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Financial technologies and traditional banking: new conditions of financial market with respect to competition and risk

Abstract

The digital revolution brought new factors that influenced the traditional banking market. Banks were forced to compete not only with other players from the banking sector but also with FinTech companies. Therefore, the aim of this paper is to investigate the impact of digital financial technology on traditional banking in the context of the new conditions of competition on the financial market in EU. This paper investigates the impact of digitalization and FinTech on performance of traditional banks.

This paper consists of a qualitative and quantitative assessments. In the theoretical part this paper confirms the crucial role of FinTech companies in shaping new financial market and that digitalization has changed the conditions of competition and risk. Finally, the quantitative investigation confirms that innovative technology had an impact on traditional bank performance.

Keywords: FinTech, competition, risk, traditional banking performance, COVID

JEL Codes: G21, F36; G2; G21; G34.

Technologie cyfrowe i bankowość tradydyjna: nowe uwarunkowania rynku finansowego w zakresie konkurencji i ryzyka

Streszczenie

Cyfrowa rewolucja wpłynęła na model tradycyjnej bankowości. Banki zostały zmuszone do konkurowania nie tylko z innymi graczami z sektora bankowego, ale także z przedsiębiorstwami FinTech. Dlatego celem niniejszego artykułu jest zbadanie wpływu przedsiębiorstw (FinTech) na tradycyjną bankowość i wreszcie na wyniki banków w UE, w nowych warun-

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kach rynkowych. Niniejsza praca składa się z analizy jakościowej i ilościowej. W części teoretycznej niniejszy artykuł potwierdza dużą rolę przedsiębiorstw FinTech w kształtowaniu poziomu konkurencji w sektorze finansowym. Badanie ilościowe potwierdza, że nowe technologie miały wpływ na wyniki tradycyjnych banków. Ponadto nowi gracze zmienili warunki konkurencji na rynku finansowym.

Słowa kluczowe: FinTech, konkurencja, ryzyko, bankowość tradycyjna, COVID

Kody JEL: G21, F36, G2, G21, G34

Introduction

In recent years, the FinTech sector has been growing extremely fast and therefore will have a massive impact on the financial market. The development of digital technologies and mobile devices have brought innovative changes in the financial system as w whole and the accessibility of numerous services rendered through electronic distribution channels has improved (Scardovi 2017; Boobier 2020; Beaumont 2020; Boot et al. 2021). The new players include both small firms (startups) and big technological firms BigTech, the importance of which is growing in the transformation of the market of services that used to be restricted only for banks. While the most noticeable change, due to the use of innovative technologies, took place in the payments segment, also FinTech companies gradually started basic banking services, including lending activities. Like banks, FinTech operators provide consumer, corporate and mortgage loans (Claessens et al. 2018). Due to the increased competition in the financial market, new players take part of the profits from traditional banks. Currently, to maintain their market position, traditional banks will change their business models, which has significant consequence for the future of the entire financial sector. Advances in information technologies have transformed banking practices and products. The technical solutions have also become one of the important internal factors enabling banks to streamline their management systems, improve work quality and create new distribution channels. Appropriate use of the innovative technologies enabled banks to keep their market positions, that in consequence enhanced the level of competition in the banking industry (Philippon 2016; Claessens et al. 2018). Competitors from the FinTech sector, firstly, have access to a wider group of customers than traditional banks, and secondly, they provide their customers with additional benefits consisting in greater convenience of using financial services at lower costs. In addition, players from the BigTech sector offer financial services as part of a much wider set of activities, have a high growth potential and can be great competitors for traditional commercial banks.

Furthermore, the COVID pandemic had a tremendous impact on the growth of the FinTech sector. On the one hand, the spread of the COVID pandemic affected the economic slowdown, on the other hand it spurred on the development of sales channels based on FinTech. Finally, the political situation has caused inflation to rise globally, which has caused interest rates to rise and problems in the traditional banking sector, confirmed by the events related to the collapse of i.e., Signature

Bank and Silicon Valley Bank (SVB) bank in 2023. These events may have weakened the position and trust in traditional banking system.

The aim of this paper is to investigate the impact of digital financial technology (FinTech) on traditional banking and finally on banking performance in EU at the new conditions of competition on the financial market. This paper consists of qualitative and quantitative analysis. In the theoretical part this paper confirms the big role of FinTech companies in shaping new financial market. Finally, the quantitative investigation based on panel data confirms that new technology had an impact on the traditional bank's performance.

1. The impact of FinTech enterprises on the structure of the financial sector

1.1. Basic definitions

FinTech is part of the process of evolving financial innovation. FinTech has theoretically been shown "to be risky but of value" (e.g., Thakor 2020), with supporting recent evidence that it yields substantial value to investors. The Financial Stability Board (FSB 2017) defines FinTech as "technologically enabled financial innovation 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. There is no uniform market definition of the FinTech. Among the entities using digital technologies on the loan and lending market, one should distinguish large enterprises, the so-called BigTech. Their activity in finance presents a special case of FinTech innovation. The term FinTech refers to enterprises using technological innovations in financial services, while large technology companies (BigTech) offer financial services as part of their activities, which have a much wider scope (BIS 2019). BigTech companies have the other lines of business. Their core business is usually non-financial, while lending is only a part of it, often a small one. Notably, technological giants such as Amazon, Apple, and Google, which already operate in the lending market, have immense potential for the development of financial services because they have access to a huge amount of customer data (BIS 2020, p. 7). Greater involvement of leading BigTech companies in the financial services market may bring significant changes. Traditional banks collect information on customer credit histories over a prolonged period, while BigTech companies can use their advantage on the lending market thanks to non-financial data about their customers and can use this data on a much larger scale in their financial activities (BIS 2020). In the era of digital technologies, traditional commercial banks face competition in the lending market not only from BigTech companies, but also from new players - the so-called neobanks. New banks use advanced technologies to provide banking services in the retail banking segment, via smartphone applications and online platforms. They can obtain

banking licenses under the existing regulatory regimes, and it is they who can grant loans, create relationships with customers or have traditional banks as business partners.

