CROSS-COUNTRY ANALYSIS OF THE FINTECH PRESENCE IMPACT ON BANKS PERFORMANCE

by

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Date _____

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Abstract

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Informational technologies development changed the way households and businesses use financial services. Fintech startups are reinventing conventional financial services giving them higher comfortability, security, and speed, starting from instant money transfers to peer-to-peer lending.

However, the number of studies on fintech and banks' relationship is growing they usually address the question of ways of fintech, and banks collaborate or compete in terms of reasons and forms. In this study, we aim to investigate whether the overall fintech development impacts banks' performance in different countries and to which extent. The related papers mostly investigated the fintech impact within one country whereas in ours the scope is much wider – 41 countries.

For this study, we collected data for more than four hundred for a period of 2018-2020 years. For the fintech development proxy, we used the country's rank in Global Fintech index for each year considered.

To estimate the relationship, we formed panel data and chose the fixed effects model as our estimation method. We found that on the world's level fintech does not impact banks' performance. But our further research found that fintech impact depends on the country level of development and banks size.

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Chapter 1

INTRODUCTION

Information technologies development influenced profoundly on all spheres of human activity. As a rule, it increases productivity, speed, comfort and usually brings much more overall benefits than disadvantages. Obviously, it couldn't omit one of the biggest and key systems of modern human civilization – the financial system. While something new is progressing, the old technics or institutions are usually left behind and replaced by those appeared that are time relevant and better performing, which can be frequently met in manufacturing and other industries. Nowadays, one of the key pillars of any financial system – banks are being threatened by the rising financial technologies represented by FinTech companies. FinTech cannot completely replace banks at the current level of development, but it provokes banks to change – change their business models, modify and widen the services they provide.

From the first sight, it seems evident that Fintech represents the combination of finance and technologies but there is still no final definition yet. Patrick Schueffel (2016) attempted to derive the FinTech definition by analyzing more than 200 scholarly articles covering more than 40 years. Based on the results of semantic analysis author comes with the next one: Fintech is a new financial industry that applies technology to improve financial activities. Financial Stability Board defines Fintech as "technologically enabled innovation in financial services that could result in new business models, applications, processes or products with an associated material effect on financial markets and institutions and the provision of financial services" which is more precise in the scope of this paper.

The cause why fintech may be considered a threat to existing banking business models due to its cost-effective, mobile-friendly solutions. Since FinTech

specificity lies not only in brand new financial products and services but in the technological improvement of the already existing financial services, i.e., enabling the most advanced information technologies such as blockchain, artificial intelligence, cloud computing, and big data into the modernization, enforcement, and improvement of traditional financial services according to Wang and Sui (2020). There is no agreed classification of Fintech services because there is a vast variety of financial technologies applications. In the study by Policy Department for Economic, Scientific and Quality of Life Policies (2018), authors state 7 main categories: deposits and lending (banking services), payments, transfers, and foreign exchange, digital currencies, asset management, personal finance, etc. As can be seen, at least 5 of them are the classic services banks provide.

FinTech now is growing as a potential substitute to the key financial institution – traditional banks, which had a monopoly in financial services for centuries. Starting as a lending and saving facility for the sovereigns and wealthy merchants and as time has gone banks grew into the main financial services provider to the whole country population or even worldwide due to globalization according to Petralia et al. (2019). Although banks have a solid position in the world's financial system, recent events have undermined people's confidence and trust in banks. One of the key events is several crises that occurred last decades. Douglas et al. (2015) stress that particular attention should be addressed to the Global Financial Crisis that took place between 2008 till 2009 which rocketed the Fintech popularity and development pace and started the growth of FinTech era 3.0. The Global Crises led to the bankruptcy of banks that were considered as "too big to fail", enormous financial losses on a world level, millions of workers lost their jobs, including professional finance workers that afterward found a new place exactly in the Fintech industry. Besides the lost trust of the population, banks also were up to much stricter regulation (e.g. Basel 3) due to the crisis. More regulation leads to

higher costs and operating limitations, which decreases their competitiveness in terms of rising Fintech danger.

According to the EY Global Fintech Index report (2019), Fintech adoption increases its pace from year to year. World's Fintech adoption was 16% in 2015 (when the first report was released) doubles every two years to 33% and 64% in 2017 and 2019 accordingly. Fintech's global investment during the same period from 2015 to 2019 increased more than three times from 67.1 USD bln. to 215.4 USD bln.

Cornelli et al. (2020) find that Fintech lending services are more used in countries with a higher level of GDP per capita and ease of doing business rank is higher. One might assume that it is quite logical because Fintech employs advanced technology, and developed countries have more resources and better conditions to deploy FinTech solutions. But the interesting fact is that among the top ten countries with the highest rate of Fintech Adoption, China and the UK are the only developed countries presented. Besides them, South Africa, Peru, Columbia, and Mexico have above-average levels (64%) of adoption. On the other hand, such countries as Canada, the USA, France, and Japan have below 50% level of adaption. Fintech contributes to financial services facilitation and financial inclusion and the country's macroeconomic indicators improvement, such as GDP per capita, improvement of lending conditions, and GDP growth rate, poverty reduction discovered by Appiah-Otto and Song (2021).

