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Effect of Foreign Banking Capital on the Financial Innovativeness of the Country: Evidence from Former Soviet Union and Young EU Members Countries

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ABSTRACT

The **main hypothesis** of the paper was the assumption that the increase in the level of innovation of the financial sector in the post-Soviet states and young European Union (EU) members with an imperfect banking sector and a protracted financial crisis is accompanied by difficulties accessing financing sources and significantly depends on the volume foreign banking capital. The **aim** of the study is to identify the correlation between the growth of financial innovativeness of the country and the level of foreign banking capital, using Panel data analysis from 2009 to 2019. Unlike previous studies, it was taken into account that the level of financial innovation of the republics of the former Soviet Union is increasingly dependent on external credit resources, while the innovative development of the EU countries becomes financially independent, and this constitutes the **scientific novelty** of the research. The **results** confirm the relationship between foreign banking capital and the growth of financial innovativeness of the country, especially with its low and medium levels. To test his hypothesis, the author presented empirical **models** with the conditions of interaction with the Financial Innovativeness Index. Based on a comparison of indicators of the financial innovation of the country and foreign banking capital, clusters of countries are distinguished according to the nature and direction of the relationship of the analyzed indicators. The author **concludes** that the increase in the level of innovation in the financial sector of the countries of the former Soviet Union and young EU members depends on the amount of foreign banking capital and the need to consistently expand the tools for the country's economic growth by attracting it.

Keywords: financial sector; foreign banking capital; financial innovations; financial innovativeness; financial services market; innovative development; investments; competitiveness; national economy; post-Soviet states; young EU members; Indexed parameters; Vector AutoRegression (VAR) model

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INTRODUCTION

The innovation of the financial sector has a positive impact on the business environment efficiency, contributes to the country's economic growth, its economic and financial development stability. Today, the innovations in the country's financial system plays a multifaceted role, manifested both in economic (diversification of financial services, efficient allocation of resources, acceleration of the production cycle, the reduction of financing and transaction costs) and social (facilitating access to financial services, financial information) points of view.

Recently, theoretical and practical issues pertinent to financial innovativeness get immense attention among researchers, state regulators, financial intermediaries, central banks, and financial institutions by admitting its critical role in fostering the financial sector. Innovations in the financial sector, according to the World Bank and IMF, are one of the key aspects of doing the financial system more efficient and competitive.

At the same time, the previous studies focus mainly on a more general analysis of the countries' innovativeness indicators in the context of their financial development, defining the main determinants of its achievement. Scientists proved the significant dependence of the financial innovation level of the country on indicators of economic development, political, demographic situation in the country [1–3]. These constituents are those which have a positive impact on the financial innovativeness of the developing countries since it is often the basic source of funding for innovation development and, therefore, has a stimulating effect on economic growth.

Despite the fact that the problem of increasing the level of financial innovativeness is investigated by researchers, existing studies have largely failed to offer a unified theoretical basis for determining the main mechanisms for innovative activity growth in the country's financial sector. One of the tools to achieve these goals is to attract foreign capital. Unfortunately, these aspects of innovative development of the financial sector in the economy are poorly studied and have not been actively reflected in the scientists' works.

Our research aims to address these unresolved issues in two ways. Based on the analysis of 12 international indexes characterizing the level of the country's economic development and its digital technology development, we define the financial innovativeness level of the country; using Panel data analysis, we will evaluate the correlation between the level of the country's financial innovativeness and the foreign banking capital level.

Previous studies combine both EU and non-EU countries. In the present paper, we focus on former republics of the USSR[1] and young EU members.[2] This article aims to investigate the relationship between the foreign banking capital and financial innovativeness based on the hypothesis that an increase in the innovativeness level of the financial sector of the former Soviet Union countries and young EU members with an imperfect banking sector and a protracted financial crisis is accompanied by difficulties accessing funding sources, and significantly depends on the volume of foreign banking capital; to develop and approve an approach to assessing the level of financial innovativeness of the country.

THEORETICAL BACKGROUND

Financial innovativeness and economic development

Innovative development is an important component in the functioning of any economy, increasing its competitiveness, ensuring sustainable economic growth. In the constant transformations of forms and types of economic activity, mutual relations with contractors, innovations are the driving force to form steady competitive advantages of the economic subject. The innovation is also a way of ensuring the competitiveness and efficiency for financial sector players. According to J. Schumpeter [4], innovation is crucial for the country's growth, is a stimulus to its economic development.

Today, there are many scientific papers exploring the role of financial innovation in the country's economic development [1, 2, 5–9], increasing business competitiveness [3, 10, 11], the formation of demand in the money market [12, 13], the functioning and digitalization of the financial market [14–25], banking sector [26–37] and international banking [38–42], etc. Valuable information on these

[1] Russian Federation, Ukraine, Belarus, Moldova, Kazakhstan, Uzbekistan, Tajikistan, Turkmenistan, Kyrgyzstan, Azerbaijan, Georgia, Armenia, Lithuania, Latvia, Estonia.

[2] Since 2004 — Croatia, Bulgaria, Romania, Slovenia, Czech Republic, Slovakia, Poland, Malta, Hungary, Cyprus.

issues is also contained in the reports of the OECD[3] and Pricewaterhouse Coopers.[4]

According to the results of the study, it is possible to conclude that the financial innovation diffusion in the economic sphere has several manifestations. According to M. Miller [43], financial innovations form a critical and persistent ingredient for economic progress. Author claims that the financial markets that actively implement financial innovation can produce financial instruments aimed at managing assets by transferring and minimizing financial risks.

The active introduction of innovations in the financial services market leads to changes in the technology of conducting financial transactions, a significant increase in the share of non-cash payments, and the online banking and mobile banking development [44, 45]. The financial innovation development contributes to the diversification of financial services, replacing traditional financial intermediaries and providers of individual financial services to the consumer's needs [46].