To sum up, FinTech is a broad concept, there are banks which use FinTech technology as an additional distribution channel, as well as new banks (neobanks) which do not have traditional branches, non-banking FinTech companies (e.g., start-ups) and large technological companies BigTech. Barclays Bank installed the first ATM in UK, in 1967. The ATM was the first innovation that clearly showed the deep potential interlinkage between finance and technology (Nicoletti 2017, pp. 14–15). Therefore, ATMs are among the product innovations that fostered the development of the FinTech sector. Currently, "FinTech", have started to play an important role in the provision of many financial services. However, Buchak et al. 2018 found that on the US mortgage market traditional banks provide products of higher quality than those of FinTech (they stressed, however, that the traditional banks lose their market share because of a greater regulatory burden).

1.2. Market structure in the financial sector; theoretical approach

An important factor shaping the financial system is the market structure, which affects the level of competition and banks' market power (cf. Pawłowska 2021; Degryse et al. 2009). The theory suggests that any departure from the perfect competition results in restricting the borrowers' access to credit, at higher prices. The impact of market structure on banks' lending and deposit operations was first studied by Pagano 1993. In recent years there have been ongoing debates concerning the economic role of market structure and size of bank within the banking industry. Changes in competition within the banking sector are taking place through two channels: mergers and acquisitions (M&A) and regulations stimulating barriers to enter and to exit. Digital technologies increase the possibility to enter and to exit the financial market. Fundamental advances on the internet, mobile communications, distributed computing, and information collection and processing have underpinned a range of recent innovations in finance (see FSB 2017; 2019). Consumers in both advanced and emerging market economies have increasingly adopted digital financial services that are more convenient.

Studies concerning competition in the banking sector draw theoretical and empirical models from the The Industrial Organization Approach to Banking (IOAB) theory, concerned with the issue of measuring competition in the banking sector and defines the following measures of competition: the Lerner index, the H-statistic, and the Boone-indicator (cf., Hicks 1935; Demsetz 1973; Besanko & Thakor 1992; Degryse et al. 2009; Van Hoose 2010; Bikker & Leuvensteijn 2014; Pawłowska 2014). On the one hand, following the traditional stance in the theory of economics, market power of banks results in a lower supply, albeit at higher costs. On the other hand, considering information asymmetry and agency costs, it is conducive to a phenomenon that shows a positive or non-linear connection between market power and access to credit. Also, the Structure-Conduct-Performance paradigm

(SCP) figures still prominently among theories that relate market power to bank profitability (cf., Van Hoose 2010). Bain (1951) developed the SCP model. This theory states that in a market with higher concentration, banks are more likely to show collusive behavior and their oligopoly rents will increase their performance (profitability) (the SCP paradigm dominated until the late 1970s). A new trend concerning structural effects on bank profitability started with the application of the Market-Power (MP) and the efficient-structure (ES) hypotheses. The MP hypothesis, which has been also referred to as the Structure-Conduct-Performance (SCP) hypothesis, asserts that increased market power yields monopoly profits. A special case of the MP hypothesis is the relative-market-power (RMP) hypothesis which was created by Smirlock (1985). Smirlock (1985) stressed that there is no relationship between concentration and profitability, but rather between bank market share and bank profitability and suggested that only banks with large market shares and well-differentiated products can exercise market power and earn noncompetitive profits. However, subsequent results of analyses based on the SCP paradigm have shown that the relationship between the structure of the market and conduct is even more complex (Pawłowska 2014).

Following the 2008 financial crisis, which validated the banks' rising role in the economy, particular attention was drawn to the growing concentration of the banking sector and a rising size of TBTF (To Big to Fall) banks and brought renewed interest to the issue of the optimum size of the financial sector (Haldane 2012). A classic model based on the SCP paradigm suggested that a more concentrated system is marked by lower competition, which enhances the likelihood of collusion, which in turn drives bank profits and a positive relationship between concentration and profitability. The market structure defined under the SCP model is of major importance for the character of such market conduct as pricing, collusion, agreements, marketing operations and scientific and research activity. In the traditional SCP model, market structure unidirectionally determines businesses' market conduct, which consequently determines market performance. Performance is measured through profitability, effectiveness, and productivity (Martin, 1989). The increase in the volume of assets of individual banks, the increase in concentration within the banking sectors, and cross-border links between large banks mean that we can now talk about the policy of international organizations in relation to TBTF institutions. Possible solutions to the problem of TBTF banks were discussed in many reports (i.e., reports by de Larosière, Vickers, Volcker, and Liikanen) and concepts were presented for reforming the banking system. In the United States, Volcker attempted to solve the problem of TBTF banks by defining the necessary reforms, which were introduced in the Dodd-Frank Act in 2010. The Vickers report (Vickers 2012), concerning the reforms of the banking sector in the UK. Pawłowska (2016) describes an important role of the banks' size and the market structure for EU banks in the context of TBTF. The empirical findings based on panel data from the period 2004–2012 show that the EU's banking sectors are not homogeneous, and that there is asymmetry between the effect of banks' competition on the stability of banking sectors in the countries of Central and Eastern Europe versus

Western Europe. There is also research showing that the excessive size of banks has an adverse effect on systemic risk (Laeven et al. 2016). However, currently in the digital age, bank's competitors are also non-banking financial institutions, including FinTech companies providing financial services and BigTech.

