innovation in non-commercial banks on economic growth.

Variables	LIPO	NLIPO	PENA	MULA	NBIA
	(1)	(2)	(3)	(4)	(5)
GDP_{t-1}	0.628***	0.465***	0.594***	0.807***	0.415***
	(0.097)	(0.424)	(0.220)	(0.092)	(0.159)
$Inno_{i,t}$	0.001***	0.001*	0.265*	0.016**	0.039*
	(0.000)	(0.000)	(0.157)	(0.008)	(0.020)
$INF_{i,t}$	-0.006*	0.016	0.001	-0.011**	-0.011***
	(0.03)	(0.011)	(0.005)	(0.005)	(0.003)
$Labor_{i,t}$	-0.006	-1.117	-1.812*	-0.010	-0.010
	(0.020)	(1.721)	(1.071)	(0.006)	(0.012)
$INV_{i,t}$	0.036***	0.097	0.314	0.006**	0.015*
	(0.007)	(0.948)	(0.909)	(0.003)	(0.006)
$GEX_{i,t}$	0.051	2.577	0.313	0.047**	0.030*
	(0.051)	(2.859)	(0.507)	(0.021)	(0.015)
$HCE_{i,t}$	0.038*	-1.253	1.968	-0.012	0.024*
	(0.014)	(4.468)	(1.899)	(0.015)	(0.001)
$TO_{i,t}$	0.017***	3.421**	0.490***	0.005*	0.018***
	(0.006)	(1.609)	(0.536)	(0.0021)	(0.006)
AR(1)	0.692	0.757	0.504	0.106	0.754
AR(2)	0.244	0.962	0.720	0.105	0.196
Hansen test	0.399	0.864	0.323	0.465	0.982

Note: The abbreviations in the columns 1 to 5 are explained as follows: LIPO denotes the number of life insurance policies; NLIPO is the number of non-life insurance policies; PENA is pension fund assets to GDP; MULA is mutual fund assets to GDP; and NBIA is non-bank institution assets to GDP. Robust standard errors reported in parenthesis. ***, **, *, significant at the 1%, 5%, and 10% levels respectively. The results of AR(1), AR(2) and Hansen test are presented in P-value.

The number of life insurance policies (LIPO) and non-life insurance policies (NLIPO) in column 1 and column 2 show significantly positive effect on economic growth. Creating more insurance policies presents product innovation and risk-transferring, capital-generating function innovation. An increase in the number of non-life insurance policies provide more protections for individuals and firms that could help to protect economic activities from negative shocks. Also, insurance could boost economic growth through investing the premiums resource mobilized from life insurance contracts to productive investments such as stock and government securities. That generates capital resources for expanding production, creating employment and industrial development, enhancing economic growth (Asongu & Odhiambo, 2019).

In column 3, the pension fund assets to GDP (PENA) presents a significantly positive effect on economic growth. By mobilizing capital through retirement source from employee and employer, pension funds offer long term financing which increase the liquidity of capital. Also, through pooling pension funds and well managing their investments, pension funds could reduce the investment risk, spurring productive investment. Therefore, pension funds present function innovation in terms of enhancing the liquidity and generating more equity capital in the economy for production and business activities, boosting economic growth at a higher level (Davis & Steil, 2001).

Similarly, the statistical significance and positive effect of mutual funds on economic growth is demonstrated in column 4. Mutual funds present function innovation in terms of enhancing liquidity, reducing risk and information asymmetric. That provide capital for the economy through profitable investments, promoting the liquidity of capital flow (Merton & Bodie, 1995). In this manner, mutual funds provide the diversification of investment, reduce risk and fulfill incomplete financial markets and making it more efficient, increasing the capital in the economy and enhancing economic growth.

The result also documented the positive effect of nonbank financial institutions' assets to GDP (NBIA) on economic growth in column 5. This is due to higher nonbank financial institutions' assets to GDP present greater function innovation in terms of mobilizing savings, transferring risk and generating credit through issuing a variety of securities, investment companies, providing many kinds of loans and credit. Thus, the economy will have a higher capital resource, resulting in higher economic growth.

