

No 4(77) 2019

ISSN 2544-7068

---

# BEZPIECZNY BANK

---

**BFG** Bankowy  
Fundusz  
Gwarancyjny

**SAFE BANK** is a journal published by the Bank Guarantee Fund since 1997. It is devoted to issues of financial stability, with a particular emphasis on the banking system.

---

#### **EDITORIAL OFFICE**

prof. Jan Szambelańczyk – Editor in Chief  
prof. Małgorzata Iwanicz-Drozdowska  
prof. Ryszard Kokoszczyński  
prof. Monika Marcinkowska  
prof. Ewa Miklaszewska  
prof. Krzysztof Opolski  
dr Ewa Kulińska-Sadłocha  
Artur Radomski  
Ewa Teleżyńska – Secretary

#### **SCIENTIFIC AND PROGRAMME COUNCIL**

Marek Dietl – Chairman  
prof. Angel Berges Lobera  
prof. Paola Bongini  
prof. Santiago Carbo-Valverde  
prof. Dariusz Filar  
prof. Eugeniusz Gatnar  
prof. Andrzej Gospodarowicz  
prof. Marko Košak  
prof. Anzhela Kuznetsova  
prof. Edgar Löw  
prof. Leszek Pawłowicz  
Krzysztof Pietraszkiewicz  
prof. Andrzej Sławiński  
Zdzisław Sokal  
prof. Rafał Sura  
dr Olga Szczepańska

All articles published in “SAFE BANK” are reviewed.  
All articles present the opinions of the authors and should not be construed to be an official position of BFG.

#### **PUBLISHER**

Bankowy Fundusz Gwarancyjny  
ul. Ks. Ignacego Jana Skorupki 4  
00-546 Warszawa

#### **SECRETARY**

Ewa Teleżyńska  
Telephone: 22 583 08 78  
e-mail: redakcja@bfg.pl



Desktop publishing:  
Dom Wydawniczy ELIPSA  
ul. Inflancka 15/198, 00-189 Warszawa  
tel. 22 635 03 01, e-mail: elipsa@elipsa.pl,  
www.elipsa.pl

Mateusz Folwarski\*  
ORCID: 0000-0001-6109-9110  
[mateusz.folwarski@uek.krakow.pl](mailto:mateusz.folwarski@uek.krakow.pl)

## Challenges of central banks as regulators to the development of the FinTech sector

### Abstract

Companies from the innovative technologies sector implement their solutions on the financial market. Their dynamic development is, amongst other things, caused both a loss of trust in traditional financial market entities and a change in consumer preferences related to the increasing use of financial services through electronic banking, specifically mobile banking. These trends, as well as legal regulations (e.g. the PSD2 Directive), and also the possibility of obtaining banking licenses by FinTech, have led to revolutionary changes on the financial markets. This is why there is a great challenge for central banks in the regulation and constant monitoring of entities from the FinTech sector that provide financial services. In connection with these changes, a survey was conducted among central banks asking them for opinions on the FinTech sector. As part of the research, numerous opinions were obtained which according to central banks indicate, among others, on:

- the positive impact of the FinTech sector on the banking market
- the need for cooperation between the banks and the FinTech sector, rather than establish competition
- the specific analysis of cybernetic risk as a threat due to the growing scale of FinTech's operations

**Key words:** central bank, FinTech sector

**JEL:** E58, G21

### Introduction

Companies from the FinTech sector are among the most rapidly developing institutions operating in the financial market. Their dynamic development is possible using technology that is playing an increasingly important role in the world of fi-

---

\* dr Mateusz Folwarski – University Economics in Cracow.

nance. The growth of internet and mobile phones users has had an impact on the growing number of electronic banking users, especially mobile banking. Therefore, innovative companies implementing new solutions in the field of financial services, offer their services mainly through a mobile access channel. Therefore, they incur relatively low costs associated with their operations than traditional financial institutions – especially banks – which must maintain their branch network and incur other costs related to their operations. FinTech companies are changing the financial market, but they can also pose a type of threat to the stability of the entire sector. Therefore, the role of central banks as regulators/supervisors, may significantly affect the scale of operations of these entities, as well as play a key role in ensuring the security of the entire financial system. The aim of this study was to analyse the opinions of central banks as market regulators in the field of FinTech market development. The article consists of an introduction and an analysis of the subject literature related to the definition and classification of FinTech companies. It also describes elements of the services provided by the FinTech sector for market regulators. Finally, it presents surveyed opinions of central banks on changes taking place in the financial market under the developmental influence of companies from the FinTech sector. The article is then finalised with a summary and conclusion.