Since FinTech is understood as a threat and substitute to traditional banks, the last ones must adapt to the market conditions in the country in which they operate. The development of financial technologies does not contribute to the Fintech companies only. There is always a choice for both banks and Fintech companies: to compete or cooperate. Several banks are implementing advanced financial technologies in their activity to improve their financial efficiency and satisfy and

retain customers. The evidence found by Wang and Sui (2020) shows that Fintech implementation increases banks' profitability, improves risk control, reduces operating costs, and increases efficiency.

The evidence shows that the intense presence of FinTech companies in the country leads the banks to face severer competition in the financial services market, which is reflected in their business model transformation, financial performance, and even the occurrence of special executive that is responsible for the bank's services digitalization - Chief Digital Officer. On the other hand, banks have much more incentives to implement financial technologies which leads to operational efficiency improvement. This paper aims to explore whether the Fintech presence in the country affects incumbent banks' performance and compare it to the bank's performance in the countries with lower levels of FinTech adaptation. The contribution of this paper is that it offers a quantitative approach on the analysis of the FinTech impact on the banks at cross country basis using the Fintech presence in the country as a proxy for the level of Fintech penetration in the banking industry.

The structure of the paper is the following. Section 2 contains a literature review. Section 3 discusses methodology. Section 4 contains the data description. Section 5 is devoted to empirical results. Conclusions are presented in Section 6.

Chapter 2

LITERATURE REVIEW

FinTech's intensive development significantly influenced traditional banks' way of doing business states Peralia et al. (2018). The key question that researchers point to is to which extent fintech influences banks. Since Fintech offers the same services as banks, the competition appears in multiple areas.

Banks are considered as the only lending facility, or maybe they were such. Fintech offers its lending solutions – Peer to Peer (P2P) Lending and Crowdfunding, the alternative financing sources. P2P lending's key feature lies in that people are lending to people, and platforms are acting as intermediation between them by providing lenders for borrowers and vice versa according to Policy Department for Economic, Scientific, and Quality of Life Policies (2018). Hughes, Jagtiani, and Moon (2019) compared the consumer efficiency between commercial banks and P2P platform – LendingClub, the biggest US P2P lending platform. Authors compare the consumer loans performance with the traditional ones using stochastic frontier analysis. Their analysis demonstrated that in the case of the non-performing loans banks and P2P platforms are performing equally, but in terms of non-performance ratio and best practice ratio Lending club is demonstrating superior results, which proves its' higher efficiency. Another finding is that P2P platforms may be both complements and substitutes to the banks. In case of negative bank credit supply low-quality bank borrowers migrate to the P2P lending platforms looking for the lending substitution according to Tang (2018). In case of no shock lenders apply to the P2P lending if they need smaller loans which banks do not provide or the borrower is not trustworthy enough for the bank what puts the platforms in complement role.

Jagtiani and Lemieux (2018) suggest that it can be addressed to better consumer credit risk processing in the P2P platform due to more advanced technologies available based on Big Data analysis. Also, they find that LendingClub covers areas where the loan customers are underserved because they did not pass the banks' face-to-face control and are considered too risky. Since P2P lending is entirely online and relies only on data available and Big Data analysis, it is not affected by biases that usual bank employees are affected by during the face-to-face interaction found in paper by Dobbie et al. (2018). There is a high probability that if you are older or immigrant that you will be rejected, whereas computers or AI will only pay attention to your credit score and other numerical determinants. The study shows that lender could possibly earn close to $160 more if Artificial Intelligence was implemented, and there would be fewer rejections.

Recently the most competitive area for the banks became the retail payment services because of the active interventions of FinTechs and the increasing popularity of cashless payments investigated by Jun and Yeo (2016). The key advantage is that it reduces cash costs for both the merchant and customer, it allows customers to carry much more cash (virtual); also it increases the speed of operations. In the beginning of start-up era banks did not pay much attention to them because they were not recognized as a threat, as potential competitors and thus banks did not take any actions according to Siek and Sutanto (2019). As the result, the payment solutions and e-wallets offered by FinTech are much more popular, and now banks are trying to overtake Fintech companies or are forced to admit them and cooperate. The dimensionality reduction analysis used by authors based on the data from a survey conducted via Google Forms shows that Fintech is leading in terms of customer satisfaction, brand loyalty and have higher customer acquisition.

Besides, if it is highly convenient for both seller and customer, does it bring real advantages to the economy on a country scale? Agarwal et al. (2020) in their paper

based on the example of the largest bank of Singapore which introduced mobile payment technology in 2017 explore the real effects for the economy. They find that mobile payment technology reduced the payment transaction costs, which increased the monthly rate of business creation by 8.9%, especially small and medium businesses, and increased by 4.2% consumer monthly total spending.

Jun and Yeo (2016) in their paper investigate the potential entry of Fintech firms in the retail market and competition there. Their research is focused on the entrance of front-end providers (e.g. ApplePay), which provide pre- and post-transaction, and end-to-end providers, which provide both front-end and back-end services with their own infrastructure (e.g. PayPal, Alipay, banks). The retail payments market has two special features that determine the outcomes for incumbents and entrants – the retail payments services market participants benefit from cross-platform externalities the provision of payment service enables economies of scale and scope. The model results show that when only end-to-end providers enter, the success depends on whether the merchants allow it to enter because there is no partial equilibrium in this case. But if the front-end enters, there is possible partial equilibrium under special regulatory conditions and mandatory back-end provision.

