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# A DYNAMIC PERSPECTIVE ON COMPETITION BETWEEN TRADITIONAL BANKING AND BANKING FINTECHS

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**Summary:** The emergence of innovative financial services is having a huge impact on competition in the banking services market. The aim of the article is to show, from a dynamic perspective, the foundations of a model of competition occurring in the banking world between traditional financial institutions and fintechs. A dynamic two-sector model of competition is proposed with built-in feedback mechanisms in the form of demand side economies of scale. The model shows changes in market shares after a challenger enters a bank's market with a portfolio of services as substitutes for the bank's product offer. The traditional and new entities do not adjust the scope of their products over time, instead competing using those already available. The model obtained three economically significant steady states. Further analysis of the time path showed that the sector is heading towards an oligopolistic market structure in which both entities stabilize their market shares. However, in the event of low initial market penetration by traditional banks, a new innovative entity (a challenger bank) will completely dominate the sector, creating a monopolistic market structure.

**Keywords:** fintech, banking sector, dynamic model.

## 1. Introduction

The rapid development of information and communication technologies is changing the face of the financial sector. This is leading to the emergence of a new category of financial intermediation companies that, by offering substitute services, are challenging traditional banking for the first time in many years.

The aim of this article is to indicate, from a dynamic perspective, the foundations of a model of the competition occurring in the banking world between traditional financial institutions and fintechs. The hypothesis is as follows: the banking sector is heading towards an oligopolistic market structure with stabilized market shares.

The analysis of the basics of the operations of these challenger banks and their gain in market position was implemented in the context of both feedback mechanisms affecting equilibrium processes and the dynamics of the economic system leading to the realization of the indicated goal.

Most neoclassical models eliminate positive feedback by relying on four abstract assumptions (Garbicz, 1996): perfect information, the perfect mobility of goods, the perfect divisibility of goods, and the rational operation of entities. The waiver of these assumptions provides the opportunity for positive feedback loops in the form of demand side economies of scale (network effects) (Dąbrowski, 2016, p. 18) and the effects of herd behaviour (Dąbrowski, 2015).

## 2. Fintechs in the banking sector – sources and catalysts of change

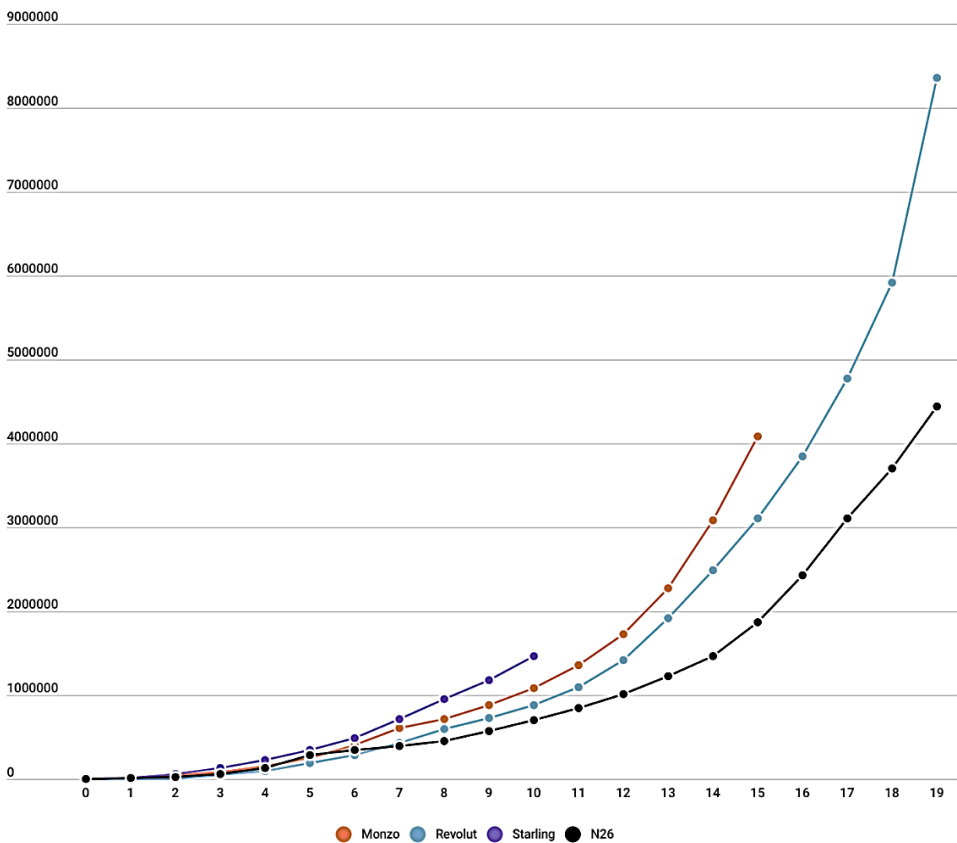
Traditional banking, as known for hundreds of years, has undergone significant transformation due to developments in communication technologies. These changes have provided the foundations for electronic banking – i.e. they have made it possible to access funds accumulated in a bank account and ancillary services via electronic devices, including stationary and mobile devices. New technologies, along with their dissemination, have not only changed the profile of banks, but have also created the basis for the development of independent payment service systems by third parties. The second decade of the 21st century is a time of dynamic development of innovative client-oriented financial enterprises that break the industry's existing functional patterns. This has been possible largely due to the decreasing barriers of market entry resulting from the implementation of new technologies. Obviously, to maintain the security of the financial system the acceptance of deposits is still reserved only to entities with a banking license; however, traditional sources of income for banks or processes within the banking system are the subject of competition with other specialized enterprises. Such services fall primarily in the areas of payment services, currency exchange, offering loans and credits, and financial management. In addition, fintechs are increasingly applying for banking licences in order to be able to completely take over the role of traditional banks. At the same time, the changing