## 1. FinTech sector – a definitional approach

Traditional banks play a key role in the financial market. However, the rapid technological development has affected the functioning of the economic world so significantly that electronic banking channels are the *main* channel of providing financial services<sup>1</sup>. This has influenced the dynamic development of companies from the FinTech sector, which provide their services mainly through this access channel. In addition, the digitisation of financial services favours and accelerates the development of financial innovation. Following the financial crisis of 2007–2009, there was a crisis of confidence in financial institutions around the world that were responsible for the turmoil in the financial markets. The main goal of FinTech companies is to compete with traditional methods of financial service delivery<sup>2</sup>. According to de Hann and others, one of the reasons for the fast expansion of the FinTech sector is the decline in public confidence in traditional financial institutions, which occurred as a result of the financial crisis<sup>3</sup>. All of these variables lead to the dynamic development of the so-called FinTech market. The term FinTech is an abbreviation of the term ‘financial technology’, which means companies or representatives of companies that combine financial services relying on modern, innovative techno-

<sup>1</sup> J. Skan, J. Dickerson, S. Masood, *The future of fintech and banking: Digitally disrupted or reimaged?* Tech. rept. Accenture, 2015, <http://www.accenture.com/us-en/Pages/insight-futurefintech-banking.aspx> (access 10.01.2019).

<sup>2</sup> W. Szpringer, *Fintech i blockchain – kierunki rozwoju gospodarki cyfrowej*, Studia BAS, nr 1(57), Warszawa, 2019, p. 9.

<sup>3</sup> J. de Haan, S. Oosterloo, D. Schoemaker, *Financial markets and institutions, a European perspective*, Cambridge: Cambridge University Press, 2015, pp. 54–60.

logies<sup>4</sup>. Defining the concept of 'FinTech' is extremely difficult due to its different interpretation<sup>5</sup>. According to the FSB, an entity from the FinTech sector is most often defined as a company that offers innovative technology in financial services. These may result in the emergence of new business models, mobile applications, processes and even products that have a significant impact on the provision of financial services by financial institutions<sup>6</sup>. FinTech companies are also described as companies operating on the financial market, whereby constituting a new special category of parabanks<sup>7</sup>.

FinTech can be considered as a wide and heterogeneous ecosystem that consists of different articulations or structures, more or less diffused on the market, that can be considered as financial activities which provide an added value by means of digital technologies<sup>8</sup>. The main goal of companies from the FinTech sector is certainly the maximisation of value and/or profit. The services offered by these companies on the financial market lead to a reduction in costs. They also lead to an improvement in the provision of services as well as faster access to them<sup>9</sup>. The development of the FinTech sector has been possible through the clear advantages of this sector (over the banking sector) in the so-called IT infrastructure<sup>10</sup>. Financial market regulations that enable the provision of banking services to companies from the FinTech sector affect the ability of these entities to conduct their business (e.g. including the PSD2 Directive). In addition to this, special attention should also be paid to the changing preferences and lifestyles of customers in the banking sector<sup>11</sup>. The speed of receiving services and conducting real-time transactions has accustomed consumers to standards that have not yet been offered. The FinTech firms have the necessary resources and in-house skills to develop their new or revamped products and services internally. This is because this approach is considered to provide more agility and flexibility in terms of business development than partnerships, which may be more time-consuming<sup>12</sup>.

<sup>4</sup> G. Dorfleitner, L. Hornuf, M. Schmitt, M. Weber, *FinTech in Germany*, Springer International Publishing, 2017, p. 5.

<sup>5</sup> J. Harasim, K. Mitrega Niestrój, *FinTech – dylematy definicyjne i determinanty rozwoju*, [w:] Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu, nr 531, Wrocław, 2018, p. 171.

<sup>6</sup> FSB, *Financial Stability Implications from FinTech*, June 2017, p. 7.

