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THE IMPACT OF FINTECH DEVELOPMENT ON BANK PERFORMANCE: EVIDENCE FROM CROSS-COUNTRY PANEL REGRESSIONS

ВПЛИВ ФІНАНСОВИХ ТЕХНОЛОГІЙ НА ДІЯЛЬНІСТЬ БАНКІВ: ЕМПІРИЧНІ ДОКАЗИ З МІЖКРАЇНОВОГО ПАНЕЛЬНОГО АНАЛІЗУ

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The article investigates the impact of FinTech development on the performance of banks across multiple countries using cross-country panel regression analysis to supplement numerous similar country-specific studies with a global perspective. The study employs fixed-effects models to assess the relationship between FinTech adoption, measured through global indices, and key indicators of bank performance such as capital adequacy ratio, total assets, and dividend yields. Special attention is given to variations in bank size, with results indicating that FinTech development positively affects small banks, negatively influences medium-sized banks, and has little to no effect on large banks. The analysis confirms that FinTech has become a significant factor reshaping the financial sector, with heterogeneous effects depending on bank size and market structure.

Keywords: FinTech development, bank performance, cross-country analysis, panel regression, capital adequacy, FinTech adoption, bank size, bank competition.

У статті досліджено вплив розвитку фінансових технологій на ефективність функціонування банків у глобальному масштабі. Актуальність теми зумовлена зростаючою роллю фінтеху у світовій фінансовій системі та необхідністю оцінки його впливу на традиційний банківський сектор в умовах, не прив'язаних до окремих країн чи регіонів – те, чого бракує наявній економічній літературі та що може стати дієвим інструментом для формування економічної політики регулювання взаємодії банків та фінтеху. Для визначення цього впливу застосовано панельну регресію з фіксованими ефектами, що дало змогу врахувати індивідуальні характеристики банків та специфіку національних економік. У моделі проаналізовано такі показники, як адекватність капіталу (достатність для покриття нагальних потреб), динаміка цін акцій банків, витрати на капітал, ESG-рейтинг, розмір активів, бета-коефіцієнт (ризиковість) і кредитний портфель, а рівень розвитку фінтеху представлено на основі індексів EY Global FinTech Adoption Index та Findexable Global Fintech Index. Отримані результати свідчать про неоднорідність впливу фінтеху залежно від розміру банків: для великих установ статистично значущого ефекту не виявлено, що пояснюється їхньою здатністю легко інтегрувати фінтех-рішення за рахунок значних внутрішніх ресурсів, створювати власні інноваційні платформи чи поглинати фінтех-стартапи з уже готовими рішеннями; для середніх банків спостерігається негативний вплив, адже вони перебувають у безпосередній конкуренції з фінтех-компаніями, які пропонують клієнтам швидші й зручніші сервіси; а малі банки, навпаки, відчувають позитивний ефект від поширення фінтеху, оскільки співпраця з інноваційними компаніями відкриває для них нові можливості розвитку, а у пряму конкуренцію із фінтех-компаніями вони не вступають. Результати також свідчать, що у країнах із недостатнім розвитком фінтех-сфери погіршується адекватність капіталу банків, що вказує на пряму залежність стабільності банківської системи від рівня розвитку фінансово-технологічної інфраструктури. Через значну кількість банків із США у панелі даних, було прове-

дено додаткову перевірку стійкості результатів шляхом виключення цих банків, що не змінило значним чином кінцеві результати. У підсумку доведено, що фінтех-технології виступають ключовим чинником трансформації банківського сектору, а їхній вплив залежить від масштабів і рівня розвитку фінансової інфраструктури країн.

Ключові слова: розвиток фінтеху, ефективність банків, міжкраїновий аналіз, панельна регресія, адекватність капіталу, впровадження фінтеху, розмір банку, конкуренція із банками.

Problem statement. FinTech, although a relatively recent phenomenon, has rapidly emerged as a significant force in the financial sector, operating within the domain of traditional banks while creating new customer-driven niches that compel banks to expand into these areas. Existing research has analysed this interaction extensively, yet the findings remain highly diverse and often contradictory. What is evident, however, is that banks and FinTech are not isolated but constantly interact, with traditional banks experiencing tangible effects from FinTech actors and their innovations. Still, key questions remain unresolved: do banks and FinTech primarily compete or cooperate, is the impact on bank performance positive, negative, or dependent on specific circumstances, do any quantitative indicators exist, and to what extent do bank characteristics such as size or location matter? These uncertainties highlight the need for further analysis to clarify the nature and implications of FinTech-banks interactions across countries.