Some of the investigators already tackled this paper's research question but in different way. For example, Wang and Sui (2020) tried to investigate the case when FinTech is not competing with banks, but on the contrary, cooperating. The authors' results demonstrate that the adaptation of FinTech into business models yields commercial banks improved service efficiency, better risk control based on data analysis, increased profitability, and reduced costs. The key requirement for banks is to have required hardware and software, which requires huge capital investments that are not available for all banks sizes. Ntwiga (2020) investigates the effect of banks and Fintech collaboration on the example of Kenya, the country that has been one the most rapid Fintech adopters in the world in recent years.

Based on the financial statement information of the five biggest Kenya banks during the Pre-Fintech and After-Fintech periods, the author compares these banks' performance using panel regression with fixed effects. Another concept used by the author is the Data Envelopment Analysis that measures the efficiency of the decision-making unit by comparing inputs to the outputs. The paper's results show that the pre-fintech period demonstrates poor inputs utilization and managerial inefficiencies, when the post-fintech demonstrated loan intensity, return on asset, and cost intermediation significant and positive impact on technical efficiency measured by DEA.

In this thesis, I employ across-country time-series panel data analysis. Because of the topic's specifics and novelty there are only two articles that use quantitative analysis. Wang and Sui (2020) in an attempt to calculate the effect of the use of FinTech by the banks use the total factor productivity (TFP) as a proxy for the bank's competitiveness. Additionally, the author states the TFP has a viscous effect and thus it is important to use lagged TFP. The authors regress the TFP on China's Fintech index and several control variables, including macroeconomic indicators including monetary policy indicators, capital market development indicators, bank size (log of total assets), capital adequacy ratio, profitability, whether banks are listed, etc. To calculate TFP author uses the DEA approach. The most crucial in it is to identify inputs and outputs correctly. The authors define bank inputs as labor force costs and capital costs, and as output – loan amount and deposit amount. The authors construct a data panel that includes 113 domestic commercial banks from 2009 to 2018. Because of the endogeneity author uses systematic generalized moment estimation (SYS-GMM) and differential generalized moment estimation (DIF-GMM).

The next one is by Ntwiga (2020) in which author analyses the impact of Fintech implementation by banks in Kenya. Here the author also uses the DEA technique to estimate efficiency scores. In this paper, the author defines such inputs and

outputs: deposits – loans, interest expenses – deposits, and loans – interest income. The data is obtained from financial statements of the five Kenya banks that collaborate with Fintech suing the 2009-2018 years. Additionally, the author defines the Pre-Fintech and Post-Fintech periods to compare the Fintech effects. The model specification used in this article is panel regression with fixed effects.

These two articles found that there is a statistically significant impact of fintech on the bank's performance. But in both of them only one country is considered, for Ntwiga (2020) it is Kenya and for Wang and Sui (2020) it is China. China is very technologically ahead of the rest of the world and the same for Chinese fintech. Fintech there is very developed and widely used especially peer-to-peer lending since this type of credit is more affordable and accessible for the population. In case of Kenya, this country is also highly fintech developed because of the specific large company M-Pesa – the first online banking company in Kenya which created and monopolized the market of mobile phone-based money transfers. It was the first company that offered banking services and was branchless at the same time. China also has several alike large companies which pioneered fintech in the country.

Meantime fintech in the rest of the world also was developing. Many countries like the USA, UK, Singapore, and others are considered to be fintech centers. And also, as a result of globalization, all of these fintech companies are operating all across the world. And transnational fintech companies are already affecting banks in several countries at the same time. there we want to address it by analyzing a big number of countries to catch this transnational fintech effect on banks' performance.

Chapter 3

METHODOLOGY

In this study, a panel regression model with the fixed effects technique is employed. This approach is also used in the two most relevant papers by Ntwiga (2020), Wang and Sui (2020). The previous research used fixed effects regressions as an additional estimation method for the main generalized moment estimation models. We cannot use this approach because of the data constraints. In those papers, several banks within one country were analyzed for a more extended time period which enabled them to use GMM models. In our research, we focus on a larger variety of banks and countries by sacrificing the number of years analyzed and bank-specific variables. Since much of the data is not available for such a number of banks we decided to choose such variables that were used before and are the most representative in terms of banks' performance.

Considering our research question the combination of approaches above is needed because we focus on banks' performance in multiple countries for three years. As the dependent variable, we have chosen the capital adequacy ratio (CAR) which represents the bank's ability to protect its assets based on papers by Ntwiga (2020) and Wang and Sui (2020). This ratio is actively used in recent publications as a proxy of banks' financial "health". Especially after the World Financial Crises, the CAR requirements became stricter. In each country, the government's financial regulator sets the satisfactory minimal CAR level that all the banks must follow. The CAR formula is next:

$$CAR = \frac{Tier\ 1\ capital + Tier\ 2\ capital}{Risk\ weighted\ assets} \qquad (1)$$

Where banks' capital is divided into two levels of capital. Tier 1 capital implies the capital that can absorb the losses without affecting banks' operating activities, it includes equity capital, ordinary share capital, audited revenue reserves, etc. Tier 2 capital includes lower-quality capital that absorbs the loss in case of the company liquidation. These capital types are summed and divided into the risk-weighted assets which are simply the sum of the bank's assets weighted by risk.