<sup>7</sup> W. Szpringer, *Nowe technologie, a sektor finansowy. FinTech jako szansa i zagrożenie*, Wydawnictwo Poltext, Warszawa 2017, p. 9.

<sup>8</sup> European Parliament, *Competition issues in the Area of Financial Technology (FinTech)*, July 2018, p. 47.

<sup>9</sup> *The FinTech revolution: A wave of startups is changing finance – for the better*, The Economist 2015, 415(8937), p. 13.

<sup>10</sup> M. Laven, D. Bruggink D, *How FinTech is transforming the way money moves around the world: An interview with*, Journal of Payments Strategy & Systems, 2016, pp. 6–12.

<sup>11</sup> B. Nicoletti, *The Future Of Fintech: Integrating Finance And Technology In Financial Services*, Nicoletti, Bernardo, n.p.: Cham Springer, HoWeR, EBSCOhost, 2017, p. 4.

<sup>12</sup> EBA, *Report on the impact of FinTech on payment institutions' and e-money institutions' business models*, July 2019, p. 15.

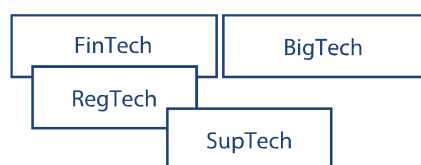
Therefore, FinTech's business models are mainly based on offering a pre-paid service free of charge or a much cheaper service. Companies from the FinTech sector can change the shape of the entire financial system by reducing the costs of doing business and accessing services, whereby improving the quality of financial services offered and by creating a more diversified and competitive financial system<sup>13</sup>.

In addition, blockchain technology is revolutionising the financial services market. Banks often charge high fees and commissions for transactions – especially in the payment sector – and blockchain allows such transactions to be carried out virtually free of charge and in real time. As stated by J. Stiglitz, the banks before the financial crisis 2007–2009 did their best to increase the costs of transfers in every possible way<sup>14</sup>. According to the creators of one of the most popular publications<sup>15</sup> on blockchain technology, this system will revolutionise the entire financial services market. According to the authors, the blockchain technology will not only break the monopoly on the financial market, but will also significantly affect the revenues of banks and their business models. There are several key aspects that emphasise the role of blockchain technology and its impact on the financial sector, which can include: trust, transaction cost, speed, risk reduction, and open software.

The dynamic development of FinTech services results in the lack of a standard classification of this sector. As part of the work of the European parliament the following classification of areas within which FinTech sector entities operate<sup>16</sup> are presented as follows: retail banking (deposits and loans), payments, cash flow, Forex market, digital currencies, asset management, personal finances, InsurTech (insurance markets), and infrastructure for new technologies.

In the FinTech sector, numerous subsectors can be distinguished, which due to cooperation on the financial market, affect financial innovations in various market segments (Figure 1).

**Figure 1. Division of the FinTech sector**



Source: own based.

<sup>13</sup> *The FinTech revolution: A wave of startups is changing finance – for the better*, The Economist 2015, 415 (8937), p. 13.

<sup>14</sup> J.E. Stiglitz, *Lessons from the Global Financial Crisis of 2008*, s. 321–339, [https://www8.gsb.columbia.edu/faculty/jstiglitz/sites/jstiglitz/files/2010\\_Lessons\\_Global\\_Financial\\_Crisis\\_Seoul.pdf](https://www8.gsb.columbia.edu/faculty/jstiglitz/sites/jstiglitz/files/2010_Lessons_Global_Financial_Crisis_Seoul.pdf) (access 10.01.2019).

<sup>15</sup> D. Tapscott, A. Tapscott, *Blockchain. Rewolucja*, Wydawnictwo PWN, Warszawa 2019.

<sup>16</sup> *Competition issues in the Area of Financial Technology (FinTech)*, Policy Department for Economic, Scientific and Quality of Life Policies, European Parliament, July 2018, p. 13.

As a result of numerous proposals for defining companies in the FinTech sector and their classification, one of the most complete market segmentations was carried out at the Basel Committee on Banking Supervision (BCBS). Within the FinTech sector classification, were entities dealing with<sup>17</sup>:

- credit, deposit, and capital-raising services (crowdfunding, marketplace lending, mobile banks, credit scoring);
- payments, clearing and settlements services:
  - retail (mobile wallets, peer-to-peer transfer, digital currencies);
  - wholesale (value transfer networks, FX wholesale, digital exchange platforms);
- investment management services (high-frequency trading, copy trading, e-trading, robo-advice);
- market support services (portal and data aggregators, ecosystems, data applications, distributed ledger technology, security, cloud computing, mobile technology, artificial intelligence).