According to the results of empirical research [47–49], concluded that higher innovation activity is typical of countries with higher levels of economic development.

At the same time, B. Ślusarczyk, A. Haque [50] emphasized a more comprehensive study of the financial innovation role in the country's development. In their opinion, it is important to consider the interdependence of financial sector innovation with certain components of their business environment, including the social, demographic, political, ecological and other dimensions. L. Kozubikova, A. Kotaskova [51] argued about the multi-channel diffusion of financial innovations in certain areas of the country's development, emphasizing their significant impact on the efficiency of public administration and the development of social spheres in the country.

Based on empirical calculations, V. Bhatt [52] confirmed a direct link between financial innovation and the development of the financial sector in the economy. In particular, the authors proved their role in accelerating the development of the country's financial sector, diversifying investments, and minimizing risks, by accumulating capital in the financial system, encouraging people to save etc.

In general, according to the analysis of the financial innovation relationship with the country's development indicators, we can identify 4 vectors of their impact. First, financial innovation increases the quality of financial services [53], the speed of their provision, accessibility for all segments of the population (internet banking and mobile banking services). Second, financial innovation is the tool for improving the institutional environment in a country [54]. Third, financial innovations contribute to the development of the corporate sector of the economy (trade efficiency and efficiency in financial institutions of dealing with a customer capital accumulation, financial reporting, customer interaction techniques) [55].

At the same time, today it is difficult to understand the nature of the relationship between financial innovation and the country's development indicators. According to the first hypothesis, financial innovation promotes economic growth by allowing financing expansion [56; 57]. Second hypothesis, financial innovations are not imperative to ensure economic progression [58]. Some authors deny the usefulness of most financial innovation because it leads to financial malpractice and instability [59–62]. The authors believe that not all financial innovation will be welfare-enhancing or successful. In this context, M. Kapidani, E. Luci [63] prove that financial innovation relates to more volatile economic growth and with greater bank fragility. Third, the feedback hypothesis states a two-way relationship between indicators [64]. A. Bara, C. Mudzingiri, using data from the banking, sectoral and national levels for 32 countries, mostly high-income, for the period 1996–2006, assessed the relationship between financial innovation in the banking sector and real sector growth and bank fragility. The authors argue that higher levels of financial innovation are due to the country's growth potential, capital growth and GDP per capita, as well as higher growth rates in industries that rely more on external financing and are more dependent on innovation. On the other

[3] OECD. Financial Markets, Insurance and Private Pensions: Digitalisation and Finance. 2018. 108 p. URL: http://www.oecd.org/finance/Financial-markets-insurance-pensions-digitalisation-and-finance.pdf (accessed on 29.03.2022).

[4] Pricewatherhouse Coopers. Implications of Fintech Developments for Banks and Bank Supervisors. Redrawing the Lines: FinTech's Growing Influence on Financial Services. Global FinTech Report 2017; 2017. 18 p. URL: (accessed on 24.02.2022).

hand, financial innovations relate to higher volatility of growth rates of industries dependent on external financing and innovation, and with higher fragility of banks, higher instability of bank profits and higher losses of banks during the crisis.

S. Lyeonov et al. [65], based on OLS and GMM estimators,[5] conclude a positive and significant relationship between global growth opportunities of a country and a higher level of financial innovation and GDP growth. Their calculations are based on expenditure data for the financial intermediation industry as a Financial Innovation proxy for bank, industry, and country-level data in 32 countries.

Buriak A. et al. [66], based on an investigation of the financial innovation impact on savings and domestic savings for twenty countries during 2005–2014, conclude that level of financial innovation and financial access are important parameters affecting both indicators.

Measurement of financial innovativeness of the country

M. Qamruzzaman, W. Jianguo [2] developed a financial innovation index as an integrated indicator that combines three indicators: the ratio of aggregate money supply to narrow money, the ratio of broad to narrow money, the percentage change in domestic credit to the private sector.

H. Shaughnessy [54] proposes to assess the level of innovation in the financial sector using the Elastic Innovation Index, as an indicator that measures innovation inputs (or capabilities), as opposed to innovation outputs (new products or new services). This index measures capability and readiness to change rather than measuring what has been achieved in the business execution process.

S. Lyeonov et al. [65] propose to use the Technological Financial Services Index as an integral indicator of the level of financial service technologization. It includes the financial component (share of population with an account in a financial institution or mobile money provider) and the technological component (share of the population using the Internet at least once a week; the share of population who use internet banking; the share of population conducting other financial transactions via the Internet; the share of population who use electronic payments; the share of population who use mobile phones to pay bills; the share of traditional loans substitution by alternative on-line financing).

The role of foreign banking capital in financial innovativeness of the country

Most scientific papers observe foreign capital as a major blessing to an economy. Foreign capital affects the national economy by attracting the necessary amount of financial resources for the introduction of new technologies, management skills.

Thus, S. Andros et al. [26] examines the relationship between the amount of borrowed capital and the innovation activity on the example of developed and emerging countries. The empirical calculations showed that larger amounts of borrowed capital coincide with stronger innovation activity. According to the study, the authors concluded that foreign banking capital is an important component of financial innovation and may therefore favorably determine national innovative capacity.

Schumpeter J. [4] emphasized the important role of bank capital in promoting innovation. The author highlighted the role of banks in promoting innovation and, accordingly, the development of the financial sector. The active attraction of foreign banking capital was associated not only with the fact that it is accompanied by attracting new investment and contributes to increasing national income and employment but also with the formation of additional benefits for the national economy, increasing exports.