Other bank-related variables are share price growth rate, Capital expenditure, ESG rank, total assets, beta, and gross loans. This research is focused on banks thus all the variables are bank activity indicators

Implying that we consider only three years it becomes impossible to consider FinTech impact for each bank because it is hard to identify the starting date of Fintech implementation in a particular bank as Ntwiga (2020) did. Thus, we decided to use Fintech on a country scale as Wag and Sui (2020) did in their paper. For this, we obtained fintech scores and ranks for each country for each year from The Global Fintech Index by Findexable. This index is based on the number of fintech companies in the country and their quality embedding their size, customer base, etc. An important point here is how Findexable approached the problem of company location because the company can be founded/headquartered in one country but operates and scales in another one. The authors decided to choose the second option- to consider the country where the company operates and scales what, they believe, is more representative for index calculation. This will be used as the Fintech development proxy variable. The higher the fintech rank or score the higher is the fintech development within the country which theoretically influences banks' performance in both ways – it can improve if banks apply financial technologies and cooperate with fintech companies, or it deteriorates banks' performance by offering better financial services than banks do because of the old-fashioned technologies.

Since we are analyzing a large number of banks, we have chosen the variables that were available for this sample and were used in previous works. The baseline regression specification is next:

$$cap\_adeq_{ij} = \alpha_0 + \alpha_1 price\_change_{ij} + \alpha_2 div\_yield_{ij} + \alpha_3 ESG_{ij} + \alpha_4 country\_finrank_j + \alpha_5 \log(tot\_assets_{ij}) + \alpha_6 beta_{ij}, \quad (2)$$

Where *i* represents bank, *j* – country, cap_adeq_{ij} represents bank's capital adequacy, $price\_change_{ij}$ is the closing share price growth rate, div_yield_{ij} - bank's dividends yield, ESG_{ij} is the ESG score of the bank (Environment, Social, Governance score);

$country\_finrank_j$ is a the country's rank in the Global FinTech Adoption Index, $\log(tot_assets_{ij})$is the natural logarithm of the bank's total assets, $beta_{ij}$is the measure of bank's risk based on the stock fluctuations.

In addition to the main model we also estimated several main model modifications regarding special features of the variables. Based on the main regression we next divided banks into special categories regarding their asset size. As the result, there are three main categories of banks related to their total assets worth (X stands for bank's total assets).

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

Next after banks categorization we insert is as factorized variable into the baseline model instead of the total assets variable:

$$cap\_adeq_{ij} = \alpha_0 + \alpha_1 price\_change_{ij} + \alpha_2 div\_yield_{ij} + \alpha_3 ESG_{ij} + \alpha_4 country\_finrank_j + \alpha_5 \text{as. factor(categories)} + \alpha_6 beta_{ij}, \quad (3)$$

where i represents bank, j – country, cap_adeq_{ij} represents bank's capital adequacy, $price_change_{ij}$is the closing share price growth rate, div_yield_{ij} - bank's dividends yield, ESG_{ij} is the ESG score of the bank (Environment, Social, Governance score), $country\_finrank_j$ is a the country's rank in the Global FinTech Adoption Index, $\text{as. factor(categories}_{ij})$ is the bank's categories based on the total assets size.

Another interesting point is to investigate whether FinTech's impact depends on the country's level of development. From one side it seems to be obvious that it has more impact in developed countries because fintech is a complex and expensive technology that is hardly affordable for the banks and population in developing countries, but the Ernst&Young Global Fintech Adoption Index (2020) represents the percentage of the country population that is using fintech products in everyday life, and here we can see that in top 10 countries the major part is developing and emerging market countries (see. Table 2).

Table 2. Global Fintech Adoption Index 2020.

Country	Fintech Adoption Index, %
China	87
India	87
Russia	82
South Africa	82
Colombia	76
Peru	75
Netherlands	73
Mexico	72
Ireland	71
UK	71
Argentina	67
Hong Kong	67

Country	Fintech Adoption Index, %
Brazil	64
Germany	64
Sweden	64
Australia	58
Spain	56
Italy	51
Canada	50
USA	46
France	35
Japan	34

At the same time according to the Global Fintech Index fintech industry is the most developed in developed countries. This one is more relevant to this paper's research question since we focus on the banks, not the population. In order to investigate this question, we estimated panel regression with fixed effects containing country-level of development categorical variables. We keep the baseline specification, but we add factorized country variables that is based on its Fintech rank. To do this we decided to look into the dataset to see after which rank there is the majority of developing countries therefore, we can set a threshold, the rank after which there are mainly developing countries, in our case it is 21. So, if

the country has a rank lower than 21 it is assumed to be developed, if higher – developing. After this classification, we have 23 developed countries and 29 developing. The model specification is next:

$$cap\_adeq_{ij} = \alpha_0 + \alpha_1 price\_change_{ij} + \alpha_2 div\_yield_{ij} + \alpha_3 ESG_{ij} + \alpha_4 tot\_assets_{ij} + \alpha_5 \text{as. factor(country)} + \alpha_6 beta_{ij} \quad (4)$$

For robustness check, we decided to address the nuance of this dataset. It lies in the fact that a substantial part of the banks (close to 25%) are located in the USA. To mitigate the bias that it can create we decided to run our baseline regression on the dataset without the USA therefore we can see if it distorts the estimation results. The specification is the same, but the data is different.