Interestingly, the phase of digital financial technology illustrates that products and services in the entire financial industry may be supported by IT. This has also led to considerations whether the regulatory institutions were in place to take advantage of these innovations and to contain the risks inherent in activities that occurred electronically<sup>18</sup>. If existing financial regulations, (for example consumer protection rules or prudential requirements), do not apply equally to BigTech/FinTech firms entering financial services, then this can lead to lower costs and a competitive advantage for BigTech/FinTech. This however, may also lead to higher risk-taking<sup>19</sup>.

## 2. Central banks and the FinTech sector

The rise of FinTech – the use of technology and innovation to provide financial products and services – is transforming the financial services landscape and will be a key economic growth opportunity<sup>20</sup>. Very often, banks in Poland did not pay attention to companies from the FinTech sector, claiming that they were not a threat to them. Nevertheless, the operational scale of these entities in addition to the increasing number of banking licenses granted to FinTech companies, constitutes a significant competitive challenge for the banking sector. Bank licenses granted to FinTech companies have led to the formation of modern banks. These are primarily the so-called neobanks/challenger banks that offer banking services without incurring such banking costs as traditional banks. Therefore, FinTech companies that

<sup>17</sup> Basel Committee on Banking Supervision, *Implications of fintech developments and bank supervisors*, Sound Practices, Basel Committee on Banking Supervision, 2018, p. 9.

<sup>18</sup> R. Alt, R. Beck, M.T. Smits, *FinTech and the transformation of the financial industry*, Electronic Markets, August 2018, Volume 28, Issue 3, pp. 235–243.

<sup>19</sup> J. Frost, L. Gambacorta, Y. Huang, H. Song Shin, P. Zbinden, *BigTech and the changing structure of financial intermediation*, BIS Working Paper, no 779, 2019, p. 10.

<sup>20</sup> *Delaware in the FinTech future*, June 2019, p. 4.

can offer a full range of banking products that have achieved lasting competitive advantages. In addition to the received license, the deposit guarantee in the EU affects the increase of consumer confidence in the services offered by neobanks. The wide range of activities evident in British and German neobanks may pose a significant threat to the stability of the entire financial sector.

The threat related to the more extensive operations of FinTech is one of the key tasks in the field of monitoring of their activities by the central banks. Nevertheless, companies from the FinTech sector also implement their innovative solutions in central banks and supervisory institutions. *Regulatory Technology* (RegTech), defined as a FinTech subassembly, is a sector that has been dynamically developing in recent years. It has attracted not only numerous start-up companies, but also companies such as IBM and other global consulting companies. Companies from the RegTech sector are very difficult to define, because it is a relatively young sector. Nevertheless, *The Institute of International Finance*, defines RegTech companies as entities using technology to more effectively address regulatory requirements and compliance with applicable law<sup>21</sup>. Entities in the RegTech sector focus on solutions that are based on technology, whilst mitigating or solving regulatory and supervisory problems faced by financial institutions. Very often such companies use digital data and complicated computer programs to replace old processes, organisational and IT structures, and analytical tools. They improve on the decision-making process in traditional financial institutions. As part of the RegTech sector, two segments of activity of these companies can be distinguished:

- RegTech for financial institutions, supervisors and regulators
- RegTech for supervisors and regulators – SupTech.

The FinTech sector has a significant impact on the shape of the financial sector around the world. Its offering of its solutions to central banks and supervisory institutions signals the need for a thorough analysis of these entities, as well as constant monitoring of their situation.