Analysis of recent research and publications. Serious advancements in the study of how FinTech influences banks have been made in a number of works, typically within single-country settings and using panel-data econometrics. In China, Wang, Y., Sui, X., & Zhang, Q. found that FinTech integration improves bank performance and that adequate hardware and software investment is a precondition for successful adoption [6]. For Kenya, Ntwiga D. applied the fixed-effects panel regression for the pre- and post-COVID periods, which revealed a strong correlation between FinTech adoption rates and the quality of the decisions, directly impacting key indicators of bank performance, with this correlation being highest in post-COVID period [7]. Nguyễn, T. demonstrates similar results for Vietnam: FinTech is associated with higher profitability and stability of the bank sector, which contributes to the narrative that banks and FinTech should collaborate rather than compete [8]. On the other hand, Övenç, G., & Nabiyev, A. B. report no statistically significant overall effect of bank–fintech cooperation on ROA/ROE, but a positive ROE effect for large banks and no significant effect for small banks, bringing an additional layer for consideration – different impact of fintech on banks depending on their size [9]. Overall, the recent research and publications, including those used in the present paper, vary in terms of proxies used as input for the analysis (number of FinTech companies, country rates in the reports, etc.) and the indicators to trace the change. However, what they have in common is the idea that FinTech, one way or the other, impacts bank performance, while the direction of its impact and its extent vary with country context, infrastructure, and bank size. The common objective of these papers is, despite differences in datasets and methodologies, to examine how FinTech adoption and development influence banks' performance and stability within a specific country.

Identification of previously unresolved aspects of the general problem. While these studies serve as excellent examples of country-level or regional analysis, collectively they reveal a critical gap: their results are often controversial across each other and remain bound to specific national contexts. Consequently, they do not provide a clear understanding of general, country-agnostic patterns in how FinTech development affects banks, underscoring the need for broader comparative research.

Formulation of the article's goals (task statement). This study aims to address the identified gap by moving beyond the country-specific understanding of how FinTech influences banks toward a global perspective. Using a fixed-effects regression model applied to panel data from 40 countries, the research seeks to identify common patterns of FinTech's impact on banks that are consistent across different economies. Such an approach is intended to provide insights that transcend national contexts and may serve as a foundation for developing effective policies to regulate and enhance interactions between banks and FinTech on a global scale.

Summary of the main research material. The 21st century has been remarkably successful in terms of innovation and digitalization, drastically transforming the life of an ordinary person – from resembling the 1970s as of the early 2000s to the emergence of Generation Z, born with smartphones in the 2020s. Naturally, this trend is evident across almost all major industries, regardless of their origin – be they

among the oldest or those that emerged just 10 or 20 years ago. Consequently, digitalization has not bypassed one of the core components of human society: the financial sector, whose origins trace back to ancient times when people traded goods for other goods or monetary equivalents. It has existed in some form throughout every historical period documented in written sources. A key component of this system, particularly in its relatively modern forms over the past couple of centuries, has been banks – traditional saving and lending institutions. However, it is logical to assume that in an era of rapid transformation and the emergence of new and – judging by user experience – highly convenient solutions, traditional players are increasingly being challenged by new entrants. For banks, the most significant challenger in recent years has been the phenomenon of financial technologies, or simply FinTech. Naturally, such a fundamental element of the global economy as banks cannot be replaced within a few years or even decades. Still, the signs of fierce competition are apparent to anyone who spends five minutes observing how people pay at a supermarket.

With all its presence in day-to-day life, the term FinTech may at first glance seem easy to explain simply by breaking it down into its two components – financial and technology. However, upon deeper examination beyond the literal semantic meaning, challenges arise, as this interpretation is overly broad and fails to clearly define what the term implies in practice. This observation is supported by academic evidence, as there is no universally accepted definition of FinTech in the scholarly literature. For example, Patrick Schueffel (2016), in his work Taming the Beast, analysed over 200 definitions of FinTech developed over a 40-year period and proposed a generalised version capturing the essence of these interpretations: FinTech is a new financial industry focused on improving financial activities through the use of technology [1, p. 1]. However, for the purposes of this article, this definition is too general, and the one proposed by the Financial Stability Board will be considered as a benchmark: technology-enabled innovation in financial services that leads to new business models, applications, processes, or products, significantly impacting financial markets, institutions, or the delivery of financial services [2, p. 1].