Chapter 4

DATA

Based on data availability the panel data was built that contains more than 1500 observations from 40 countries during the period 2018-2020. There are in total 11 variables collected major part of which is bank-level data.

To be representative the sample used for analysis includes both big and small banks in both developed and developing countries (see Figure 2). That was done because of the interesting observation that in developed countries fintech adoption is lower than in poorer and less developed countries. Potentially if the fintech adoption is lower thus the banks may not use advanced technologies and consequently, banks in less developed countries will demonstrate superior efficiency results. In the graph below you can see the map of the banks presented in the dataset with the number for each country.

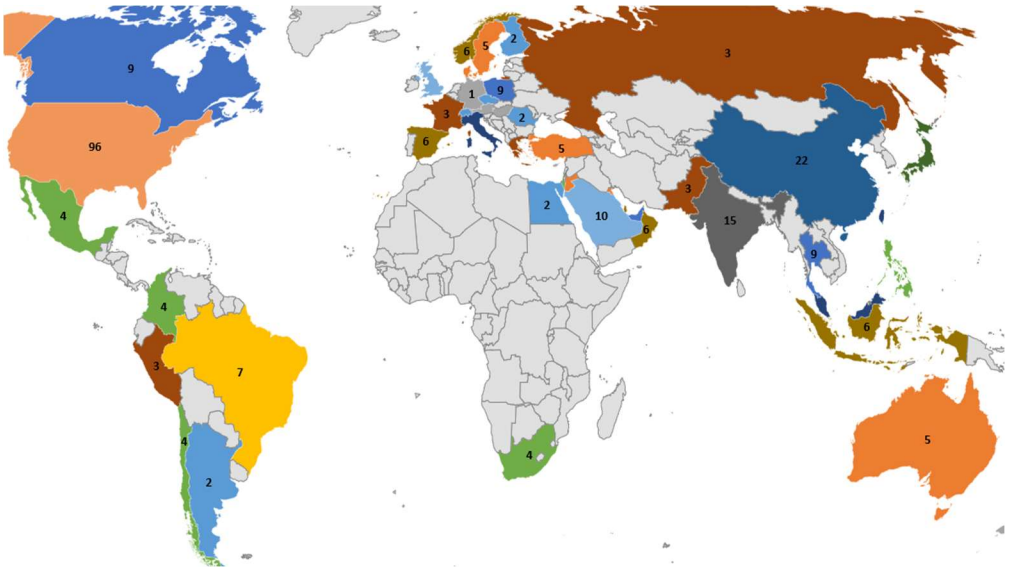

Figure 1. Map of banks presented in the dataset.

The main source of data is Thomson Reuters Refinitive, where I obtained the key financial bank's characteristics. Because not all the banks disclose their financial data, I decided to include only publicly held banks, so that there is information available. After cleaning all information lacking banks there are close to five hundred banks from all around the world left in the dataset (see Table 4).

Table 3. Bank size distribution across the countries.

	Small	Medium	Large		Small	Medium	Large
Argentina	6	0	0	South Korea	0	9	9
Australia	0	6	9	Kuwait	7	8	0
Austria	1	0	2	Malaysia	3	13	8
Brazil	7	2	12	Mexico	6	6	0
Canada	3	6	18	New Zealand	3	0	0
Chile	1	10	1	Norway	12	6	0
China	1	9	54	Pakistan	6	3	0
Colombia	2	10	0	Peru	0	9	0
Cyprus	3	0	0	Philippines	3	9	0
Czech Republic	3	3	0	Poland	10	17	0
Denmark	6	6	3	Qatar	3	12	3
Egypt	5	1	0	Romania	5	1	0
Finland	3	0	3	Russia	0	3	6
France	0	0	9	Saudi Arabia	2	24	4
Germany	3	0	0	Singapore	0	0	9
Greece	0	9	0	South Africa	3	6	3
Hong Kong	0	6	9	Spain	0	5	13
Hungary	0	3	0	Sweden	6	0	9
India	12	17	16	Switzerland	0	6	0
Indonesia	4	11	3	Taiwan	1	20	3
Ireland	0	3	6	Thailand	7	13	7
Israel	0	5	7	Turkey	3	11	1
Italy	0	15	9	UK	12	1	17
Japan	3	35	37	UAE	10	9	8
Jordan	12	3	0	USA	202	60	18

Table 4. Summary of bank size distribution across the countries.

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

After dividing banks and countries according to the methodology described in the previous section, we can obtain the number of all categories of banks for all kinds of countries. Table 4 demonstrates that in developed countries there are more small and large banks when in developing countries there are predominantly medium-sized banks presented in our dataset.