Based on a panel model for 54 developing countries for the period 1980–2009, R. Crescenzi et al. [69] proved the existence of non-linear effects in the relationship between foreign investment and innovation. The paper identifies the threshold value of innovative development, below which the attraction of foreign capital has a negative impact on innovation.

S. Sandu, B. Ciocanel [68] studied the relationship between foreign capital and the country's innovative development. Based on the calculations, the authors concluded that foreign capital increases the innovative potential of businesses. At the same time, the authors emphasized the short-term effect of financing innovations with foreign capital because they are targeting immediate profit.

R. Crescenzi et al. [69] stress on positive impacts of foreign capital on the innovative performance of domes-

[5] OLS — Ordinary Least Squares, GMM — Generalized Method of Moments.

tic firms. He points out that investments generate positive spillovers through virtuous cycles of cooperation and competition. In developed countries, domestic firms with greater foreign investment have stronger innovative performance than in less developed countries [70].

The nexus between financial innovation and foreign banking capital is yet to be unleashed through empirical investigation. Empirical literature produced evidence proving the correlation between financial innovation and banking capital variables, such as banking credits, assets, profit. Therefore, with the available nexus between financial innovation and banking capital, it can be presumed that there is a relationship between foreign banking capital and financial innovations in the financial system.

MATERIALS AND METHODS

Our proposed integral Index of Financial Innovativeness is based on a linear model of calculating the service innovation in the financial sector of the economy using the weighted sum method [65]. Twelve indicators characterizing the level of national economic development and the development of its innovative technologies (Financial Development Index, Digital Economy and Society Index, Global Innovation Index, Index of Economic Freedom, Ease of Doing Business and so on), weighted by the appropriate weighting factor, are included in the index calculation [2, 22]. The international indexes, which are calculated by international experts and organizations, will be used as sub-indices that characterize the level of innovation in the financial sector. The annual values of the above indicators were used for calculations. The characteristics of the indicators selected for analysis are presented in *Table 1*.

The evaluation of the integrated Index of Financial Innovativeness will be carried out according to the following formula:

$$FII = w_{SDI} \cdot SDI + w_{HDI} \cdot HDI + w_{GCI} \cdot GCI + w_{IEF} \cdot \\ \cdot IEF + w_{GI} \cdot GI + w_{EPI} \cdot EPI + w_{DB} \cdot DB + w_{DI} \cdot DI + \\ + w_{DRS} \cdot DRS + w_{DESI} \cdot DESI + w_{FDI} \cdot FDI + w_{GII} \cdot GII, \quad (1)$$

where w_i — a weighting coefficient of indicator *i*.

Sources of information for generating input data to calculate the foreign banking capital are the official World Bank Database. Foreign banking assets among total bank assets (%) were used as an indicator of the foreign banking capital. Malta, Romania, Tajikistan, and Turkmenistan were excluded from the sample since there is no information on foreign banking assets for these countries. The data of international organizations defined in *Table 1* are used to calculate the Financial Innovativeness Index.

Determining the rank of sub-indices used as components of the Financial Innovativeness Index will be done using the Fishburn formula (*formula 2*). The priority of indices will be determined using the expert assessments [65].

$$w_i = \frac{2 \cdot (n - i + 1)}{n \cdot (n + 1)}, \quad (2)$$

where *n* is the total number of sub-indices to assess the Financial Innovativeness Index;

i — the rank of the sub-index to assess the Financial Innovativeness Index.

The use of the expert assessment method is due to the lack of complete information on the importance of the impact of each of the analyzed indicators on the level of development of the country and its ability to eliminate these shortcomings.

Based on this formula, the priority and weights for all 12 sub-indices were determined, the values of which are given in *Table 2*.

The obtained values of Financial Innovativeness Indexes will form the basis to test the hypothesis of the foreign banking capital impact on the level of innovation of the financial sector in the economy. The hypothesis will be tested using the VAR / VEC model, describing the relationship between the indicators. The choice of model depends on the characteristics of the indicators (stationary, cointegrated):

1) Vector error correction model will be used for non-stationary spatial panel data which are cointegrated (VEC model):

$$\Delta y_t = a_0 + A y_{t-1} + \sum_{m=1}^{p} A_m \Delta y_{t-m} + \sum_{n=0}^{q} B_n \Delta x_{t-n} + \varepsilon_t, \quad (3)$$

where $\Delta y_t = y_t - y_{t-1}$ is the differencing operator, A is the coefficient matrix for the first lag and are A_m, B_n the matrices for each differenced lag.

2) The VAR model will be used for stationary indicators:

$$y_t = a_0 + \sum_{m=1}^{p} A_m y_{t-m} + \sum_{n=0}^{q} B_n x_{t-n} + \varepsilon_t, \quad (4)$$

where a_0 is the vector-valued mean of the series A_m, are the coefficient matrices for each lag and ε_t is a multivariate Gaussian noise term with mean zero.