2. The effect of FinTech on the financial sector

In entering the area of traditional operations restricted for banks only, FinTech companies exert a tremendous impact on the competition in financial services. The so-called traditional banking or traditional banks include banks that have a universal banking business model, but also banks that conduct investment activities; for the sake of simplicity, the word traditional will be used to describe the combined model of universal banks (Blakstad, Allen 2018, pp. 148–149). Traditional banks align their business models with digital techniques, which entails serious consequences for the future of the entire financial sector (cf. Petralia et al. 2019).

2.1. The impact of FinTech on the market structure of the financial sector

In the era of digitalisation and internet use growing ever more common, it is important to analyse the effect of FinTech financial innovation on the market structure, including on the emergence of channels through which new technologies affect the competition level in respective market segments. The analysis of the interactive version of the classic SCP paradigm may lead to a conclusion that the new digital techniques are currently the prevailing element of technological progress affecting respective elements of the paradigm, i.e., structure, conduct and performance. FinTech firms affect a change in the structure of the financial services market owing to the following factors: the number and size of market participants, entry and exit barriers and the access to information and technology for all the market participants. According to (FSB 2019, pp. 3–4), financial technologies may affect the structure of the financial services market via the following channels: influence on banks' profitability, providing valid services by third persons.

The new providers of financial services i.e., loans or payments, such as FinTech, may take over a portion of the revenues of banks and other existing financial institutions, which on the one hand may potentially send their profits higher than the banks', but also make them more vulnerable to losses. Accordingly, the financial sector's resilience and its risk raking capacity may be affected. The pace at which new providers enter the sector may be a key factor in finding how bank align their models with the existing market situation. It seems that neobanks and BigTech companies may have a competitive advantage over traditional banks, especially in the retail banking segment. Thanks to the use of digital technologies, they can provide banking services at lower costs than traditional banks. On the one hand, their profit model is based on fees and commissions, but also (to a lesser extent) on interest income, with lower

operating costs related to the use of cloud technology and Big Data. In turn, traditional banks may face additional costs in adapting old, complex systems to the current data technology and architecture. Therefore, new banks may take away profits from traditional banks, which may become less profitable (BIS 2019).

Providing valid services by third persons i.e., segment of payments within the third-party providers (TPPs) has impact on market structure. Financial institutions rely on third party service providers as regards data, physical communication, and cloud services. It seems that over time, the dependence of traditional financial institutions and FinTech firms on external providers may grow. Furthermore, the entry of a big, well established technological firm to the financial services market ("Big Tech"), with their well-established networks and intensive customer data collection, have got a foothold in the financial services, particularly in payments, but also in lending, insurance, and property management. Entering a business area restricted for banks may be a source of tougher competition with renowned financial institutions. Moving forward, the new BigTech players could offer cheaper services as they could use the data acquired in other areas of their activity. BigTech have scope to compete with financial sector incumbents because of their vast size, global customer networks, brand recognition and ability to leverage their proprietary data to offer personalised services. Many also have strong financial positions. Although the use of BigTech provided financial services is currently more prevalent in jurisdictions such as China for reasons of economic and regulatory development, demographics, and culture, BigTech have the potential to gain significant market share in developed regions, also including the EU soon (BIS 2019). Big techs can leverage unique market power in providing contextual finance the bundling of financial services with core activities, due to the Data-Network-Activity (DNA)[1] feedback loop. Contextualized finance may result in improved operational efficiency and portfolio performance relative to traditional financial institutions (Feyen et al. 2021, pp. 23–25).

According to Vives (2017), competitors from the FinTech sector are putting pressure on the traditional business model of banks. Compared to FinTech companies, banks have two competitive advantages in the financial market (1): they can borrow cheaply, have access to cheap deposits and have access to explicit or implicit insurance by the government, and (2) they enjoy privileged access to a stable customer base (Vives 2017).

It should be noted that the activities of traditional banks are influenced differently by threats and opportunities from BigTech than by FinTech companies (BIS 2020). BigTech companies usually enter the financial services market thanks to brand recognition. Their entry into the financial services sector is possible thanks to the complementarity of databases of financial and non-financial services customers and the associated economies of scale and product scope (BIS 2019, p. 63). BigTech

[1] Data analytics, Network externalities and interwoven Activities ("DNA") constitute the key features of big techs' business models. These three elements reinforce each other, (e.g., the "network externalities" beget more users and more value for users (see. BIS 2019, p. 62). The source and type of data and the related DNA synergies vary across platforms.

companies seem to play a significant role in shaping financial services in the future. It seems, however, that the differentiator for banks, which provides them with loyal customers, is the element of trust and the fact that traditional banks, unlike the new players, are institutions of public trust (Thakor 2020). Endogenously, banks have stronger foundations to maintain trust. And trust is asymmetrical - it is harder to gain it than lose it. When a borrower defaults on their obligations, the borrower's trust is undermined, banks can withhold a crisis of trust, whereas for FinTech lenders it may be difficult on account of the nature of their operations. While considering the effect of COVID on the above issue a conclusion may be drawn that, on the one hand, the spread of the pandemic affected economic slowdown and the banks' worse performance, on the other hand it spurred the development of sales channels based on FinTech new technologies. Much as researchers agree on the profound and widespread consequences of new technology affecting the financial sector, there is no consensus on the probable future model of financial services provision. Some are of the opinion that what counts the most is the cooperation between the traditional banks and the new FinTech entities, including through mergers and acquisitions. Notwithstanding, according to a report by Carletti et al. 2020, banks will behave differently with respect to FinTech than to Big Tech. Future cooperation based on so-called coopetition is viewed as more likely in the case of FinTech, whereas in the case of Big Tech, it is dominance in certain segments that seems to be more likely.