The next stage of data collection was to find the FinTech country development representative proxy that also can be traced for three years. Unfortunately, this kind of information is not available, thus we decided to use the Global Fintech Adoption Index from Ernst & Young in our paper. This report was launched in 2015 and the last version of it was published in 2019. The results are based on the interviews on population Fintech usage that are taken across the world. Then the analysts calculate the Fintech Adoption Index of each country which we use in this paper as the FinTech development proxy.

Table 5. 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
Price growth rate, %	-0.090	0.226	-0.852	0.921

TABLE 5 – Continued

	Mean	St. Dev.	Min	Max
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	1.048	0.404	-0.759	2.957
ROA, %	0.009	0.021	-0.371	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

As can be seen from the high standard deviation for total assets there are banks of completely different sizes, from international banks to even local ones (see Table 5). The difference between min and max proves this statement. The capital adequacy borders are not that wide because they are set up by the national regulators. Fintech investments are not as differentiated as the total assets are.

To be more confident that we can properly represent FinTech development in the country we also collected data on all the deals in the Fintech industry for each country each year on Crunchbase. Crunchbase is an open platform that provides information about companies and deals, especially in the IT industry.

The correlation between fintech variables and other variables is not high (see Figure 3). In the case of Fintech investments, its' maximum is 0.45 but the major part is under 0.2, additionally, there are several negative correlation signs. The country rank has a different situation similar; it is correlated the most with the capital adequacy and share price growth rate while fintech investment is the most correlated with these two and also the dividend yield variable. The most correlated variables are total assets and gross loans. The correlation graph is presented in Figure 3.

From the Figure 2 it can also be seen that country's fintech rank strongly correlates with the investments in fintech for the country. It is expectable so that we do not include both of them simultaneously, but on the other hand, it creates an opportunity to interchange them. Country fintech rank also strongly negatively correlates with the share price growth rate of the bank which is an unexpected finding here.

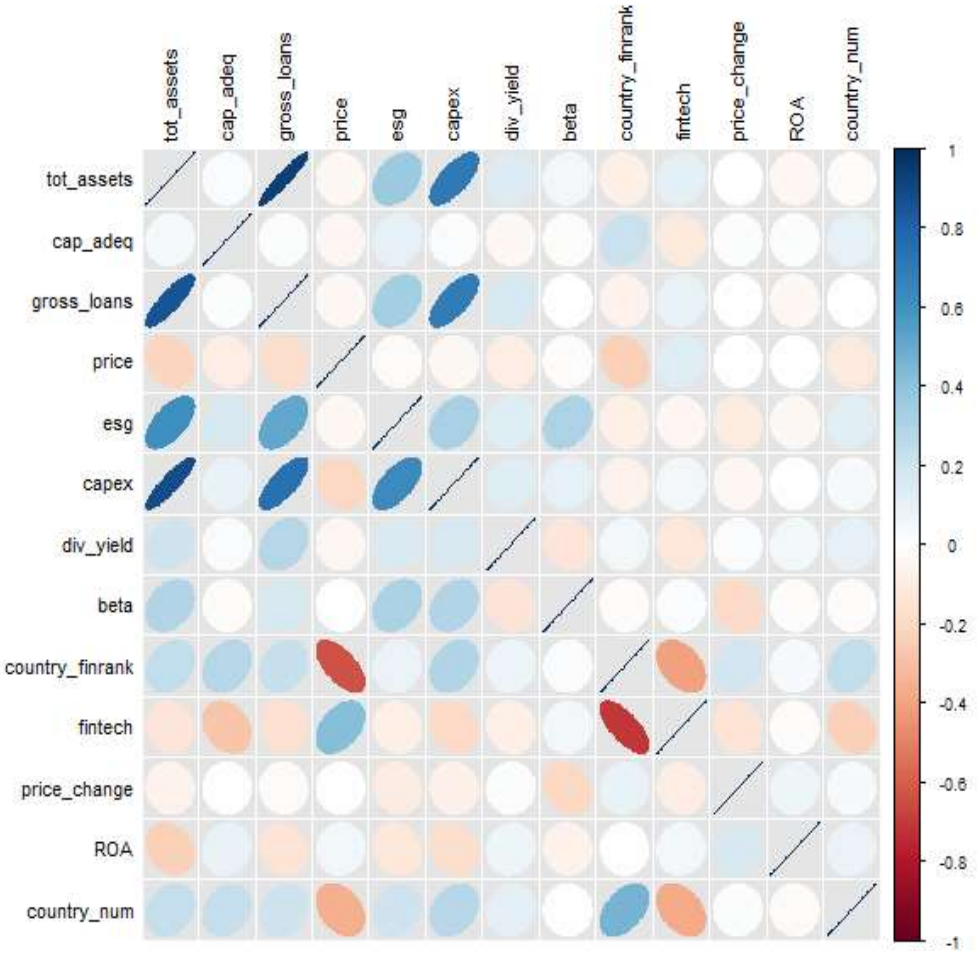

Figure 2. Correlation graph between the variables.