regulatory environment, including the principle of a single license in the EU, facilitates competition.

Undoubtedly, the ability to compete on the banking market in the European Union has also dramatically increased due to the implementation of the PSD2 directive which introduced the concept of open banking to the regulatory order and practice. Pursuant to the provisions of the directive, banks must (with the client's consent in each instance) provide access to their clients' accounts to external entities: other banks, fintechs, payment services – referred to as TPP (Third Party Providers). More broadly, the manifestations of open banking are the processes that have dynamically changed the banking sector around the world in recent years and which are associated with the emergence of the BaaS concept (Banking as a Service) and the API (Application Programming Interface). APIs make it easier to connect banks' systems with those of other service providers, which can also independently create APIs used by banks to offer their services to the TPPs' own customers. In the open API scenario, business data are shared with entities with which banks, fintechs, and e-commerce companies have no formal relationships. As a result, customers gain access to their accounts and view the financial history of the systems and applications they use. The open API also brings many other benefits to customers: simplified identity confirmation, the ability to connect bank accounts with different operators to initiate payments, better management of own resources and financial liabilities by integrating accounts with different operators, faster transfer of data to process transactions, receiving competitive offers from many lenders, implementing online accounting (automatic data collection), monitoring multiple accounts, and detecting fraud attempts (Ciesielski, 2020). The API offers opportunities for both banks and third parties such as fintechs. Within the broadly understood concept of open banking, new entities are being created that offer services previously only available from traditional banks. These are the so-called neobanks, challenger banks, and iBanks (Nguyen Trieu, 2015). Neobanks are companies that do not have a banking licence but offer banking services using the licence of a cooperating bank. They usually provide services via mobile applications and do not have physical branches. A neobank may offer access to services such as maintaining an account, asset management, granting of credits, accepting deposits, and brokerage in the purchase of participation units in investment funds (Rubini, 2019). Some neobanks additionally entice customers by providing services in the field of crowdfunding, P2P loans, cryptocurrency trading, and robo-advice.

In the case of an iBank, the business model of a neobank is transformed based on the monetization of the bank's customer data — e.g. by directing specific marketing messages based on a behaviour pattern. An example is the defunct startup Loot, addressed to students, which was not able to obtain the financing necessary to continue operations. Some observers define iBanks as the Google or Facebook of the banking sector.