It should be noted that financial market imperfections are also of significance to the new players. Historically speaking, the operations of traditional banks aiming to foster relations with their customers used to be considered a factor lessening information asymmetry between the fund's provider and the credit market customer (inter alia Akerlof 1970; Stiglitz & Weiss 1981), both ex ante risk (negative selection), as well as moral hazard may be mitigated by banks on account of their experience in finding and monitoring borrowers (Diamond 1991). However, the spread of internet use and its platforms has enabled the immediate of matching lenders and borrowers thanks to so-called peer-to-peer loans (P2P). In their case, the intermediation of financial institutions is not necessary, which is emphasised, among others, by Morse 2015. Bank's traditional functions include borrower information processing. Therefore, adaptation and special attention being drawn to products' usefulness, convenience of use and accessibility have become a basic requirement for banks. This can help build and maintain customer loyalty, although, first and foremost, it is a way to stand out on the market.

2.2. Risks attributable to FinTech and BigTech companies operating in the financial market

The technological progress and digitalisation provide numerous advantages, but they may also bring new risks and give rise to new threats. Risks associated with the operations of FinTech and Big Tech may be classified on a micro- and macroeconomic level.

Microeconomic risks involve, directly or indirectly, possible losses brought by loss of funds by financial institutions due to operational risk, e.g., because of a cyberattack, due to risk inherent in sharing infrastructure, such as cloud services, or due to infractions or failures of new solutions that have not been tested yet.

There is also operational risk related to usage of service providers being third persons. External service providers have growing visible and critical impact on financial institutions, especially in so-called cloud computing and data services. Because many third-party service providers can cross regulatory limits, greater attention is shifted to the management of combined operational risks, which may ultimately weaken financial stability. Also, the role of cyber risk systemically increased. Cross-border cooperation and coordination among authorities is important for a well-operating financial system. Innovations in cross-border credit, trade, and payment transactions, including smart contracts, raise doubts as to their compliance with domestic laws regarding jurisdiction have impact on legal risk. The application of a large amount of data as the basis for financial services comprehensively covering economic functions, including credit, investment, and insurance, is growing. The analysis of large data amounts fuels transformations in various industries as it enables extensive analyses and improves risk identification and assessment.

Macroeconomic risks chiefly pertain to systemic risk. Systemic risks are of high significance for the macroprudential policy (FSB 2017). Systemic risks address the effects of contagion, pro-cyclicality and increasing volatility. Another risk source may arrive along with so-called systemically important institutions. As mentioned, an important aspect is enhancing cyber security (Bobbier 2020). Although cyber risk does not only threaten FinTech, the higher the reliance on digital solutions, but the more access points for hackers also looking for a weak link in the network. BigTech provide their financial services either competing with the traditional financial institutions or in cooperation, as an overlay on their products and infrastructure. Next to providing financial services alone, BigTech also invest in financial institutions from outside of their groups. It follows that the fundamental problem associated with new technology is posed by security systems arising from the use of an electronic distribution channel.

A systematic rise in the value of online transactions justifies their need for continuous perfection. Transaction security is central to building trust between the customer and the company providing financial services. Also, the pro-cyclicity may arise from a few sources, including greater concentration in certain market segments, as well as from financial flows becoming large and unstable on FinTech credit platforms. Any assessment of FinTech influence on financial stability, however, is undermined by restricted access of both official, as well as privately disclosed FinTech data. The gravity and universality of complex networks and the related effects of contagion may rise as FinTech's importance grows. It must be noted that the threats and opportunities from BigTech affect banking operations differently than those from FinTech (cf. Tanda & Schena 2019, p. 47). It must be noted that BigTech are predominantly active in financial sectors targeting markets, the largest of which being China, USA, Japan, Korea, and the UK in Europe (BIS 2020).

To mitigate these risks, many regulators are already undertaking proactive monitoring of developments and cooperating across economic sectors at national, and international – European levels. The financial crisis brought about several regulatory measures related to the introduction of uniform regulations for the banking sector in the whole EU, (CRD IV package). Currently, the European Parliament is working on The Digital Services Act package consist of the Digital Services Act and Digital Markets Act, and the DORA Act (Digital Operational Resilience Act). The aim of this Acts is to create a safer digital space and to establish a level playing field for business.

3. The impact of digital technology on profitability of traditional banks: empirical results

3.1. Models' description

In the empirical part was examined the impact of new technologies on the bank performance in EU with using simple regression model based on panel data. BigTech companies were not considered in the study due to the lack of data in this area. Only FinTech companies were examined. However, when examining the influence of the FinTech on bank performance, it should be distinguished whether we are examining the FinTech as an element within the banking sector (new technologies used by traditional banks) or as an external element outside the banking sector, because new digital technologies are being adopted also by traditional banks. Product innovations in traditional banks include ATMs and modern PayTech payment systems using applications for mobile devices (smartphones).