From Figure 3 we can find that the biggest banks are from developed countries, which proves the threshold we set. As also can be seen capital adequacy ratio is spread between 10 and 25% concentrating mainly in the area of 15% which is close to the minimum of 12% set by the Basel Committee. Since it is a mandatory level of CAR it is expected that banks will follow it, but there are banks with too low CAR.

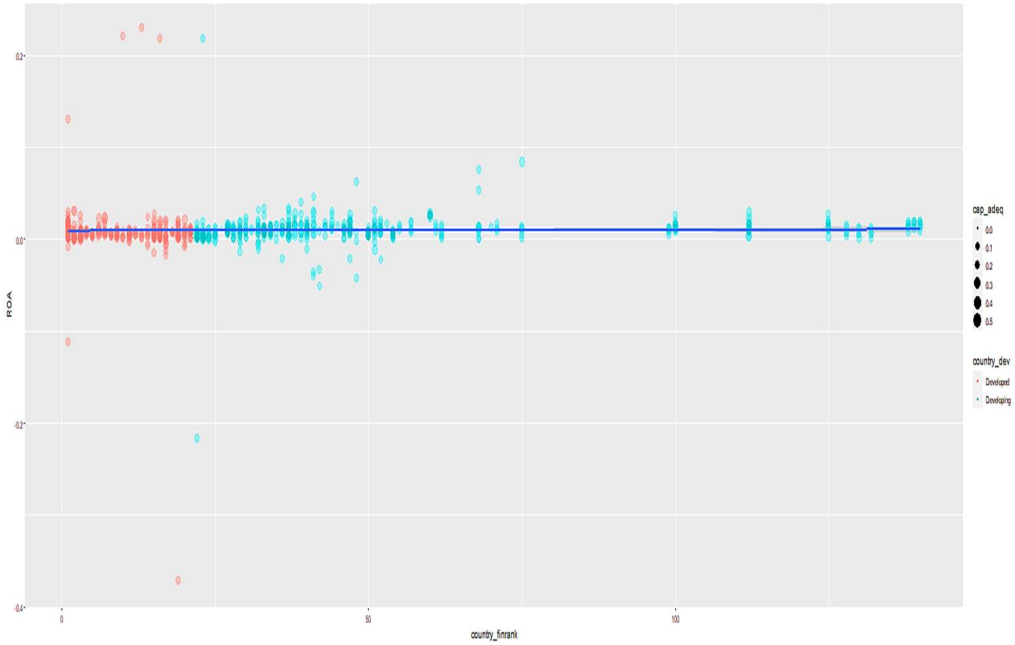

Figure 3. Scatterplot of the ROA and country fintech rank

From Figure 4 the distribution of the variables can be seen. The majority of the banks possess assets of value close to 500 USD mln., whereas the capital adequacy ratio is concentrated between 10% and 20% since there are requirements from the regulators for banks to keep a specific level of the capital adequacy ratio, even though there are banks who violate it.

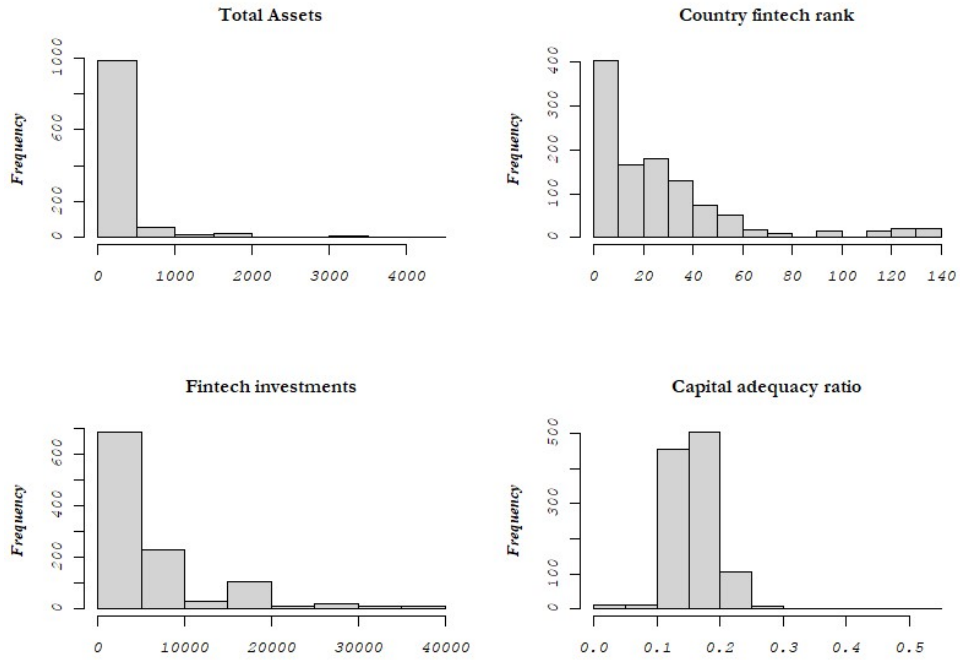

Figure 4. Histogram of key bank and country level variables.

According to the country's fintech rank, most of the countries are within the top 40 but there are also countries that hold ranks of higher than 100.

Chapter 5

ESTIMATION RESULTS

First, we start with the baseline regression – panel regression with fixed effects with taken log for total assets (see Table 6). The variable of interest for us is the country's Fintech rank which does not have a statistically significant impact.