Regarding the effect of financial innovation in the financial markets on economic growth, the results from table 5, columns 1 to 4 show that all indicators measuring financial innovation in financial markets have statistical

significance and negative effect on economic growth.

Table 5. The effect of financial innovation in financial markets on economic growth.

Variables	SMCAP	SMVTD	INDEBT	CORBD
	(1)	(2)	(3)	(4)
GDP_{t-1}	0.724***	0.347*	0.756***	0.751***
	(0.063)	(0.202)	(0.081)	(0.048)
$Inno_{i,t}$	-0.002**	-0.003*	-0.016*	-0.018*
	(0.001)	(0.001)	(0.009)	(0.010)
$INF_{i,t}$	-0.007***	-0.008**	-0.009**	-0.007***
	(0.002)	(0.004)	(0.004)	(0.002)
$Labor_{i,t}$	-1.319**	-1.605**	-1.432	-0.433
	(0.616)	(0.784)	(0.952)	(0.538)
$INV_{i,t}$	0.421**	0.220	-0.002	-0.021
	(0.164)	(0.288)	(0.255)	(0.142)
$GEX_{i,t}$	0.234	0.977*	0.539	-0.179
	(0.343)	(0.575)	(0.518)	(0.230)
$HCE_{i,t}$	3.499***	-1.696	2.074**	1.545***
	(1.117)	(1.309)	(0.967)	(0.549)
$TO_{i,t}$	0.860***	1.609**	1.575***	1.088***
	(0.283)	(0.744)	(0.423)	(0.235)
AR(1)	0.368	0.393	0.469	0.929
AR(2)	0.425	0.701	0.228	0.129
Hansen test	0.617	0.160	0.315	0.867

Note: The abbreviations in the columns 1 to 4 are explained as follows: SMCAP denotes stock market to GDP; SMVTD is stock market value traded to GDP; INDEBT is international debt securities to GDP; and CORBD is corporate bond issuance to GDP. Robust standard errors reported in parenthesis. ***, **, *, significant at the 1%, 5%, and 10% levels respectively. The results of AR(1), AR(2) and Hansen test are presented in P-value.

In terms of financial innovation in stock markets, both indicators including stock market capitalization to GDP (SMCAP) and stock market value traded to GDP (SMVTD) shown in column (1), (2) negatively affected economic growth. Similarly, financial innovation in the bond market measured by the outstanding total international debt securities (INDEBT) and the issuance of corporate bond (CORBD) to GDP shown in column (3), (4) are found to be negatively associated with economic growth. The probable explanation for the negative effect of financial innovation in economic growth in the financial markets is the shortage of financial market's infrastructure, policies, and regulations in transition countries. This is due to after the transition process, structuring new institutions to support the market-based economy has been much slower than the change of the economy (Beck & Laeven, 2006). Also, financial markets in transition countries mostly are underdeveloped and at medium level (Mahirun et al., 2023; Cojocaru et al., 2016; McNulty & Harper, 2012) so they do not have robust backgrounds to adapt new financial innovations such as complex securities. Hence, increase in the number of financial innovations in financial market could lead to the complexity and fragility of the financial markets, causing financial crises and economic downturn. This finding is in line with some previous empirical research (Satia & Okle, 2020; Qamruzzaman & Jianguo, 2018; Laeven et al., 2015; Beck et al., 2016; Adu-Asare Idun & Q.Q. Aboagye; 2014).