The panel data set was constructed based on the annual panel data at the level of EU countries. The set of used data contained microeconomic and macroeconomic data in the form of a (cross-sectional and time-series) panel for 28 countries of the European Union excluding Croatia and Romania but including data for UK. The following variables are considered to be variables describing new technology: share of the number of individuals using the internet for online banking in the population, with internet banking understood as electronic transactions, such as bank transfers or direct debits, as well as checking the account balance or history; ATMs allowing authorized users to withdraw cash and number of ATMs per 1,000 km; number of mobile phone subscriptions per 100 people; internet access from a mobile device, laptop, or notebook (percent of people); and number of secure web servers per 1 million people. Profitability was measured by ROA and ROE indices published by the European Central Bank. Data concerning loans are form European Credit Research Institute (ECRI) at the Centre for European Policy Studies (CEPS). Macroeconomic data for individual EU countries were obtained from publicly available online databases of international organizations, such as International Monetary Fund, European Central Bank (Statistical Data Warehouse), Eurostat. Additionally, we consider FinTech variables from the study:

Cornelli, Doerr, Franco, & Frost (2021). It should be noted that FinTech solutions have emerged in the last 5–6 years, so analysing them in earlier periods is difficult. Another limitation, in addition to missing data and some variables have been available since 2014. Finally, panel data covered the years from 2010 to 2021 and included data from 26 EU economies. Due to missing data, this was an unbalanced panel. Descriptive statistics of the collected and correlation matrix are presented in Table 1 of the Appendix.

3.2. Model and Results of Panel Data Regressions

In this chapter we present the definition of the models and variables and present the results of models based on baseline equation. The model was estimated using panel data analysis techniques. Also, the model concerns the impact of the COVID pandemic on the performance of banks.

In the model, the dependent variable is banks' profitability, while the independent variables are GDP, size of the banking sector measured by the size of lending market, concentration of the banking market, digitalization and FinTech. The model uses two types of variables to describe the new technology (inside $DigTech1_{c,t}$ and outside the banking sector $DigTech2_{c,t}$).

Baseline equation (1) represents the output specification of the constructed econometric model:

$$Y_{c,t} = \mu_t + \gamma_c + \alpha_1 MS_{c,t} + \alpha_2 GDP_{c,t} + \alpha_3 Size_{c,t} + \alpha_4 DigTech1_{c,t} + \\ + \alpha_5 DigTech2_{c,t} + \alpha_6 FinTech_{c,t} + \beta_1 \mathrm{COV}_{c,t} + \beta_2 FinTech_{c,t} * COV_{c,t} + \varepsilon_{c,t} \quad (1)$$

where the explained variable $Y_{c,t}$ is expresses return on assets (ROA) or return on equity (ROE) in country c in year t.

As explanatory variables the following variables were used in country c in year t:

- as variable describing $GDP_{c,t}$ was adopted *GDP* grow *y/y*;
- as variable $Size_{c,t}$, describes the size of the banking sector as: total loans to *GDP*(*L_GDP*)[2] and total loans per capita (*L_PC*);
- the concentration ratios $MS_{c,t}$ as indicators of market structure: the share of the five largest credit institutions in total assets (*CR5*) and the HHI for assets (the sum of the squares of the market share of individual banks)[3].

The model uses two types of variables to describe digitalisation:

- as variables describing the new technology inside the banking sector $DigTech1_{c,t}$: *INTER* as the number of individuals using the internet for online banking in the population, *ATM* as number of ATMs per 1,000 km^2; *CARD* as logarithm of number of payment cards.

[2] The HHI index was used for the robustness check in the regressions based on equation (1).
[3] This variable was used for the robustness check in the regressions based on equation (1).

- as variables describing the new technology outside the banking sector $DigTech2_{c,t}$, we considered: *MOBILE* as the number of mobile phone subscriptions per 100 people[4], server as the number of secure web servers per 1 million people (*Server*).

The above variables concerning digitization in financial system were selected after examining the correlation between them. Also, we consider the following new FinTech variables from the study Cornelli, Doerr, Franco, Frost, (2021), for country *c* in year *t*:

- as variables describing a FinTech we considered, FinTech equity financing in relation to GDP (*FinTech*1); logarithm of number of transactions in the FinTech sector in relation to GDP (*FinTech*2)[5].

In the model we consider the impact of the COVID pandemic on the credit market and the performance of banks. In case to test the impact of a pandemic on the banking sector was defined a binary variable defining the COVID pandemic (COV): COV = 1 for 2020–2021 years, COV = 0 otherwise. The model also considers the interactions between variables to estimate the influence of the development of the FinTech companies and the COVID pandemic: $FinTech_{c,t} * COV_{c,t}$.

Based on the equation (1) ten estimates were made. Table 2 in the Statistical Appendix presents the results of the five panel regressions[6]. Table 3 in the Statistical Appendix presents the results of the five linear regressions with multiple fixed effects. The coefficients of the model were estimated using the STATA package.

In Table 2, the negative and significant coefficient α_1 was found for *CR5* (Column 4). Also, in Table 3 the negative and significant coefficient α_1 was found for *CR5* (Columns 4–5). It may mean that concertation in the banking sector had a negative impact on profitability in the EU in the analysed period. Also, the impact of *Size* is negative in the analysed period. This may mean that concentration has negative impact of profitability of traditional banks. However, the impact of GDP is ambiguous in the analysed period.

It should be noted that, the coefficient of the variable *INTER* turned out to be positive, which means that Internet use for Internet banking affected banks' profitability (Columns 2, 4 and 5 in Table 2). In Table 3, also, a positive and significant coefficient α_4 was found for the variable *INTER* (Columns 2, 4 and 5) as well as the coefficient of the variable ATM (Column 4 in Table 3). However, the impact of variable *Card* is insignificant in the analyses period.

Furthermore, variable *Server* also affected the level of profitability in the banking sector. In Tables 2 and 3, a positive and significant coefficient α_5 was found for the variables indicating server as the number of secure web servers per 1 million people (Columns 1, 2 and 4 in Table 2 and in Table 3). However, the impact of variable *MOBILE*, indicating the share of people using mobile devices to access banks via Internet, is insignificant in the analysed period.