Table 1

Indexed parameters of innovation in the financial sector of the economy

Index	Methodology	Source / developers
Social Progress Index (SPI)	It includes 12 indicators organized into three categories: – Basic human needs (nutrition and basic medical care, water and sanitation, shelter, personal safety); – Foundations of wellbeing (access to basic knowledge, access to information and communications, health and wellness, environmental quality); – Opportunity (personal rights, personal freedom and choice, tolerance and inclusion, access to advanced education)	Social Progress Imperative
Human Development Index (HDI)	It is a summarized measure of average achievement in key dimensions of human development: a long and healthy life, being knowledgeable and have a decent standard of living	United Nations Development Program
Global Competitiveness Index (GCI)	It includes 103 indicators organized into 12 pillars: Institutions, Infrastructure, ICT adoption, Macroeconomic stability, Health, Skills, Product market, Labor market, Financial system, Market size, Business dynamism, Innovation capability	World Economic Forum
Index of Economic Freedom (IEF)	The Index is based on 12 quantitative and qualitative factors, grouped into four broad categories, or pillars, of economic freedom: Rule of Law (property rights, government integrity, judicial effectiveness); Government Size (government spending, tax burden, fiscal health); Regulatory Efficiency (business freedom, labor freedom, monetary freedom); Open Markets (trade freedom, investment freedom, financial freedom)	The Wall Street Journal and the Heritage Foundation
Gini Index (GI)	It is a measure of statistical dispersion intended to represent the income inequality or wealth inequality within a nation or any other group of people	Eurostat
Environmental Performance Index (EPI)	It includes 20 indicators in 9 categories: health impacts; air quality; water and sanitation; water resources; agriculture; forests; fisheries; biodiversity and habitat; climate and energy	Yale Center for Environmental Law and Policy; Center for International Earth Science Information Network; World Economic Forum
Doing business (DB)	It covers 10 areas of business regulation: starting a business, dealing with construction permits, getting electricity, registering property, getting credit, protecting minority investors, paying taxes, trading across borders, enforcing contracts and resolving insolvency	World Bank Group
Democracy Index (DI)	It includes 60 indicators within the five categories: electoral process and pluralism; civil liberties; the functioning of government; political participation and political culture	Economist Intelligence Unit
Digital Readiness Score (DRS)	It includes seven components: basic needs, human capital, ease of doing business, business and government investment, start-up environment, technology infrastructure, technology adoption	Cisco Corporate Affairs
Digital Economy and Society Index (DESI)	DESI is a composite index that summarizes relevant indicators on digital performance and tracks the evolution of countries in digital competitiveness. Includes 6 index groups: Connectivity, Human Capital/Digital Skills, Use of Internet, Integration of Digital Technology, Digital Public Services, Research and Development ICT	European Commission
Financial Development Index (FDI)	FDI is aggregate of the Financial Institutions index (Financial Institutions Depth index, Financial Institutions Access index, Financial Institutions Efficiency index) and the Financial Markets index (Financial Markets Depth index, Financial Markets Access index, Financial Markets Efficiency index)	International Monetary Fund
Global Innovation Index (GII)	The Global Innovation Index is based on 80 indicators within these categories: political environment, education, infrastructure, and business sophistication	Cornell University, INSEAD, the World Intellectual Property Organization

Source: generalized by the author.

3) VAR model will be used in a difference for nonstationary spatial panel data which are not cointegrated.

RESULTS

The initial step in analyzing the relationship between indicators is to study their stability. For this purpose, we will calculate the standard deviation, coefficient of variation, maximum, and minimum values, Financial Innovativeness Index depending on the level of foreign banking capital of the country.

The data presented in *Table 3* show significant variability in the volume of foreign banking assets in the analyzed countries. For most countries (Azerbaijan, Croatia, Cyprus, the Czech Republic, Georgia, Lithuania, Slovenia, Uzbekistan), the share of foreign banking capital for the period 2009–2019 has hardly changed. However, if for Croatia, Lithuania and other countries with high indicator it is an index of confidence from foreign investors and the banking system stability, for countries with low values (Uzbekistan, Azerbaijan, etc.) this situation may indicate the absence of positive changes in the banking service market and the need to implement measures aimed at increasing confidence from foreign partners. In most former Soviet Union countries, the share of the foreign banking assets among total bank assets is low and on average does not exceed 10%.

One of the tools to increase the country's investment attractiveness is to increase the level of financial inclusion and transparency of financial transactions, facilitating access to financial services, which can be achieved by increasing the level of innovation in the financial sector.

The interdependence between the level of financial sector technologicalization and the amount of foreign banking capital shown in *Fig. 1* demonstrates the existence of a straightforward relationship between them. With the increase in the share of foreign banking capital, the level of innovation is also increasing in the country's financial sector.

We will analyze the relationship between certain indicators in terms of groups of countries depending on the Financial Innovativenes Index (0–20; 20–40; 40–60; 60–80; 80–100%) using economic mathematical tools to verify the validity of the established dependencies.

At the first stage, we analyze the stability of the Financial Innovativeness Index of the country using the statistical analysis. The results in *Table 4* indicate a significant deviation of the indicators over the years. The standard deviation of the analyzed countries is characterized by a significant scale. If for countries with a foreign banking capital 20–40% the variation scope of the Financial Innovativeness Index is 0.5033, for other countries its value is more than 7. The greatest variability has indicators for countries with a foreign banking capital of more than 60%. For most of these countries, there has been a significant increase in the Financial Innovativeness Index over the past 11 years. One of the reasons for this situation may be the availability of better financial opportunities to finance innovative development, including through access to foreign banking capital.

Table 2

Weighting coefficients to assess the Index of Financial Innovativeness

Sub-index	The rank of the sub-index, *i*	Weighting coefficient, w_i
SPI	3	0.128205
HDI	4	0.115385
GCI	5.5	0.096154
IEF	5.5	0.096154
GI	2	0.141026
EPI	1	0.153846
DB	7	0.076923
DI	8	0.064103
DRS	10.5	0.032051
DESI	10.5	0.032051
FDI	9	0.051282
GII	12	0.012821

Source: compiled by the author.

The correlation analysis carried out using the Multiple regressions method indicate the influence of the foreign banking capital on the Financial Innovativeness Index in terms of all groups of countries. Most results are statistically significant at 0.1% and 0.05%. The results of the calculations are shown in *Table 5*.