### 3. Opinion of central banks on FinTech in the light of the survey

The disruptive implication of FinTech is often accompanied heated debate with different orientations on its purposes, potentialities and related benefits, but above all on its relative risks for consumer protection and financial stability. The debate focuses on regulatory approaches to adopt. FinTech is building consensus in support of digital innovation and new technologies applied to the financial sector, but is also meeting the dissent of those who believe there is evidence that it risks the financial system as a whole<sup>22</sup>. The dynamic development of the FinTech sector is a challenge

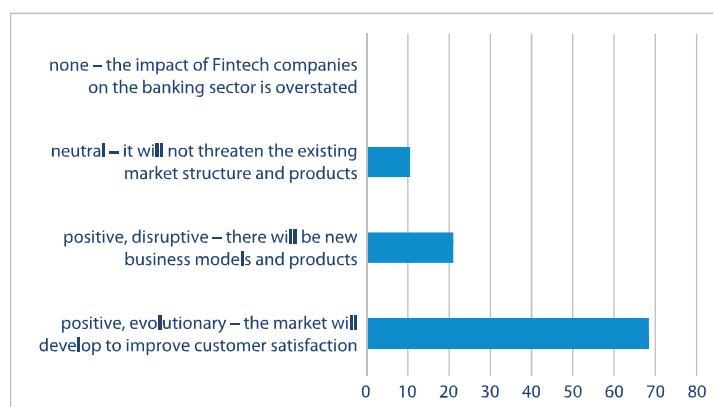
<sup>21</sup> Institute of International Finance, *RegTech: Exploring Solutions for Regulatory Challenge*, October 2015, <https://www.iif.com/topics/regtech/regtech-exploring-solutions-regulatory-challenges>.

<sup>22</sup> M.T. Paracampo, *FinTech between regulatory uncertainty and market fragmentation. What are the prospects for the technological single market of financial services?* Studia prawno – ekonomiczne, T.CX, 2019, p. 119.



especially for central banks, which must consider the level of regulation of this sector and supervise the developmental scale of individual institutions. Therefore, in the period December 2018 – January 2019, a survey was conducted. It was addressed to central banks, asking them for opinions on the developmental direction of the FinTech sector and the impact of these institutions on the banking market. The survey was sent to central banks around the world, including to all central banks of the EU countries. 19 responses were received, including 13 from the central banks of EU countries, three from the European central banks of non-EU countries, and three responses from central banks outside Europe. The results of the survey are illustrated in Figures 2–9. Central banks were asked to express their opinion on the impact of the FinTech sector on the banking market (Figure 2). The vast majority of central banks suggested that the FinTech sector will have a positive, evolutionary impact on the banking market, which will improve customer satisfaction as part of their use of financial services. It is worth noting that none of the central banks indicated the answer suggesting the lack of impact of the FinTech sector on the banking sector.

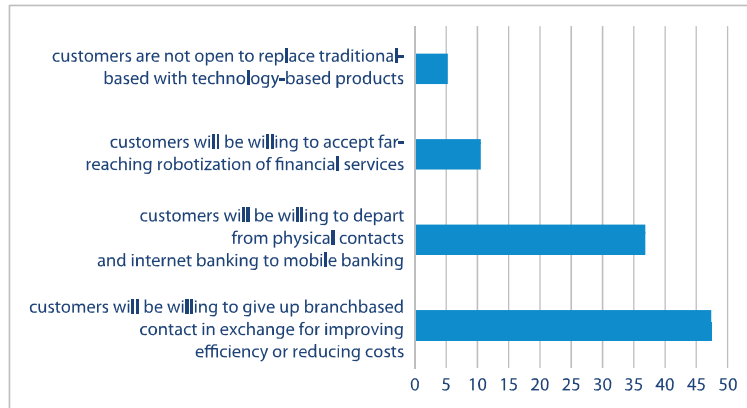
**Figure 2. In the regulatory assessment of your institution, the impact of Fintech sector on the financial markets will be (%)**



Source: own study.

Central banks were asked to express their opinion on the openness of consumers of financial services to technological challenges. The vast majority of central banks responded that consumers are willing to give up physical contact in branches of financial institutions in exchange for improving efficiency or reducing service costs (47%). They also responded that consumers will be willing to give up physical contact in branches of financial institutions and online banking and go to mobile banking (37%) (Figure 3).