[4] Of course, mobile phone users also use the services of traditional banks.
[5] This variable was used for the robustness check in the regressions based on equation (1).
[6] The model was estimated with using panel regressions (FE) and simple regression based on cross-sectional data.

To sum up, those above results confirm that digitalisation, in the banking sector and outside banking sector, had a positive and significant impact on the profitability of banks in the EU.

Finally, in Table 2, a negative and significant coefficient α_6 was found for the variables FinTech (Column 2). Furthermore, in Table 3, also a negative and significant coefficient α_6 was found for the variables FinTech (Columns 2 and 5) This implies that new FinTech had a negative and significant impact on profitability of banking sector in the EU.

On the one hand, digitalisation had a positive impact on bank performance. On the other hand, Fintech companies had a negative impact on bank performance. The impact of COVID pandemic is ambiguous. The results of the quantitative study presented in Tables 2 and 3 showed that variable defining the COVID pandemic has insignificant affect on the performance of traditional banks. Also, in Tables 2 and 3, an insignificant coefficient β_2 was found for the variables to estimate the influence of the development of the FinTech companies and the COVID pandemic. However, the COVID pandemic can be said to have caused accelerated development of digital technologies and of the FinTech companies.

To sum up, the results of the models allowed to confirm that digital technologies and FinTech have the impact on bank profitability.

Summary

In recent years, financial innovation called FinTech has become the main factor in the transformation of the financial sector on a global scale and has impacted the level of competition due to the possibility of increasing the bank's market power, creating new business models, and introducing processes and products. Undoubtedly, technical changes have a significant impact on the shape of traditional banks. By entering the area of activity previously reserved for banks, FinTech companies exert a huge influence on the financial services sector. Traditional banks adapt their business models to digital technologies, which has significant consequences for the future of the entire financial sector. The COVID pandemic has only accelerated this process.

This paper finds, based on the panel data model, that new technologies and FinTech companies have the impact on bank profitability in EU. On the one hand, digitalization had a positive impact on bank performance. On the other hand, FinTech companies may deprive traditional banks from the profit. Furthermore, new players have changed the conditions of competition and create new risks in the financial market.

The move to platform-based business models is changing market structure in financial services. While platforms can harness powerful economic forces to achieve efficiency gains and greater financial inclusion, at the same time, BigTech firms have the potential to become dominant through the advantages afforded by the so-called data-network-activities (DNA). Also, BigTech, which already operate in the

lending market, have immense potential for the development of financial services. Improving data statistics in this area of BigTech remains an important issue that will improve monitoring of this phenomenon and analysis of the competitive advantage of FinTech providers compared to traditional banking services.

References

Akerlof G. (1970), *The market for 'lemons': quality uncertainty and the market mechanism*, "The Quarterly Journal of Economics", 84(3), 488–500.

Bain J.P (1951), *Relation of profit rate to industry concentration: American manufacturing 1936–40*, "Quarterly Journal of Economics", 65, s. 293–324.

Beaumont P.H. (2020), *Digital Finance, Big Data, Start-ups, and the Future of Financial Services*, Routledge, London.

Bikker J.A., Leuvensteijn M. (2014), *A new measure of competition in the financial industry*, Routledge, London.

BIS (2019), *Big tech in finance: opportunities and risks*, Annual Economic Report, Chapter III, Bank for International Settlements, https://www.bis.org/publ/arpdf/ar2019e3.pdf.

BIS (2020), *Central banks and payments in the digital era*, "BIS Annual Economic Report", Chapter III, Bank for International Settlements, https://www.bis.org/publ/arpdf/ar2020e3.pdf.

Besanko D., Thakor A.V. (1992), *Banking deregulation: allocation consequence of relaxing entry barriers*, "Journal of Banking & Finance", 16, 909–932.

Blakstad S., & Allen R. (2018), *FinTech Revolution*, Jeremy Williams.

Boobier T. (2020), *AI and the Future of Banking*, Wiley.

Boot A.W.A., Hoffmann P., Laeven L., Ratnovski L. (2021), *FinTech: what's old, what's new?*, "Journal of Financial Stability", Volume 53, April 2021, 100836, https://doi.org/10.1016/j.jfs.2020.100836.

Boyd J., Nicoló G.D. (2005), *The theory of bank risk taking and competition revisited*. "J. Financ", 60(3), 1329–1343.

Blakstad S., Allen R. (2018), *FinTech Revolution Universal Inclusion in the New Financial Ecosystem*, Palgrave Macmillan.

Buchak G., Matvos G., Piskorski T., Seru A. (2018), *FinTech, regulatory arbitrage, and the rise of shadow banks*, "Journal of Financial Economics", 130(3), 453–483.

Carletti E., Claessens S., Fatás A., Vives X. (2020), *The bank business model in the post-Covid-19 world*, Centre for Economic Policy Research, 18 June, https://voxeu.org/article/bank-business-model-post-covid-19-world.

Cecchetti S., Mohanty M., Zampolli F. (2011), *The real effects of debt*, "BIS Working Papers" No. 352.

Claessens P., Laeven L. (2004), *What drives bank competition? Some international evidence*, "Journal of Money, Credit, and Banking", 36(3) (June 2004, Part 2), 564–583, The Ohio State University Press.

Claessens S., Frost J., Turner G., & Zhu F. (2018), *FinTech credit markets around the world: size, drivers and policy issues*. "BIS Quarterly Review", September, 29–49.

Cornelli G., Doerr S., Franco L., & Frost J. (2021), *Funding for FinTech s: patterns and drivers*. "BIS Quarterly Review", September, 31–43.

Degryse H., Kim M., Ongena S. (2009), *Microeconometrics of Banking: Methods, Applications and Results*, Oxford University Press.