The multiple regression method is given by:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \cdots + \beta_k X_{ki} + u_i, i = 1, \cdots, n. \quad (5)$$

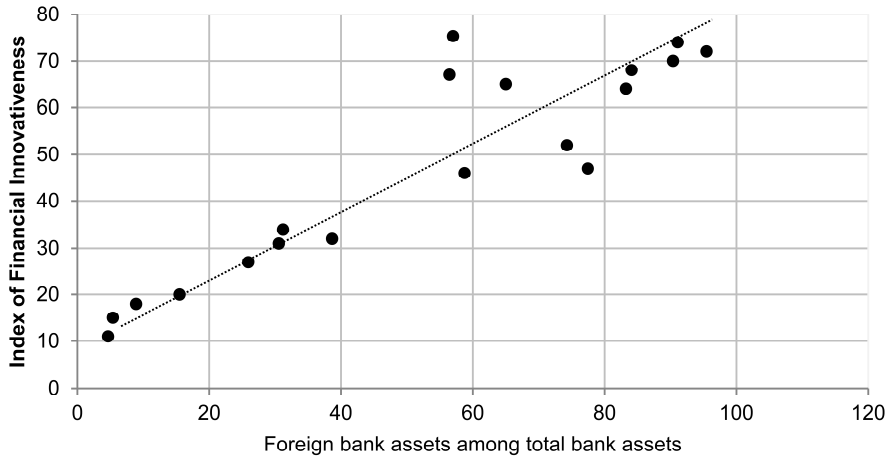

Fig. 1. **Correlation zone of foreign banking capital and the Financial Innovation Index**

Source: compiled by the author.

Table 3

Foreign banking assets among total bank assets (%) from 2009 to 2019**

Country	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Armenia	71	84	84	83	85	86	88	88	86	86	84
Azerbaijan	5	5	4	4	4	4	4	5	5	6	5
Belarus	24	27	31	33	31	31	32	32	31	33	31
Bulgaria	82	79	73	70	62	60	60	57	57	56	55
Croatia	90	90	90	90	90	90	90	91	91	91	91
Cyprus	19	12	*	*	*	16	15	15	15	16	16
Czech Republic	83	83	82	81	85	83	83	82	87	*	*
Estonia	99	99	97	97	97	95	95	93	93	93	92
Georgia	67	65	62	64	64	66	66	65	65	65	66
Hungary	64	63	63	59	56	53	53	52	52	53	53
Kazakhstan	18	16	18	17	13	12	13	13	11	11	12
Kyrgyzstan Latvia	* 68	* 66	71 60	76 60	79 58	* 57	* 57	* 55	* 56	* 56	* 53
Lithuania	92	90	89	94	91	90	89	92	92	93	90
Moldova	41	41	46	39	27	24	24	26	26	25	24
Poland	73	73	72	76	76	77	73	*	*	*	*
Russian Federation	12	10	10	10	8	8	7	8	8	9	8
SlovakRepublic	86	86	87	78	75	75	73	73	74	73	72
Slovenia	25	24	24	26	25	25	27	27	27	29	26
Ukraine	57	54	55	36	28	31	36	34	32	31	31
Uzbekistan	5	5	6	6	5	6	6	5	5	5	5

* no data. **banks where more than 50 percent of shares are owned by foreigners.

Source: based on the World Bank (for 2009–2013), Bank Focus database (for the countries of the former Soviet Union), the official website of Statista (for the Czech Republic and Poland for 2014–2019); the official website of Deutsche Beratergruppe Ukraine (for Ukraine for the period of 2014–2019); European Investment Bank (for Belarus after 2013) data; calculated by the author based on European Banking Federation; Trading Economics (for other countries) data and official statistics of relevant countries' central banks.

Table 4

Descriptive statistics of Index of Financial Innovativeness for the period from 2009 to 2019

Group	Mean	Std. Dev.	Max	Min
Countries with the level of foreign banking capital 0–20%	11.84444	7.572666	18	4
Countries with the level of foreign banking capital 20–40%	21.46667	.5033223	57	24
Countries with the level of foreign banking capital 40–60%	29.5	7.778175	74	53
Countries with the level of foreign banking capital 60–80%	27.96	9.612648	86	62
Countries with the level of foreign banking capital 80–100%	33.2	9.613532	91	71

Source: compiled by the author.

Table 5

Multiple regressions (OLS) for foreign banking capital and the Financial Innovativeness Index in the post-Soviet states and young EU countries

Group	OLS	cons
Countries with the level of foreign banking capital 0–20%	1.49403**	1.33247**
	(0.28549)	(0.11563)
Countries with the level of foreign banking capital 20–40%	2.78212*	2.6477***
	(0.63758)	(0.1435)
Countries with the level of foreign banking capital 40–60%	2.82884**	2.31124*
	(0.67351)	(0.19626)
Countries with the level of foreign banking capital 60–80%	4.09876**	3.29025**
	(4.38755)	(0.83115)
Countries with the level of foreign banking capital 80–100%	1.42545**	1.3125**
	(0.2758)	(0.10256)
*p<.05 ** p<.01 ***p<.001. Standard errors within parentheses		

Source: compiled by the author.

According to the obtained results, the greatest influence on the Financial Innovativeness Index is made in the countries with the level of the foreign banking capital from 60 to 80%. Countries with the level of foreign banking capital in the range of 0–20 and 80–100% have the lowest correlation coefficient.

The group of countries with high Financial Innovativeness Index includes economically developed countries — young EU members, which have a high potential for self-financing of innovation and investment development measures. The insignificant values of the regression coefficient for the former can be explained by the low share of foreign banking capital in the country, the volume of which during the analyzed period was almost at the same level, and hence its insignificant impact on the result.

We check the all-time series for stationarity using the Dickey-Fuller test (ADF test) to build a model of the Financial Innovativeness Index dependence on the foreign banking capital (*Table 6*).