For the control variables, table 3, table 4 and table 5 show the significant results and as the expectation of almost all variables. In particular, the lagged GDP $(EG_{i,t-1})$ in all regression shows a significant positive sign, as expected. This result indicated that economic growth in the present year is also positively affected by previous periods. For inflation (INF), this variable in almost all regressions shows significant negative influence on growth and in line with the expectation. Different from the expectation, labor force participation (Labor) indicates negative effects on economic growth. The negative sign could be explained by the measurement of labor force participation based on the data of the World Bank which measures this variable by a total population aged above 15 to total population. Hence, including the old-aged population in the labor force participation probably is the cause of reduced economic growth (Futagami & Nakajima, 2001). The gross domestic investment (INV), government expenditure (GEX), trade openness (TO) shows significant positive effects on economic growth in most regression, as expected.

Table 3, table 4 and table 5 also presents the result of AR(1) and AR(2) tests for auto-correlation and the Hansen test for instrument validity. These tests show a non-rejection of the null hypothesis, confirming that the model does not contain residual correlation and the instruments used in the first-difference GMM estimation are valid.

Conclusion

This research aims to examine the effect of financial innovation on economic growth in 28 transition countries from 2004 to 2021. Financial innovation in this study is classified and measured based on the structure of the financial system, including financial innovation in commercial banks, financial innovation in non-commercial banks and financial innovation in financial markets. This study uses the first-difference GMM to estimate the empirical results.

The empirical results demonstrate that financial innovation in the commercial banks and non-commercial banks sectors have a significantly positive effect on economic growth. These findings also support that introducing more financial innovation in commercial banks and non-commercial banks in terms of products and services, processes, technology and function can positively affect on economic growth due to it facilitates financial transactions more conveniently, reduces transaction costs, transfer risk, creates more savings, credit and equity sources. This encourages business activities, provides more capital resources and creates impulses for the economy.

For the effect of financial innovation in financial markets, this research found the significantly negative effects on economic growth. The empirical results also indicate that financial innovation in financial markets in terms of process and function innovation can negatively affect economic growth in transition countries. This is probably due to transition countries do not have robust backgrounds for financial markets as well as a shortage in regulation and financial markets' infrastructure. In this situation, adapting a variety of financial innovations could lead to a higher risk, more complexity and fragility in the financial markets causing financial crises and economic downturn.

The findings of this research imply crucial issue for policy makers in transition countries. For financial innovation in commercial banks, the positive effect on growth shows that policy makers should develop more financial innovations such as credit cards, debit cards, bank branches, ATMs, POS, mobile and internet banking. Besides increasing more product, service and process innovations, policymakers should focus on constructing financial infrastructure such as investing in technological infrastructure, upgrading payment systems and collaboration with fintech companies to provide broad technology innovations. For the positive effect of financial innovation in non-commercial banks, policy makers should enhance financial innovations in the activities of insurance companies, pension funds, mutual funds and non-bank financial institutions. In particular, policy makers should boost economic growth by facilitating financial innovation in terms of credit-generating function of pension funds, mutual funds and non-bank financial institutions. Also, policymakers in transition countries should more support the activities of insurance institutions in the private sectors by relaxing barriers such as monopolisation and the coverage of social systems. In terms of the negative effect of financial innovation in financial markets on economic growth, policymakers should examine whether the background of financial markets in terms of infrastructure and legal system is robust enough before implementing new financial innovation in stock and bond markets. Overall, transition countries should strengthen the financial system through improving a well-functioning infrastructure such as information technology network, payment systems, blockchain technology and clearing and settlement mechanisms. Also, developing the robust legal system and regulatory framework in order to protect the rights of participants and reduce systematic risks. Executive and supervision activities should be improved to ensure the transparency and stability of the financial system.

This research documented significant contributions to the effect of financial innovation on economic growth, however there might be some limitations remained. Due to the shortage of data in transition countries in the observed period, this research could not capture new kinds of financial innovation such as crypto currencies and peer to peer lending. Therefore, future works would be done by taking account of these new kinds of financial innovation. Also, the causality between financial innovation and economic growth can be examined in further research. Furthermore, due to financial innovation possibly having a negative effect on economic growth, future works would focus on this issue, such as the effect of financial innovation in financial risk and financial stability.

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