Degryse H., Ongena S. (2008), *Competition and regulation in the banking sector: A review of the empirical evidence on the sources of bank rents*. In: Thakor A.V., Boot A. (Eds.), *Handbook of Financial Intermediation and Banking Elsevier Science*, 483–554.

Demsetz H. (1973), *Industry structure, market rivalry, and public policy*, "Journal of Law and Economics", 16(1), 1–9.

Dewatripont M., Tirole J. (1994), *The Prudential Regulation of Banks*, MIT Press, Cambridge.

Diamond D. (1991), *Monitoring and reputation: the choice between bank loans and directly placed debt*, "Journal of Political Economy", 99, 689–721.

Feyen E., Frost J., Gambacorta L., Natarajan H., Saal M. (2021), *FinTech and the digital transformation of financial services: implications for market structure and public policy*, "BIS IS Papers", No 117.

FSB (2017), *Financial stability implications from FinTech: supervisory and regulatory issues that merit authorities' attention*, Financial Stability Board, https://www.fsb.org/wp-content/uploads/R270617.pdf.

FSB (2019), *FinTech and market structure in financial services: market developments and potential financial stability implications*, Financial Stability Board, https://www.fsb.org/wp-content/uploads/P140219.pdf.

Frost J. (2020), *The economic forces driving FinTech adoption across countries*, "BIS Working Papers", 838, February.

Frost J., Gambacorta L., Huang Y., Shin H.S., Zbinden P. (2019), *BigTech and the changing structure of financial intermediation*, "Economic Policy", vol. 34, no. 100, 761–799.

Haldane A.G. (2012), *On being the right size*, Bank of England, 25 October.

De Haas R., van Lelyveld I. (2006), *Foreign banks and credit stability in Central and Eastern Europe. A panel data analysis*, "Journal of Banking and Finance", vol. 30(7), 1927–1952.

He D., Leckow R., Haksar V., Mancini-Griffoli T., Jenkinson N., Kashima M., Khiaonarong T., Rochon C., Tourpe H. (2017), *FinTech and financial services: initial considerations*, IMF Staff Discussion Note, SDN/17/05.

Hicks J.R. (1935), *The Theory of Monopoly*, "Econometrica", 3(1), 1–20.

Laeven L., Ratnovski L., Tong H. (2016), *Bank size, capital, and systemic risk: Some international evidence*, "Journal of Banking & Finance", No. 69, 25–34.

Lamfalussy A. (2011), *Keynote Speech, The Future of Central Banking under Post Crisis Mandates*, Ninth BIS Annual Conference, BIS Papers, Bank for International Settlements, No. 55.

Liikanen E. (2012), *Final Report of the High-level Expert Group on Reforming the Structure of the EU Banking Sector*, Brussels.

Martin S. (1989), *Industrial Economics, Economic Analysis and Public Policy*, Macmillan Publishing Company, New York, Collier Macmillan Publishers, London.

Morse A. (2015), *Peer-to-Peer Crowdfunding: Information and the Potential for Disruption in Consumer Lending*, "Annual Review of Financial Economics", 7(1), 463–482.

Nicoletti, B. (2017), *The future of FinTech: Integrating finance and technology in financial services. Palgrave Studies in Financial Services Technology*, Palgrave Macmillan, Cham, Switzerland.

Pagano M. (1993), *Financial markets and growth: An overview*, "European Economic Review", 37(2–3), 613–622.

Pawłowska M. (2016), *Does the Size and Market Structure of the Banking Sector have an Effect on the Financial Stability of the European Union?*, "The Journal of Economic Asymmetries", (4), 112–127.

Pawłowska M. (2014), *Konkurencja w sektorze bankowym. Teoria i wyniki empiryczne*, Wydawnictwo C.H. Beck, Warszawa.

Pawłowska M. (2021), *Kredyt w zmieniającej się strukturze rynkowej sektora bankowego - nowe techniki, nowe wyzwania*, Wydawnictwo C.H. Beck, Warszawa.

Petralia K., Philippon T., Rice T., Véron N. (2019), *Banking Disrupted?, Financial Intermediation in an Era of Transformational Technology*, International Center for Monetary and Banking Studies (ICMB), CEPR.

Philippon T. (2019), *The Great Reversal: How America Gave Up on Free Markets*, Belknap Press.

Scardovi, C. (2017), *Digital transformation in financial services*. Springer: London.

Smirlock M. (1985), *Relationship between concentration and profitability in banking*, "Journal of Money, Credit and Banking", 17(1), 69–83.

Stiglitz J.E., Weiss I. (1981), *Credit rationing in markets with imperfect information*, "American Economic Review", 71(3), 393–410.

Tanda A., Schena C.-M. (2019), *FinTech, BigTech and Banks Digitalization and Its Impact on Banking Business Models*, Palgrave Macmillan Studies in Banking and Financial Institutions 2019, s. 47.

Thakor A.V. (2020), *FinTech and Banking*, "Journal of Financial Intermediation", January, vol. 41(C), DOI:10.2139/ssm.3332550.

Vickers J. (2012), *Some economics of banking reform*, University of Oxford, Department of Economics, Discussion Paper Series, 632.

Van Hoose D. (2010), *The Industrial Organization of Banking, Bank Behavior, Market Structure, and Regulation*, Springer-Verlag, Berlin–Heidelberg.

Vives X. (2016), *Competition and Stability in Banking: the Role of Regulation and Competition Policy*, Princeton University Press.

Vives X. (2017), *The impact of FinTech on banking*, w: Navaretti G., Calzolari G., Pozzolo A.F. (red.), *FinTech and Banking. Friends or Foes?* https://blog.iese.edu/xvives/files/2018/02/EE_2.2017.pdf.