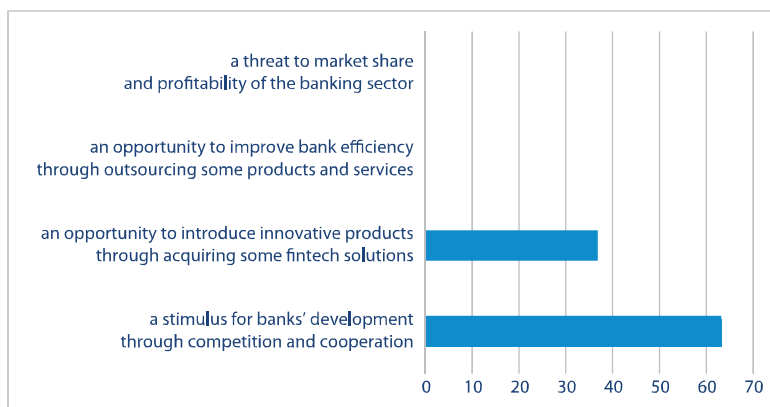
**Figure 3. Assessment of the customers' openness to technological challenges (%)**



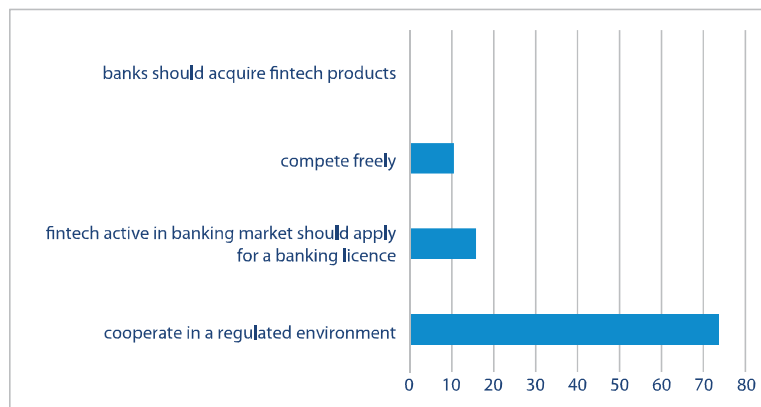
Source: own study.

Central banks note the significant impact of FinTech companies' activities on the banking sector. In the opinion of central banks, the development of companies from the FinTech sector will be an incentive for banks to their own development, as well as enable the introduction of innovative products by traditional banks through the acquisition of some FinTech solutions (Figure 4). Nevertheless, central banks believe that FinTech companies should not be taken over by traditional banks (Figure 5). In the strong opinion of central banks, FinTech and traditional banks should cooperate with each other in a regulated environment. Nevertheless, some central banks point to an even higher level of regulation of companies in the FinTech sector, pointing to the need to apply for a banking license by FinTech.

**Figure 4. The development of the Fintech sector will pose (%)**

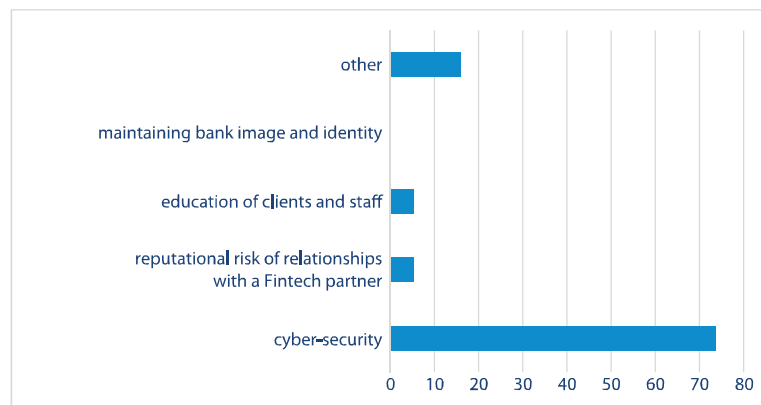


Source: own study.

**Figure 5. According to your assessment, banks and fintech firms should (%)**

Source: own study.

The dynamic increase in the number of FinTech companies and the increasing scale of these entities' activities may lead to generating various types of risks related to their operations, and which effects may have consequences for the whole financial system. Therefore, in identifying the biggest problems related to banks' cooperation with the FinTech sector, central banks mentioned cybernetic security (Figure 6).