Table 6. 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	
R2	0.040		0.001	
Adjusted R2	-0.459		-0.516	
F Statistic	5.046*** (df = 6; 727)		0.175 (df = 5; 726)	
Note:				*p<0.1; **p<0.05; ***p<0.01

To understand which exactly panel regression we need to run (random, fixed effects, or pooling) the Hausman test was conducted, according to which we have to choose the fixed-effects model. The logarithm of total assets and dividend yields demonstrate a high level of significance with a negative sign for the dividend yield, which is unexpectable for us. If total assets increase by 1% then the capital adequacy ratio will increase by 0.01%. To address the clustering bias created by the fact that there are several banks from one country will also calculate clustering standard errors which revealed higher standard errors which are more consistent. Running regression on the total assets as a dependent variable led to a statistically significant impact on the country's Fintech rank, but after considering the clustering effect this significance disappeared proving that there is a clustering effect.

The next model is the panel regression for a different levels of country development. As mentioned in the Methodology section, we categorized countries into developed and developing. The results are presented in Table 7.

Table 7. 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)
ESG	-0.0001*	0.00001	0.0003***
	(0.0001)	(0.0001)	(0.0001)

TABLE 7 – Continued

	Fixed	Random	Pooling
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
R2	0.042	0.019	0.038
Adjusted R2	-0.456	0.013	0.033
F Statistic	5.448*** (df = 6; 727)	17.827***	6.512*** (df = 6; 1099)

*p<0.1; **p<0.05; ***p<0.01

Here to the basic model specification, we added a categorical variable - level of country development based on the FinTech rank. Conducting the Hausman test again recommended using the fixed-effects model. As we can see from the results developing countries have a negative impact on the capital adequacy ratio and a 5% level of significance. Considering that this reflects the Fintech ranking we can also say the countries that are in the lower part of the Fintech Ranking have less fintech development which negatively affects the capital adequacy ratio of the domestic banks, which is what we expected to see.

The next stage of our analysis is to investigate the Fintech development impact that differs depending on the bank size (see Table 8). We found interesting results which state that country Fintech rank has a statistically significant influence on small and medium-sized banks and has no impact on big banks. Another feature is that Fintech rank has a negative impact on the medium banks and a positive on small banks. This can be explained by the different sizes of banks that interact with Fintech companies. Large banks usually apply or even introduce financial technologies, they acquire fintech companies or create hubs for fintech startups.

The Fintech companies are that big yet to have a significant impact on the industry giants like BNP Paribas and others.

But for medium-sized banks, the situation is quite different since now fintech companies' sizes are comparable to the banks, and in this "weight category" they are competitors fighting for the market, for the customers. In that case, Fintech development may negatively impact medium-sized banks if these companies offer better and faster services than medium-sized banks do. And banks cannot invest that much in R&D or acquire good-performing fintech startups because they do not have as many funds as big banks have. As for the small-sized banks, Fintech has a positive impact which is an unexpected result for us.

Table 8. 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)		

TABLE 8 – Continued

	Small (Random)	Medium (Fixed)	Large (Fixed)
Observations	379	411	316
R2	0.056	0.129	0.056
Adjusted R2	0.041	-0.440	-0.533
F Statistic	9.089	6.108*** (df = 6; 248)	1.904* (df = 6; 194)

To address the problem of a large number of US-located banks in the dataset we decided to conduct a robustness test in form of baseline regression but without US banks. The results are presented in Table 9 compared to the main regression. Results do not change much proving that USA banks do not distort analysis results obtained.

Table 9. 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
R2	0.063	0.040

Chapter 6

CONCLUSIONS

This paper combines approaches Ntwiga (2020) and Wang and Sui (2020) used to investigate the effect of fintech on banks' performance but we broadened the analysis out of the one country borders. Widening the geography cost us the variables variety that we were able to collect. For the fintech development proxy, we have chosen country rank from the Global Fintech Index and the worth of the fintech industry deals in each country collected from Crunchbase. The bank variables were chosen according to the previous research – capital adequacy ratio, total assets, beta, share price growth rate, etc.

Based on the above analysis we can conclude that fintech development in the country does not have a significant impact on the capital adequacy ratio, but it has a significant impact on the total assets of the bank. Our baseline panel regression demonstrated that in terms of the whole world fintech level of development does not influence, but after when we divided countries by level of development it turned out, that fintech development negatively impacts banks' performance in developing countries compared to developed ones.

The next research question was whether this influence depends on the banks' size. We found that fintech development does not influence large banks. But has a significant negative effect on medium-sized banks and a positive on small banks. This can be explained by the type of interaction each size of bank has with the fintech companies.

A robustness check demonstrated that even though a substantial part of the banks presented in the dataset is US-based it does not distort the analysis results.

For future research on this topic an enhanced dataset could be used. Especially better pick of bank level variables that would improve banks' performance

representation. Additionally, it would be interesting to investigate pandemic effect since fintech gained much attention because of the lockdowns and unavailability of banks branches which boosted mobile banking, but larger time period is needed for this kind of research to differ pre- and post-pandemic periods.

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