The last category mentioned in the context of open banking is challenger banks, newly established licensed banking enterprises that are distinguished by a fresh approach to customer needs. Challenger banks compete with traditional institutions by offering better quality services or trying to better understand and meet customer needs, and sometimes operating in market niches to address the needs of specific customer groups. Often, challenger banks are the next stage in the evolution of neobanks, but they can also act as banks from their inception. To some observers the Polish mBank exemplifies a challenger bank. Among foreign solutions, it is worth mentioning the German N26 and the British Starling, Atom Bank, and Revolut, which were conceived as neobanks and eventually acquired banking licences.



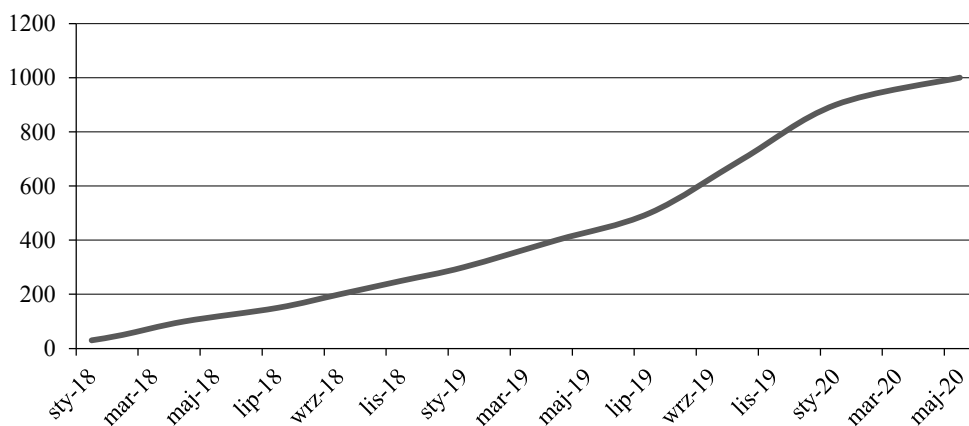
**Fig. 1.** The number of challenger bank customers in the quarters following launch (by number of mobile app downloads)

Source: Sensor Tower by: <https://sifted.eu/articles/challenger-banks-monzo-starling-revolut-n26-compared/> (26.11.2020).

Open banking is a catalyst for a revolution in the banking market as it enables customers to choose solutions that best meet their expectations while maintaining their preferred service interface. Thanks to their advantages, fintechs open to customers may entice the clients of the existing market leaders without providing the full range of services of traditional banking entities. They can become hubs connecting the product offers of all entities providing services to retail clients, while being the institutions of first choice.

The changes on the market are well illustrated by quantitative indicators. The growth rate of customers in active challenger banks in Europe is interesting. According to forecasts, Revolut was expected to have nearly 16.5 million customers at the end of 2020 (Statista, 2020a). Other banking fintechs have been growing at an equally impressive pace, as shown in Fig. 1 – to ensure comparability of data, they are compared based on the number of downloads of the mobile application in consecutive quarters following the initiation of service.

The data on the last three years of Revolut's provision of financial services to Polish clients are particularly interesting (Fig. 2). The collected data take the shape of a logistic curve.



**Fig. 2.** The number of Revolut fintech clients in Poland (January 2018-May 2020) (in thousands)

Source: own study based on data published by Revolut (26.11.2020).

It is also worth noting that the pace of growth in the number of traditional bank customers has stabilized in recent quarters, while a clear trend can be seen in the transition of an increasing number of customers from traditional banking relationships (branches) to electronic channels (computers and mobile devices) [Statista 2020b]. Undoubtedly a long-term trend is visible here, further reinforced by the circumstances resulting from the effects of the coronavirus pandemic.