User experience is not the sole – nor the most persuasive – piece of evidence of the growing significance of FinTech. More compelling proof lies in market figures. According to the Global FinTech Market Analysis Report, the global FinTech market – encompassing sectors such as digital payments, blockchain, online lending, personal finance applications, and others – was valued at USD 210 billion in 2024. It is projected to grow at a compound annual growth rate (CAGR) of 25%, reaching over USD 1.5 trillion by 2033 [3, p. 1]. Notably, the key drivers behind this rapid expansion have shifted over time. While pre-COVID growth was primarily fuelled by digitalisation, increasing smartphone penetration, and the global move toward cashless transactions, the pandemic catalysed a new wave of demand. Post-2020, online lending platforms, digital wallets, and contactless payment systems emerged as the dominant accelerators of FinTech adoption and investment. Such rapid growth rates in the FinTech sector can be attributed to a variety of factors, the most significant of which include the increasing number of FinTech users, as well as the rising volume and frequency of transactions. One of the most comprehensive studies on FinTech adoption – the EY Global FinTech Adoption Index Report – although published in 2019, still provides valuable and relevant insight into the scale and pace of this phenomenon. According to the report, global FinTech adoption more than doubled within just two years, rising from 33% in 2017 to 64% in 2019 [4, p. 6]. For comparison, the first edition of the report in 2015 indicated an adoption level of only 16%, underscoring the exponential nature of FinTech's expansion across consumer markets [4, p. 6].

Simultaneously, FinTech remains a highly promising destination for investment due to its ability to generate stable and steadily increasing revenue, even in the face of economic shocks. As illustrated in Figure 1 (based on [5]), despite significant fluctuations in the volume of investments, particularly the sharp decline caused by the COVID-19 shock in 2020 and the downward trend observed from 2021 to 2023 – the revenue generated by the FinTech sector shows no clear correlation with investment dynamics. Instead, it continues to grow steadily, nearly doubling over a six-year period and projected to surpass 200 billion USD after 2023 [5, p. 1].

Considering the growing significance of FinTech in the world of finance, researchers have investigated in recent years the various ways in which it impacts traditional banks and the magnitude of this impact. Among the first comprehensive attempts to quantify the impact of FinTech on banks is the study by Wang Y.