We use Augmented Dicky-Fuller test (1981) to testify variables stationery and integration order. It is conducted by the consideration of n_{th} order difference of the seven variables.

$$x_t = D_t\gamma_1 + \gamma_2 x_{t-1} + \sum_{i=1}^{n}\pi_i \Delta x_{t-1} + \varepsilon_t, \qquad (6)$$

where D_t is a vector of deterministic term (constant, trend etc.), n for lagged difference term, Δx_{t-i} term for

Table 6

The testing results of the data group for stationarity by the Dickey-Fuller and Philips-Perron tests

Groups	ADF Test Statistics			Philips Perron Test Statistics		
	Prob.	lag	Test statistic	Prob.	lag	Test statistic
Countries with the level of foreign banking capital 0–20%	0.9785	1	0.1163**	0.9785	1	0.1163**
Countries with the level of foreign banking capital 20–40%	0.0750	1	–3.7338**	0.7222	1	–3.1178*
Countries with the level of foreign banking capital 40–60%	0.0105	0	–3.4587**	0.0105	0	–3.4587**
Countries with the level of foreign banking capital 60–80%	0.0001	0	–4.6919***	0.0001	1	–4.6919***
Countries with the level of foreign banking capital 80–100%	0.4268	2	–3.7405**	0.5007	1	–3.5977**
*p < .05 ** p < .01 ***p < .001						

Source: compiled by the author.

ARMA structure of the error and ε_t is for white nose (error term).

According to the results, most indicators are non-stationary. The absolute calculated value is less than the critical value at 1%, 5%, and 10% significance levels. Thus, the ADF test statistic for countries with the foreign banking capital less than 20% is 0.1163, is less than the critical value (–2.66) and indicates the non-stationarity of the analyzed data. For other countries, the obtained values are more than critical. The results of the Philips-Perron Test Statistics allow us to reject the unit root null hypothesis for stationary of all indicators within all groups of countries at the 10% level of significance.

For most indicators, p-value[6] does not allow to reject the null hypothesis about a single root in the time series. The first difference of the series (*Table 7*) is fixed for all groups of countries, allowing to conclude about first-order integration (I (1)).

The absolute value of t-statistics in the first differences exceeds the critical values for the significance level of 1%, 5%, and 10% and the p-value for all indicators is less than 10%. It allows us to reject the null hypothesis about the nonstationarity of the first differences in the data series with a minimum error probability (almost 0% of cases with 100%). Thus, the series in the first difference is stationary and has the order of integration — 1.

At the next stage of forming a relationship model between the Financial Innovativeness Index and the volume of foreign banking capital we will test the hypothesis of the indicator cointegration from rank 0 to rank k — 1 by Johansen tests (the alternative hypothesis is the cointegration of the data). If the hypothesis is not rejected for rank 0, then the rank is considered to be null (no co-integration) and so on to k — 1. If the trace statistic is more than 5% critical value it allows us to accept the alternative hypothesis of data co-integration.

According to the results shown in *Table 8*, for all countries the values obtained for 0 rank are critical values. It enables to accept the hypothesis of analyzed data series co-integration. For example, for countries with the foreign banking capital level from 0 to 20%, the trace statistic is 31.253 and exceeds 5% (15.41) and 1% critical value (20.04), for 20–40%, it is 27.841, for 40–60% — 17,841. At the same time, rank 1 is lower than the 5% critical value for countries with the foreign banking capital level more than 40%.

Confirmation of the hypothesis about the stationary and the data cointegration indicate the expediency of formalizing the relationship between the Financial Innovativeness Index and the volume of foreign banking capital by the VAR model.

For the construction of the VAR model, we will determine the time lag through which this effect is max-

[6] p-value — a value used in testing statistical hypotheses. In fact, this is the probability of error when rejecting the null hypothesis (error of the first kind).

Table 7

The first differences of the data series for stationarity by the Dickey-Fuller test

Groups	ADF Test Statistics		
	Prob.	lag	Test statistic
Countries with the level of foreign banking capital 0–20%	0.0125	0	–3.3562**
Countries with the level of foreign banking capital 20–40%	0.0178	0	–3.9585**
Countries with the level of foreign banking capital 40–60%	0.0014	0	–3.6454***
Countries with the level of foreign banking capital 60–80%	0,0058	0	–4,6919***
Countries with the level of foreign banking capital 80–100%	0.0405	0	–4.125***
*p <.05 ** p <.01 ***p <.001			

Source: compiled by the author.

Table 8

Johansen tests for cointegration

Groups	Rank	5% critical value	1% critical value	Trace statistic
Countries with the level of foreign banking capital 0–20%	0	15.41	20.04	31.253
	1	3.76	6.65	9.039
Countries with the level of foreign banking capital 20–40%	0	15.41	20.04	27.841
	1	3.76	6.65	8.790
Countries with the level of foreign banking capital 40–60%	0	15.41	20.04	17.841
	1	3.76	6.65	1.792
Countries with the level of foreign banking capital 60–80%	0	15.41	20.04	19.746
	1	3.76	6.65	1.589
Countries with the level of foreign banking capital 80–100%	0	15.41	20.04	17.842
	1	3.76	6.65	1.965

Source: compiled by the author.

imum and their optimal structure. These calculations are based on tests for maximum lag and exclusion.

The results indicate that for countries with a foreign banking capital from 0 to 40%, from 80 to 100% the maximum lag is 5 years, 40 to 80% — 6 years (*Table 9*). The VAR model with these lags has the best values for the Akaike, Hannan-Quinn, Schwar'z Bayesian criteria among other considered model specifications.

These dependences indicate a certain gap in time between the growth of the foreign banking capital share and the increase in the level of the country's financial innovation. However, given the fact that the implementation of any innovation is a long-term process that involves the development and design of innovation, its testing and implementation, the presence of time lag is a natural and only confirms our hypothesis about the relationship between these indicators.