### 3. The dynamics of feedback loops between banks and challenger banks

The emergence of fintechs, especially challenger banks with a banking licence, has disrupted the balance in the banking market. The change in the structure of the system is a source of dynamics in the economic system, perpetuated by the feedback mechanisms. In the case of the model of the incumbent bank–challenger bank, there are both stabilizing negative feedback and positive feedback, where the effect supports the cause, resulting in further accumulation of the effect (demand side economies of scale appear). The occurrence of demand side economies of scale (also called network effects) in the case of fintechs is consciously induced by their creators and results from the unique features of these enterprises in using modern mobile technologies and building a customer community. A good instrument for analysing the directions of changes in this dynamic model is the phase portrait<sup>1</sup> – i.e. a family of trajectories in the coordinate system representing the behaviour of the object observed under constant excitation, but for different initial conditions, which are then the only cause of changes observed in the system (Czemplik, 2012).

In order to describe the behaviour of the competing markets of traditional banks and challenger banks, a model was built to illustrate how the entrance into the market by a fintech with a standard of service that substitutes for the bank's product offer affects the parameters of this dynamic system. For the sake of simplicity it was assumed that both traditional banks and fintechs do not adjust their offered range over time.<sup>2</sup>

Let us proceed to the analysis of the model of incumbent bank–challenger bank with network cardinality (Papadimitriou, Gogas, & Tabak, 2013)  $B_i$  and  $B_c$ <sup>3</sup>, respectively, with feedback in the form of network effects. The model's assumptions are as follows:

- the increase in the network cardinality of  $B_i$  bank's network causes a mechanism of positive feedback on the challenger's market
- the increase in the network cardinality of  $B_c$  challenger bank's network triggers a negative feedback mechanism in the bank's market.

This means that the services on the traditional banking market are not fully compatible with those offered by the challenger bank. However, the services offered by the challenger bank are fully compatible with the traditional banking market. The

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<sup>1</sup> This is a graphical way to visualize the dynamic properties of linear or nonlinear objects. The easiest way to obtain phase portraits is by simulation methods based on given differential equations. The number of trajectories necessary to recreate a portrait can be significantly reduced due to one of the basic properties - the trajectories do not intersect because the systems under study are deterministic.

<sup>2</sup> In reality, traditional banks take up competition with fintechs, while fintechs also modify their products over time, primarily trying to become independent from partners in the banking industry. This article presents possible strategies for both types of players in the banking market.

<sup>3</sup> Defined in this case as the possibility (potential number) of connections between customers (e.g. to transfer funds).

greater the number of clients of the challenger bank, the greater the tendency to abandon the services of a traditional bank. For the analysis, the authors used a system of first degree nonlinear differential equations:

$$\begin{cases} \frac{dB_i}{dt} = 5B_i(1 - B_i) - B_c \\ \frac{dB_b}{dt} = 5B_c(1 - B_c) + B_i \end{cases}, \tag{1}$$

where:  $B_i$  – the network cardinality of the traditional bank market network,  
 $B_c$  – the network cardinality of the challenger bank market network,  
 $t$  – time.

The system of equations (1) together with the assumptions given above will be called the model of two interdependent logistics markets with weak linear network effects.

To illustrate the relationship between  $B_c$  and  $B_i$ , a phase portrait of the system of equations (1) was constructed, placed in the phase space. The determination of isoclines is the starting point. Figure 3 shows the nullclines of  $dB_c/dt = 0$  and  $dB_i/dt = 0$ . The isoclines of a given variable are curves on which this variable is independent of time. The independent variable  $t$  is represented by arrows in the phase portrait. Steady states — namely solutions that do not change over time — are located at the intersection of the isoclines of both variables. Isoclinic intersections also establish sub-areas in the phase space, in which each variable has a fixed direction of change.