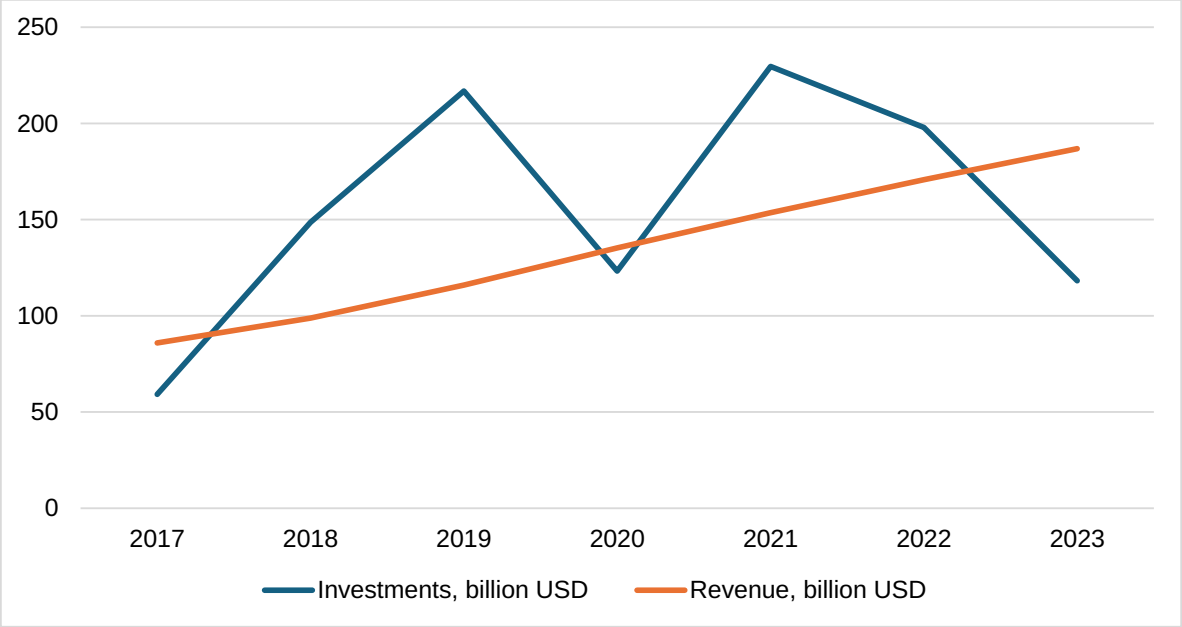

Figure 1. FinTech: investments and revenue

Source: [5, p. 1]

& Sui X. (2020), which assessed the benefits of integrating FinTech into the operations of Chinese banks by regressing total factor productivity (TFP) indicators (measured through labour and capital inputs) on a FinTech index alongside other control variables [6, p. 1]. Using a panel dataset covering the period 2009–2018 for 113 Chinese banks, the authors evaluated banks' performance through the volume of deposits and loans. In addition to confirming that FinTech integration improves bank performance, the study highlighted that sufficient investment in both hardware and software infrastructure is a critical prerequisite for the successful adoption of FinTech solutions [6, p. 1]. A similar approach was adopted by Ntwiga D. (2020) to examine the extent to which FinTech influenced the performance of the five largest banks in Kenya over the same period, with an additional distinction between the pre- and post-FinTech eras (2009-2014 and 2015–2018 respectively) [7, p. 1]. Using deposit–loan, interest expense–deposit, and loan–interest income pairs as input-output indicators, the author employed a panel regression model with fixed effects, complemented by Data Envelopment Analysis (DEA) to evaluate decision-making efficiency based on input-output factors, which revealed that the post-FinTech era exhibited significantly improved performance in terms of DEA efficiency [7, p. 2].

From the variety of recent studies, one by Nguyen T. (2025) may be highlighted as typical example of the framework and methodology: the author uses panel data from 14 Vietnamese commercial banks for 2013–2022; represent the volume of FinTech development throught he number of such companies and the google trends index while focusing on profitability (return on assets indicator, ROA) and stability (Z-score) and the core performance metrics for banks [8, p. 4]. Having applied Generalised Least Squares (GLS) regression models, the author comes to similar overall conclusions as in the previous two papers – FinTech enhances financial stability and profitability of banks, thus it should be deemed as a complement rather than a threat [8, p. 6].

On the contrary, for an emerging economy like Türkiye, with a rapidly expanding fintech ecosystem and high digital banking penetration, Övenç, G. & Nabiyev A. obtained different results. Applying the One-Step System GMM methodology to panel data from 22 commercial banks for the period 2013–2021, and using return on assets (ROA) and return on equity (ROE) as performance indicators, they concluded that cooperation with fintech does not have a statistically significant effect on ROA or ROE across Turkish banks overall. However, they noted that for large banks, collaboration with fintech positively affects ROE, while for small

banks no significant effect is observed in either indicator, suggesting the heterogeneous nature of fintech's impact on banks [9, p. 11].

In summary of the most representative examples of research papers on the topic under discussion, it can be observed that each is highly specific to the conditions of the country in which it was conducted. This results in rather controversial outcomes that are not applicable on a global scale and remain silent as to whether the observed effects reflect the overall impact of FinTech on banks in general, or are relevant only to the specific country studied. Therefore, this research aims to adopt a broader perspective on the problem and to identify common patterns in the impact of FinTech at the cross-country level.