In doing so, the obtained data correspond to the results of the study by [68], regarding the impact of foreign banking capital on the level of the country's financial innovation with a certain time lag. At the same time, empirical calculations confirmed the

Table 9

The maximum lag of the impact of the foreign banking capital on Financial Innovativeness Index*

lag	LL	LR	df	p	FPE	AIC	HQOC	SBIC
Countries with the level of foreign banking capital 0–20%								
0	125.185	.	27		1.63E-18	–33.9721	–34.5721	–34.0207
1	1104.778	.	27		–2.01E-91			
2	1667.18	–15.879	27		–2.30E-84*	–463.92	–468.12	–464.259
3	1659.761	10.129	27			–461.651	–465.851	–461.991
4	1664.825	33.728	27	1.258		–463.098	–467.299	–463.439
5	1681.687	22.547	27	0.457		–467.917*	–472.117*	–468.256*
6	1692.958	28.965	27			–471.137	–475.338	–471.478
Countries with the level of foreign banking capital 20–40%								
0	130.5956		27		4.65E-19	–35.5181	–36.1181	–35.5666
1	842.8112	1424.36	27		1.88E-84*	.	.	.
2	1676.824	1668.0*	27			–466.528	–470.729	–466.868
3	1684.552	15.444	27	1.236		–468.735	–472.935	–469.074
4	1674.236	–20.635	27	1.123		–465.787	–469.988	–466.126
5	1685.909	23.3533	27	1.026		–469.123*	–473.322*	–469.462*
6	1683.383	–5.0422	27			–468.402	–472.602	–468.742
Countries with the level of foreign banking capital 40–60%								
0	148.1919	.	27		3.28E-19	–40.3038	–40.9846	–40.3588
1	956.371	.	27		1.18E-79*	–261.028	–265.113	–261.358
2	1902.759	.	27			–529.388	–534.155	–529.773
3	1911.527	17.5259	27			–531.892	–536.658	–532.277
4	1899.821	–23.415	27	1.402		–528.547	–533.313	–528.932
5	1913.067	26.4999	27	1.164		–469.123	–473.322	–469.462
6	1910.201	–5.7215	27			–531.514*	–536.28*	–531.9*
Countries with the level of foreign banking capital 60–80%								
0	111.9442		27		1.46E-18	–30.3789	–30.9154	–30.4224
1	987.9253		27	0.000	–2.01E-91*			
2	1491.309		27	0.000		–173.921	–176.643	–174.141
3	1484.208	–14.200	27	0.984		–352.727	–355.903	–352.984
4	1488.736	9.05846	27	1.1224		–354.396	–357.571	–354.652
5	1503.815	30.1607	27	0.4089		–352.167	–355.343	–352.423
6	1513.894	20.163	27	0.9494		–347.222*	–350.33*	–347.473*
Countries with the level of foreign banking capital 80–100%								
0	158.3119		27		2.07E-18	–42.962	–43.7207	–43.0234
1	1397.128	1254.68	27		–2.54E-91*	–258.965	–239.854	–398.58
2	2109.016	1258.9*	27			–402.076	–405.717	–402.37
3	2098.974	–20.081	27	0.8658		–400.109	–403.75	–400.405
4	2105.377	12.8105	27	1.5874		–401.364	–405.005	–401.659
5	2126.702	42.6535	27	0.5783		–405.54*	–409.181*	–405.834*
6	2140.955	28.5146	27	1.3427		–408.331	–411.972	–408.627
*p < .05								

Source: compiled by the author.

* LL – log-likelihood function; LR – the likelihood ratio test; df – calculate degrees of freedom for fixed effects; p – p-value; FPE – final prediction error; AIC – Akaike information criteria; HQOC – Hannan-Quinn information criteria; SBIC – Schwar'z Bayesian information criteria.

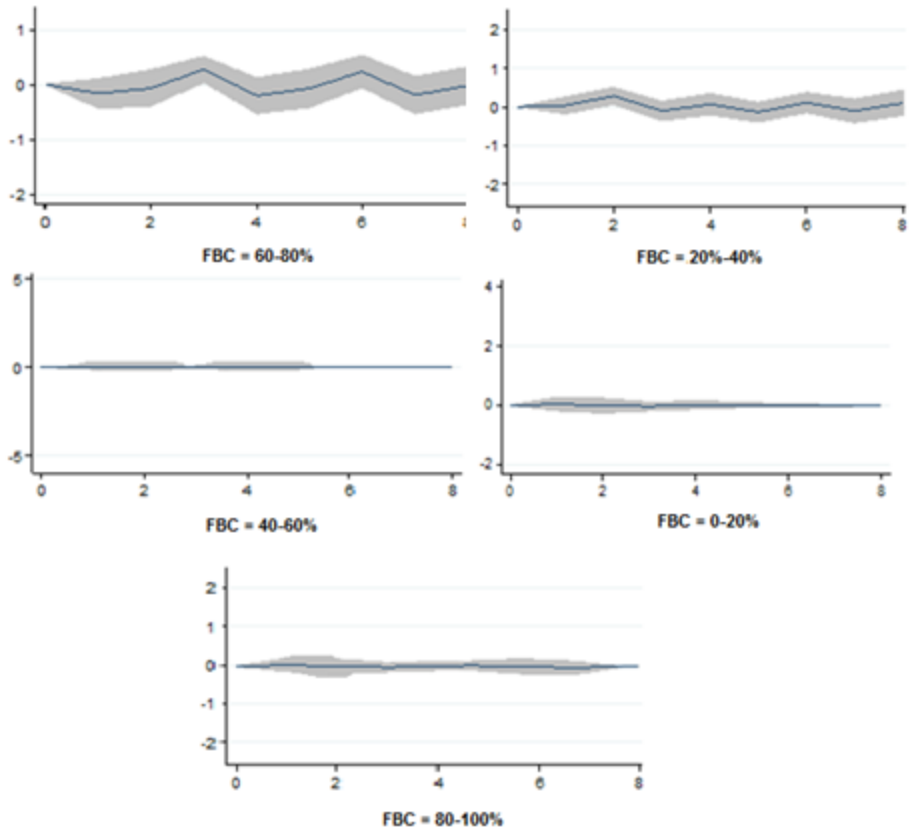

Fig. 2. **Impulse function of the Index of Financial Innovativeness response to the shocks of the foreign banking capital**