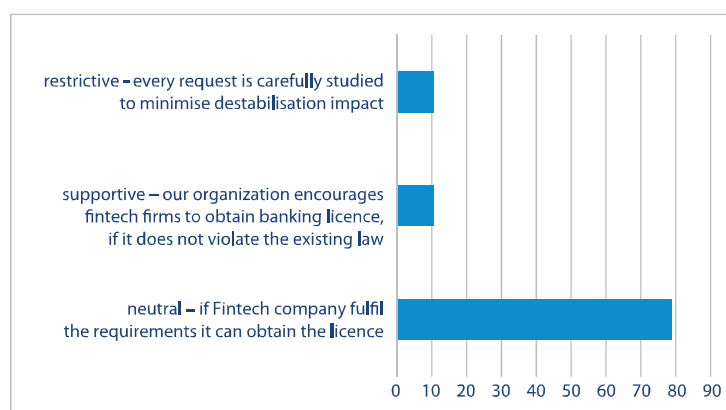
**Figure 6. The main problems with bank cooperation with the Fintech sector in the open architecture model is (%)**

Source: own study.

Central banks indicate an increasing need to regulate this sector so as not to jeopardise the stability of the financial sector. Therefore, they suggest applying for a FinTech banking license. Hence, as part of the survey central banks were asked about

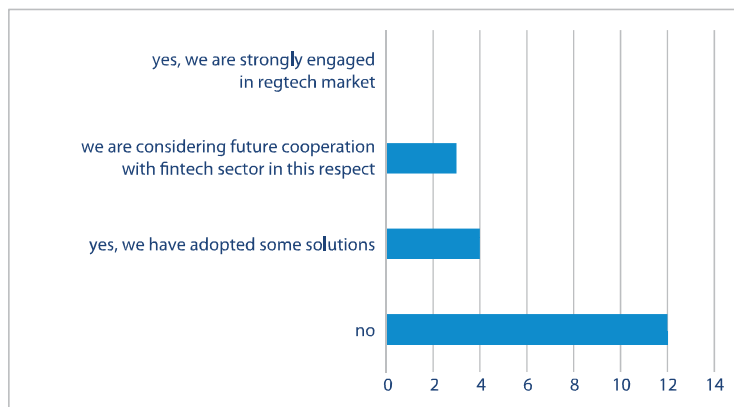
their dominant attitude towards granting banking licenses to FinTech (Figure 7). In the vast majority (79% of responses) central banks indicated a neutral attitude – suggesting that if FinTech meets the requirements, it can obtain a banking license.

**Figure 7. In your institution, what is a dominant tendency in assessing requests for banking licenses from the Fintech sector (%)**

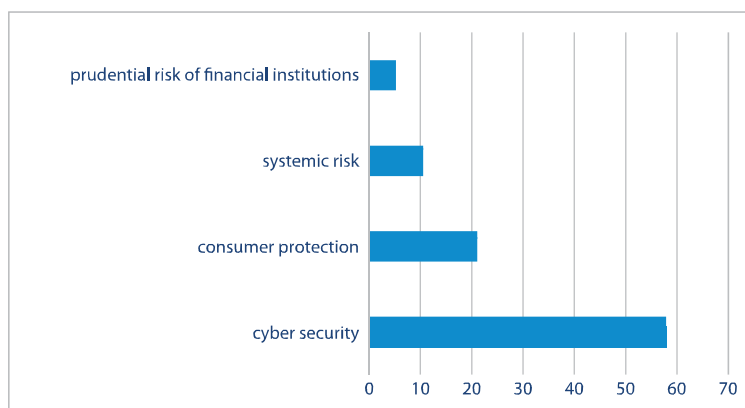


Source: own study.

The vast majority of central banks that responded to the survey do not yet cooperate with FinTech companies within the RegTech sector (Figure 8). Central banks, noting the dynamic growth of the FinTech market and the cross-border provision of financial services by them, pay particular attention to several types of risks related to the activities of these entities. In the vast majority of central banks' responses, this is a problem related to cyber security, which is the biggest challenge for central banks in monitoring the activities of these companies. Nevertheless, central banks also pay attention to regulatory challenges related to consumer protection on the financial market and systemic risk (Figure 9).

**Figure 8. Does your institution use RegTech solutions (%)?**

Source: own study.

**Figure 9. The biggest regulatory challenge related to Fintech and new technologies are (%)**

Source: own study.