This study, similar to the approaches of Ntwiga D. (2020) and Wang Y. and Sui X. (2020), employs a panel regression model with the fixed effects methodology, primarily due to the broader scope of banks analyzed over a shorter time frame, which limits the applicability of GMM models. The variables used include the capital adequacy ratio (CAR), share price growth rate, capital expenditure, ESG rank, total assets, beta, and gross loans. As a proxy for FinTech, the study utilizes FinTech scores for each country in which the banks under examination operate, sourced from the Findexable Global Fintech Index. 2019. The Global Fintech Index 2020 [10]. The baseline regression equation for the research is as follows:

$$cap_{adeqij} = \alpha_0 + \alpha_1 price_{changeij} + \\ + \alpha_2 div_{yieldij} + \alpha_3 ESG_{ij} + \alpha_4 country_{finrankj} + \\ + \alpha_5 \log\left(tot\_assets_{ij}\right) + \alpha_6 beta_{ij},$$

Where i – bank, j – country, cap_adeq_{ij} – bank's capital adequacy, $price\_change_{ij}$ – share price growth rate, div_yield_{ij} – dividends yield, ESG_{ij} – Environment, Social, Governance score of the bank; $country\_finrank_j$ – country's rank in the Global FinTech Adoption Index, $\log\left(tot\_assets_{ij}\right)$ – natural logarithm of the bank's total assets, $beta_{ij}$ – measure of bank's risk based on the stock fluctuations.

To validate the results of Övenç, G. & Nabiyev A. regarding the heterogeneous impact of FinTech on banks of different size, banks have been distributed according to the following methodology (Table 1).

Subsequently, this distribution is incorporated in the baseline equation:

$$cap_{adeqij} = \alpha_0 + \alpha_1 price_{changeij} + \\ + \alpha_2 div_{yieldij} + \alpha_3 ESG_{ij} + \alpha_4 country_{finrankj} + \\ + \alpha_5 \text{as.factor}\left(\text{categories}\right) + \alpha_6 beta_{ij}, \\ + \alpha_5 \text{as.factor}\left(\text{country}\right) + \alpha_6 beta_{ij}$$

The third point of analysis is to identify whether fintech's impact depends on whether the bank is in a developed or developing country by adding to the baseline equation country specific variables with the reference to the rate of countries in [10, p. 29]: if the country belongs to top-21, it is deemed to be developed, if lower – a developing one. Thus, the equation becomes as follows:

$$cap_{adeqij} = \alpha_0 + \alpha_1 price_{changeij} + \\ + \alpha_2 div_{yieldij} + \alpha_3 ESG_{ij} + \alpha_4 tot_{assetsij} +$$

Considering the presence of approximately a quarter of US banks, the regression excluding US banks will be conducted to eliminate excessive impact of the US-specific factors.

The data panel for the regression is composed of over 1500 indicators for 40 countries recorded

Table 1

Bank size distribution methodology

Size	Small	Medium	Large
Total assets, USD bln.	X < 20.	20 < X < 100	X >100
Number of the banks	379	411	316

Source: composed by the author based on [11]

Table 2

Summary of bank size distribution across the countries

Bank size / Country development	Small	Medium	Large
Developed	256	153	188
Developing	123	258	128

Source: composed by the author using [10, p. 29]

during 2018–2020 and redistributed across 11 variables for the baseline equation. The data has been retrieved in

Geographically, the scope of the research covers the majority of the countries in all regions, except for Africa, where available data is highly limited.

As a proxy for FinTech development in each respective country, the study utilizes the 2019 EY Global FinTech Adoption Index. Following data aggregation, the resulting statistics database is constructed as follows (Table 3).

As a result of the correlation analysis available at Figure 2, apart from the expected correlations among size variables such as assets, loans, capex, a negative link between fintech development and banks' stock price growth has been identified, suggesting that the FinTech development is accompanied by the decline of interest to bank shared among the investors, who consider FinTech as a more beneficial asset compared to banks. One must admit that the correlation between FinTech indicators and other variables is not high, with the