Source: author's calculations using Stata 14 software.

long-term effect of foreign capital due to financing innovations. Simultaneously, the authors insisted on a small time lag (not more than 3 years) between them.

The determination of the number of lags and cointegration relations form a VAR model, describing and confirming the relationship between the foreign banking capital and Financial Innovativeness Index of the national economy.

This model reflects the dependence of the differences in the values of the Financial Innovativeness Index on the lag differences in the values of both the same indicator and other parameters. The model can be written as follows:

$$D(FI) = f(D(FI(L)), D(FBC(L)), \quad (7)$$

where $D(FI)$ — the differences in the series of Financial Innovativeness Index; $D(FI\,(L))$ — lag differences of the Financial Innovativeness Index of series; $D(FBC(L))$ — lag differences of the foreign banking capital series.

All model variables are endogenous. Exogenous variables were not included. Graphs of responses of the model parameters to single and accumulated shocks of the foreign banking capital were constructed to visualize the simulation results. The model assumes that other parameters are not changed. Graphs of single shocks are demonstrated in *Fig. 2*.

The established interdependencies correlate with the regression coefficients given in *Table 5*, obtained using the OLS method. Thus, according to the results of the analysis, we can conclude that the growth of the foreign banking capital share is an important component of increasing the financial innovation level for those countries where this value is in the range of 20–40% and 60–80%. At the same time, for countries with the foreign banking capital of 0–20% and 40–60%, a change in its level has an insignificant effect on the Financial Innovativeness Index.

Testing the model for normality, autocorrelation, stability, using the Lagrange-multiplier test, Jarque-Bera test and eigenvalue stability condition confirmed the reliability of the results. According to the stability test of the underlying VAR model,

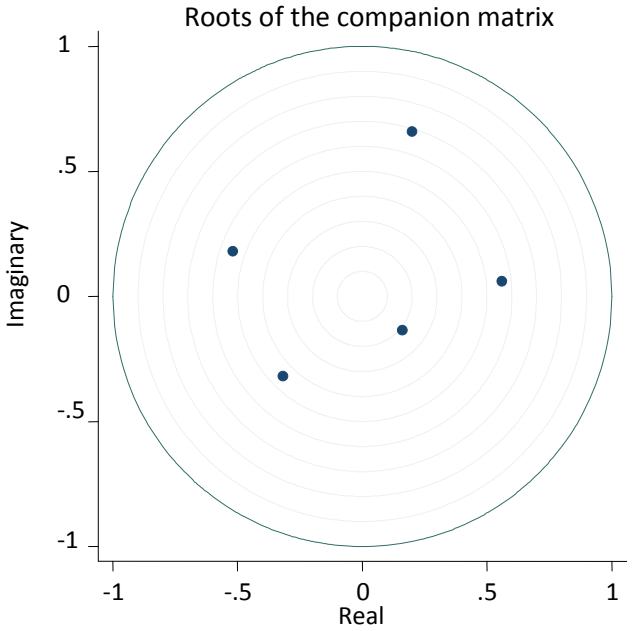

Fig. 3. **Results of VAR model validation using Eigenvalue stability condition test**

Source: compiled by the author.

all the eigenvalues lie inside the unit circle (*Fig. 3*). It implies that the estimated model is dynamically stable.

Since the estimated VAR passed all the diagnostic tests, we can conclude about bidirectional causality between foreign banking capital and Financial Innovativeness Index. It means that foreign banking capital increases the level of the country's financial innovativeness, and high level of financial innovativeness causes foreign banking capital attraction.

CONCLUSIONS

Assessment of the innovative development level in the financial sector involves the analysis of its level dependence on the structure of funding sources for activities. One of the indicators is the amount of bank capital. Meanwhile, a lack of understanding of the relationship between the level of the country's financial innovativeness and the foreign banking capital volume can affect the stability of the financial sector and reduce its economic growth.

Considering the lack of research on the impact of foreign banking capital on the level of financial innovativeness of the former Soviet Union and young EU members countries, our study sheds light on the nature of this connection. According to the analysis results, the increasing level of innovation in the financial sector in post-Soviet countries and young EU members depends significantly on the amount of foreign banking capital. Thus, our results are consistent with the research of previous scientists [19, 26, 68] regarding the importance of foreign banking capital in the growth of national innovation potential.

The scientific value of the research is the expansion of tools to increase the financial innovation of the country. The study complements the results of the previous scientists' analysis and along with traditional tools (stimulating business to finance innovation, GDP growth) justifies the feasibility of attracting foreign banking capital as one of the key tools to increase the innovation level in the financial sector.

The conducted research has certain practical implications. Unlike previous studies, this research suggests a significant dependence of the financial innovativeness level of the former Soviet Union countries on external credit resources, while the EU is financially independent. Namely, public authorities must consider the established interdependencies in the implementation of their investment and monetary policy. At the same time, they should continuously implement measures aimed at increasing the innovation of the financial sector, update their investment and innovation policies.

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