Annex

Table 1. Construction of variables and summary statistics of EU of banking sectors data and real economy data (mean and standard deviation (SD). Panel data are observed yearly from 2010–2021.

Variable names	Definitions	Nu. of Obser	Mean	Std. Dev.	MIN	MAX
GDPpc	The gross domestic product per capita	336	35023.6	22098.2	6812.41	118823.6
GDP	The gross domestic product growth rate yoy	336	2.975	2.7812	-1.4	25.1
L_GDP	Loans to GDP %	336	12.907	12.201	0.522	50.905
L_PC	Loans per capita	336	0.065	0.0359	0.0117	0.1802
CR5	Share of the 5 largest credit institutions in total assets[a)]	336	62.96	18.1816	26.18	97.28
HHI	Herfindahl-Hirschman index is the sum of the squares of the market share of individual banks for assets[b)]	336	0.14	0.156	0.0245	1.3
ROA	Return on assets	336	0.61	0.7828	-2.55	3.04
ROE	Return on equity	336	7.1482	8.3403	-29.28	24.07
*FinTech*1	FinTech equity financing in relation to GDP; data from the study: Cornelli, Doerr, Franco, & Frost (2021), pp. 31–43.	266	0.1068	0.468	0	6.69
*FinTech*2	Log of number of transactions in the FinTech sector in relation to GDP; data from the study: Cornelli, Doerr, Franco, & Frost (2021), pp. 31–43.	286	0.00023	0.0004	0	0.0027
Card	Log of number of credit cards	233	1.280	1.379	0.3225	19.665
ATM	Number of Automated Teller Machines per 1000 km^2 (ATM)	283	118.7	130.891	4.79	687.5
INTER	Internet banking (% of individuals)	278	48.44	16.84	2	90
Server	Number of secure servers	295	24628.98	11298.2	39.02	277133.7
MOBILE	number of mobile phone subscriptions per 100 people	281	124.375	15.625	91.9	172.12

a) CRk denotes the market share of the *k* largest banks in net assets.

b) The Herfindahl-Hirschman Index (HHI) is calculated as the sum of the squares of each commercial bank's market share (e.g., in net assets). Index values range from 0 to 1, with higher index values indicating higher market concentration.

Source: own calculations based on ECB, Eurostat data, European Credit Research Institute (ECRI). Data concerning FinTech are observed yearly, data are missing for Romania and Croatia, also some data for 2021 is not available (see: Cornelli, Doerr, Franco, Frost 2021).

Table 2. Empirical Results for the model (FE)

	(1)	(2)	(3)	(4)	(5)
	ROA	ROA	ROA	ROA	ROA
CR5	0.000	0.001	0.001	-0.011**	-0.004
	(0.005)	(0.005)	(0.006)	(0.005)	(0.006)
GDP	0.001	0.001	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Size (L_PC)	-0.299***			-0.387***	
	(0.093)			(0.095)	
Card	0.034	-0.032			-0.047
	(0.031)	(0.056)			(0.145)
Server	0.163***	0.154***		0.152***	
	(0.029)	(0.032)		(0.038)	
FinTech	-0.008	-0.039*	0.014	-0.015	-0.012
	(0.021)	(0.021)	(0.024)	(0.023)	(0.025)
COV	-0.035	0.094	0.977	0.243	0.663
	(0.985)	(1.145)	(0.970)	(1.079)	(1.304)
FINCOV	0.022	0.010	-0.052	0.002	-0.044
	(0.053)	(0.063)	(0.053)	(0.060)	(0.071)
INTER		0.013***		0.019***	0.020***
		(0.004)		(0.004)	(0.005)
ATM			0.000	0.001	
			(0.001)	(0.001)	
MOBILE			0.128		0.212
			(0.589)		(0.595)
Constant	-0.426	-1.112**	-0.674	-0.406	-1.271
	(0.516)	(0.477)	(2.816)	(0.532)	(2.862)
Observations	200	196	164	160	152
Number of krajid	25	25	26	26	25

*** p < 0.01, ** p < 0.05, * p < 0.1.

Source: own calculations.

Table 3. Empirical Results for the model of linear regressions with multiple fixed effects

	(1)	(2)	(3)	(4)	(5)
	ROA	ROA	ROA	ROA	ROA
CR5	-0.003	-0.004	-0.001	-0.010***	-0.006*
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)
GDP	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Size (L_PC)	-0.209***			-0.341***	
	(0.051)			(0.063)	
Card	0.044	-0.046			-0.061
	(0.034)	(0.063)			(0.141)
Server	0.188***	0.169***		0.157***	
	(0.031)	(0.033)		(0.037)	
FinTech	-0.022	-0.072***	-0.019	-0.013	-0.046*
	(0.020)	(0.019)	(0.022)	(0.021)	(0.023)
COV	0.187	1.138	1.455	0.632	1.912
	(1.121)	(1.295)	(1.143)	(1.172)	(1.454)
FINCOV	0.016	-0.038	-0.072	-0.018	-0.104
	(0.060)	(0.072)	(0.063)	(0.066)	(0.080)
INTER		0.010***		0.017***	0.015***
		(0.003)		(0.003)	(0.003)
ATM			0.000	0.001*	
			(0.000)	(0.000)	
MOBILE			0.371		0.433
			(0.492)		(0.488)
Constant	-0.406	-0.212	-1.172	-0.533	-1.406
	(0.407)	(0.420)	(2.411)	(0.455)	(2.407)
Observations	200	196	164	160	152

*** p < 0.01, ** p < 0.05, * p < 0.1.

Source: own calculations.