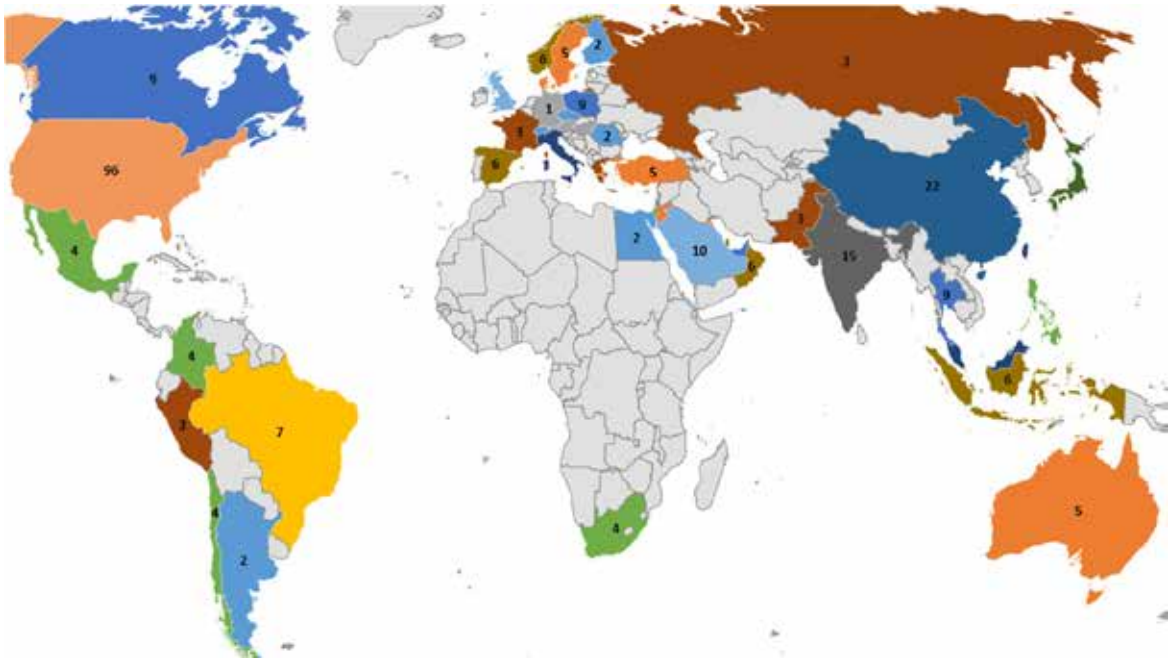

Figure 2. Map of banks presented in the dataset

Source: composed by the author using [10, p. 29]

Table 3

Descriptive statistics of variables in the dataset

	Mean	St. Dev.	Min	Max
Total assets, mln. USD	216.133	528.934	0	4,324.9
Capital adequacy, %	0.160	0.04	0	0.508
Gross loans, thsd. USD	106.073	262.312	0	2,427.3
ESG score	44.627	24.190	0.000	94.60
Capital expenditure, thsd.. USD	357.175	1,142.235	0	15,854.31
Dividends yield, %	0.035	0.023	0	0.203
Beta ROA, %	1.048 0.009	0.404 0.021	-0.759 -0.371	2.957 0.229
Country fintech rank	26.667	30.842	1	153
Country Fintech investments, mln. USD	5,839.911	7,543.629	0.530	37,761.9

Source: composed by the author using [4]

FinTech investments and dividend yields being the most connected variables within the group. Another interesting observation is that CAR is concentrated around 15%, which corresponds to the indicator of 13% set by the Basel Committee [12].

After the confirmation that fixed-effects panel regression is the most suitable one, done via the Hausman test, such panel regression for total assets have been conducted, revealing that while log total assets significantly and positively affect capital adequacy, dividend yield shows an unexpectedly negative impact, and after correcting for clustering by country, previously observed significance of FinTech rank on total assets disappears – indicating the presence of clustering bias.

The next step was to add a variable of the country FinTech development represented by its place in the FinTech rank and to apply a fixed-effects regression model (Table 5), the main result of which is the conclusion that developing countries, typically ranking lower in FinTech development, have a statistically significant negative impact on the capital adequacy ratio of domestic banks.

The third stage of the analysis was to introduce into the regression a bank size variable, which revealed that FinTech positively impacts small banks, potentially due to the fact that they do not engage in direct competition and rather supplement each other. On the contrary, FinTech has a statistically significant negative impact on medium banks, as they face direct competition with FinTech firms but lack resources to acquire them or compete on their internal capabilities. In the continuation of this logic, large banks do not experience significant impact as they can acquire FinTech companies to gain the necessary expertise or lead the