## Conclusion

Companies from the innovative technologies sector are revolutionising the financial market. Their initial activity was not immediately noticed as competitive, by traditional banks that adopted passive attitudes towards FinTech companies. Nevertheless, the dynamic development of these companies, which mainly use electronic sales channels for financial services, forced banks to change the perception of these companies, as they deprive banks of a significant part of their revenues (e.g. in the payments sector). The FinTech sector is a relatively young market, while compa-

nies established in this market segment typically started their operations several years ago. The dynamic development and obtaining of banking licenses by FinTech, (e.g. Revolut, Atom Bank, N26) may pose a significant challenge for central banks in maintaining the stability and security of the financial market. Central banks notice the scale of FinTech's operations and suggest that traditional banks cooperate with these entities in a regulated environment. Among the biggest threats related to the functioning of new entities on the market, central banks notice the problem of cybercrime, which is related to FinTech's main distribution channel.

## Bibliography

Alt R., Beck R., Smits M.T., *FinTech and the transformation of the financial industry*, Electronic Markets, August 2018, Volume 28, Issue 3.

Basel Committee on Banking Supervision, *Implications of fintech developments and bank supervisors*, Sound Practices, Basel Committee on Banking Supervision, 2018.

*Competition issues in the Area of Financial Technology (FinTech)*, Policy Department for Economic, Scientific and Quality of Life Policies, European Parliament, July 2018.

de Haan J., Oosterloo S., Schoenmaker D., *Financial markets and institutions, a European perspective*, Cambridge: Cambridge University Press, 2015.

*Delaware in the FinTech future*, June 2019.

Dorfleitner G., Hornuf L., Schmitt M., Weber M., *FinTech in Germany*, Springer International Publishing, 2017.

EBA, *Report on the impact of FinTech on payment institutions' and e-money institutions' business models*, July 2019.

Frost J., Gambacorta L., Huang Y., Song Shin H., Zbinden P., *BigTech and the changing structure of financial intermediation*, BIS Working Paper, no 779, 2019.

FSB, *Financial Stability Implications from FinTech*, June 2017.

European Parliament, *Competition issues in the Area of Financial Technology (FinTech)*, July 2018.

Harasim J., Mitreġa-Niestrój K., *FinTech – dylematy definicyjne i determinanty rozwoju*, [in:] Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu, nr 531, Wrocław, 2018.

Institute of International Finance, *RegTech: Exploring Solutions for Regulatory Challenge*, October 2015, <https://www.iif.com/topics/regtech/regtech-exploring-solutions-regulatory-challenges>.

Laven M., Bruggink D., *How FinTech is transforming the way money moves around the world: An interview with*, Journal of Payments Strategy & Systems, 2016.

Nicoletti B., *The Future Of Fintech: Integrating Finance And Technology In Financial Services*, Nicoletti, Bernardo, n.p.: Cham Springer, HoWeR, EBSCOhost, 2017.

Paracampo M.T., *FinTech between regulatory uncertainty and market fragmentation. What are the prospects for the technological single market of financial services?* Studia prawno-ekonomiczne, T.CX, 2019.

Skan J., Dickerson J., Masood S., *The future of fintech and banking: Digitally disrupted or reimagined?* Tech. rept. Accenture, 2015, <http://www.accenture.com/us-en/Pages/insight-futurefintech-banking.aspx>.

Stiglitz J.E., *Lessons from the Global Financial Crisis of 2018* [https://www8.gsb.columbia.edu/faculty/jstiglitz/sites/jstiglitz/files/2010\\_Lessons\\_Global\\_Financial\\_Crisis\\_Seoul.pdf](https://www8.gsb.columbia.edu/faculty/jstiglitz/sites/jstiglitz/files/2010_Lessons_Global_Financial_Crisis_Seoul.pdf).

Szpringer W., *Fintech i blockchain – kierunki rozwoju gospodarki cyfrowej*, Studia BAS, nr 1(57), Warszawa 2019.

Szpringer W., *Nowe technologie, a sektor finansowy. FinTech jako szansa i zagrożenie*, Wydawnictwo Poltext, Warszawa 2017.

Tapscott D., Tapscott A., *Blockchain. Rewolucja*, Wydawnictwo PWN, Warszawa 2019.

*The FinTech revolution: A wave of startups is changing finance – for the better*, The Economist 2015, 415 (8937).