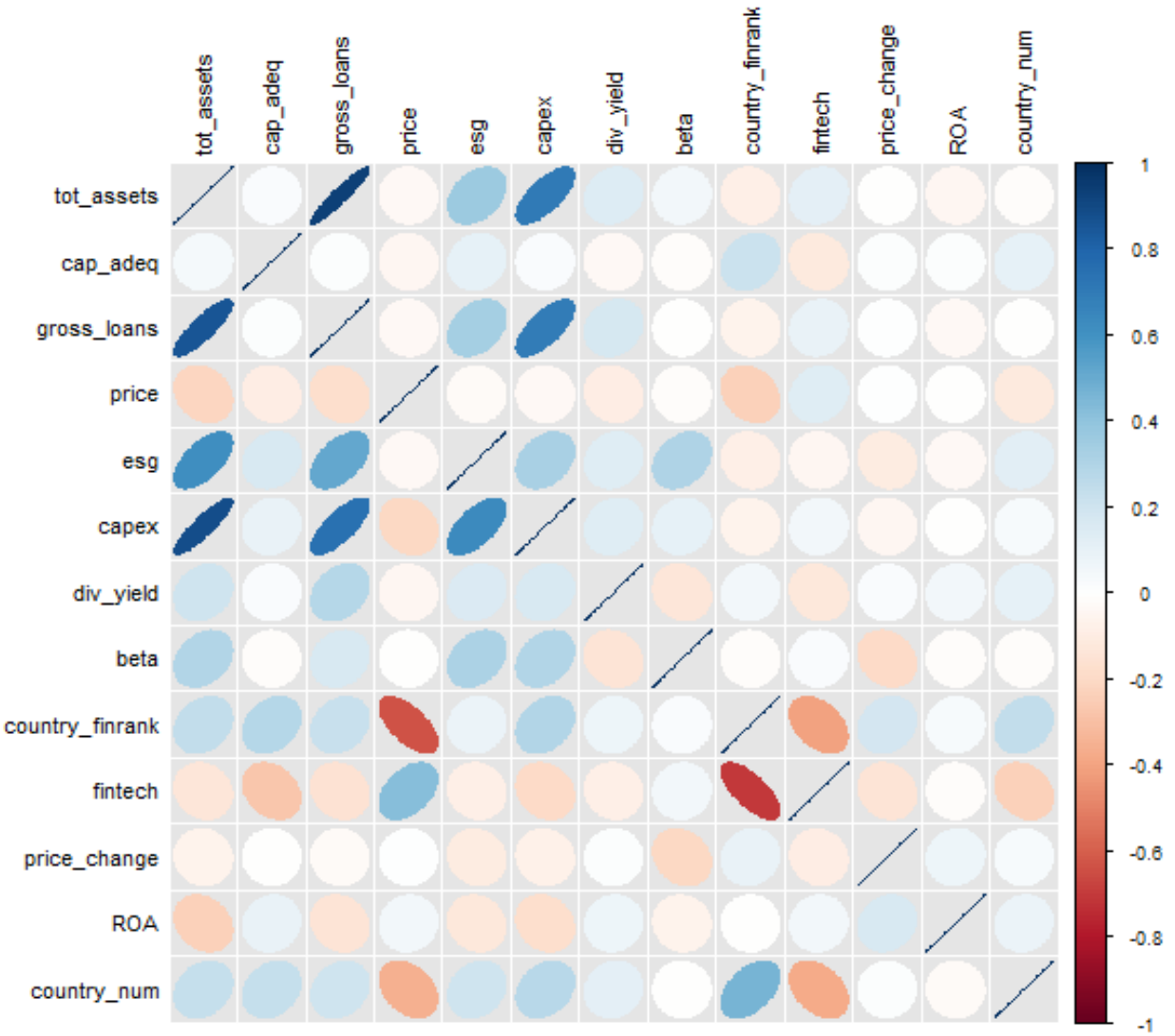

Figure 3. Correlation graph between the variables

Source: authors calculations

Table 4

Panel model estimation results

	Dependent variable:			
	Capital adequacy ratio		**Log (total assets)**	
	Fixed	***Coef. test***	**Fixed**	***Coef. test***
	(1)	(2)	(3)	(4)
Share price growth rate	-0.0004	-0.0004	-0.134***	-0.134***
	(0.003)	(0.003)	(0.045)	(0.044)
Country fintech rank	-0.0001	-0.0001	0.003**	0.003
	(0.0001)	(0.0001)	(0.001)	(0.002)
Log (total assets)	0.010***	0.010*		
	(0.003)	(0.006)		
Beta	0.002	0.002	-0.007	-0.007
	(0.004)	(0.004)	(0.053)	(0.095)
ESG	-0.0001	-0.0001	0.007***	0.007***
	(0.0001)	(0.0001)	(0.001)	(0.003)
Dividend yield	-0.149***	-0.149**	-0.043	-0.043
	(0.042)	(0.066)	(0.606)	(1.139)
Observations	1,106		1,106	
F Statistic	5.046*** (df = 6; 727)		0.175 (df = 5; 726)	
Note:	*p<0.1; **p<0.05; ***p<0.01			

Source: authors calculations

Table 5

Panel regression with countries results

	Dependent variable: Capital adequacy ratio		
	Fixed	**Random**	**Pooling**
Share price growth rate	-0.001	-0.001	0.001
	(0.003)	(0.003)	(0.005)
Country (Developing)	-0.005*	0.0003	0.011***
	(0.003)	(0.002)	(0.003)
Log(total assets)	0.010***	0.002**	-0.001
	(0.003)	(0.001)	(0.001)
Beta	0.003	-0.0001	-0.007**
	(0.004)	(0.003)	(0.003)
Dividend yield	-0.153***	-0.144***	-0.119**
	(0.042)	(0.039)	(0.053)
Constant		0.157***	0.158***
		(0.005)	(0.004)
Observations	1,106	1,106	1,106
F Statistic	5.448*** (df = 6; 727)	17.827***	6.512*** (df = 6; 1099)

Source: authors calculations

competition using their enormous resources and capabilities.

As a final step, robustness was assessed (Table 7), which, when compared to the main regressions, demonstrated that the significant share of US banks did not materially affect the results.

Conclusions. Based on the conducted analysis, FinTech development does not exert a significant influence on banks' capital adequacy ratio, but it does have a statistically significant effect on their total assets. The baseline panel regression confirmed that, at the global level, FinTech development is not a decisive factor

Table 6

Panel regression with different bank sizes

	Dependent variable: Capital adequacy ratio		
	Small (Random)	**Medium (Fixed)**	**Large (Fixed)**
Share price growth rate	0.0002	0.003	-0.0004
	(0.0001)	(0.005)	(0.004)
Log (total assets)	0.004	0.033***	0.040***
	(0.005)	(0.010)	(0.013)
Country fintech rank	0.0003**	-0.0003**	-0.00005
	(0.0001)	(0.0002)	(0.0002)
ESG	-0.0001	0.0001	-0.0001
	(0.0001)	(0.0001)	(0.0002)
Beta	0.003	-0.004	-0.006
	(0.006)	(0.006)	(0.005)
Dividend yield	-0.096	-0.202***	-0.053
	(0.093)	(0.057)	(0.052)
Constant	0.152***		
	(0.010)		
Observations	379	411	316
F Statistic	9.089	6.108*** (df = 6; 248)	1.904* (df = 6; 194)

Source: authors calculations

Table 7

Robustness test regression

	Dependent variable: Capial adequacy ratio	
	Without USA (fixed)	**Main (fixed)**
Share price growth rate	-0.0004**	-0.0004
	(0.0001)	(0.0001)
Country fintech rank	-0.0001	-0.0001
	(0.0001)	(0.0001)
Log (total assets)	0.012***	0.010***
	(0.003)	(0.003)
Beta	0.004	0.002
	(0.004)	(0.004)
ESG	-0.0002**	-0.0001*
	(0.0001)	(0.0001)
Dividend yield	-0.141***	-0.149***
	(0.042)	(0.042)
Observations	826	1,106

Source: authors calculations

in shaping bank performance. However, once countries were divided by their level of economic development, clear differences emerged: FinTech exerts a negative influence on banks in developing economies compared to developed ones. Furthermore, the analysis of bank size revealed important heterogeneity: FinTech development has no measurable effect on large banks, exerts a negative effect on medium-sized banks, and has a positive impact on small banks, which can be explained by the nature of their interactions with FinTech firms. Overall, the presence of shared patterns in such a wide data panel for 40 countries suggest a huge potential for further investigation into the nature of interactions between FinTech and banks, which

may serve as a foundation for the strategies or policies of future collaboration between banks and FinTech on a national scale. In the Ukrainian context, this represents a promising opportunity due to the well-developed FinTech sector represented by such giants as Monobank.

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