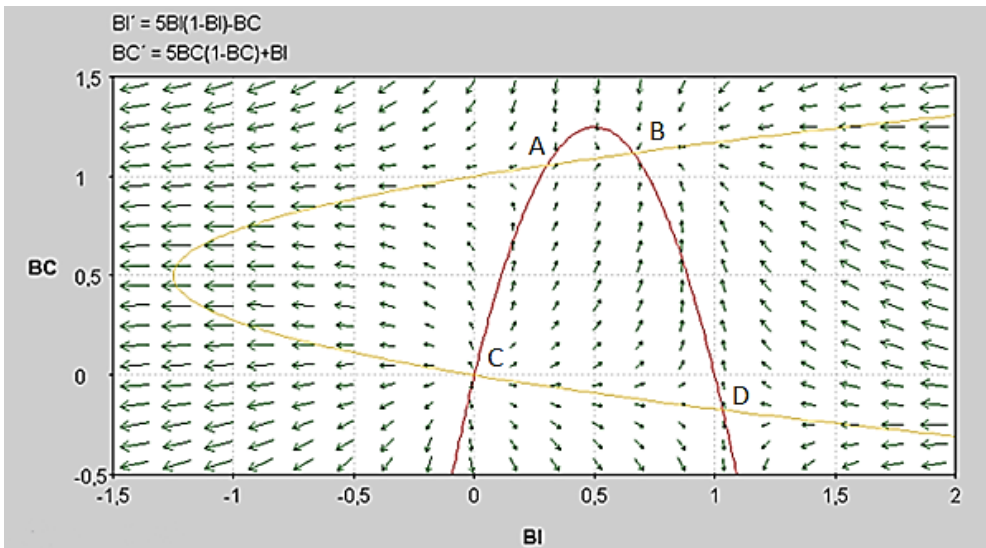


Fig. 3. Zero rise isoclines  $dB_c/dt = 0$  and  $dB_i/dt = 0$

Source: own study in the dfield and pplane program.

The authors obtained four steady states, but only three make economic sense (A, B, C) because for non-negative initial data they are unambiguous and non-negative. The steady states are as follows:

A (0.30376; 1.0575) – saddle point

B (0.66222; 1.1184) – nodal sink

C (0; 0) – spiral source

D (1.034; -0.17587) – saddle point.

The determination of the phase portrait of a non-linear system in a sufficiently large vicinity of the equilibrium points enables the determination of the areas of stable initial conditions (stability areas). Figure 4 shows the boundaries of the stability regions and orbits in the phase portrait. Equilibrium point A (0.30376; 1.0575) is a saddle point (repeller<sup>4</sup>), equilibrium point B (0.66222; 1.1184) is a nodal sink (attractor<sup>5</sup>), and equilibrium point C (0; 0) is a spiral source (repeller).

In the described system, dynamic properties such as stability depend on the initial conditions and on the forcing function at the entrance. For this model, the

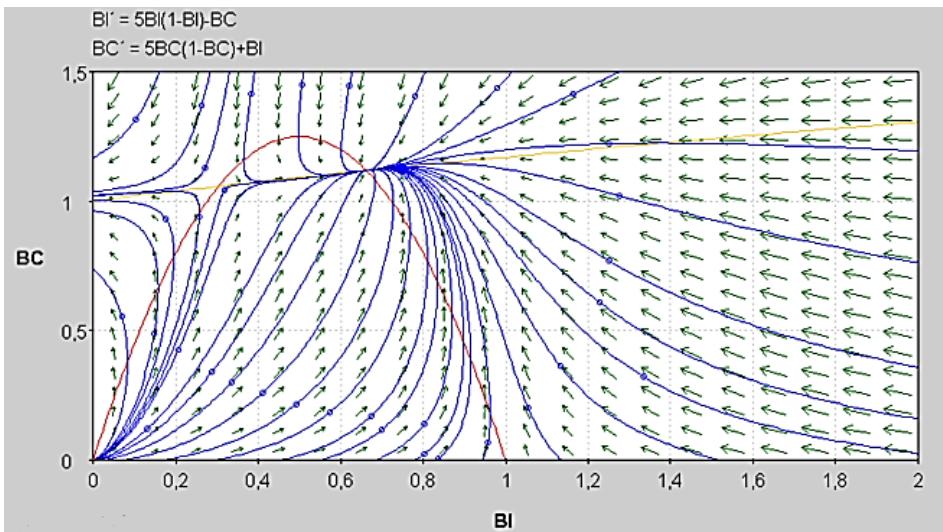


Fig. 4. Phase portrait for 
$$\begin{cases} \frac{dB_i}{dt} = 5B_i(1-B_i) - B_c \\ \frac{dB_c}{dt} = 5B_c(1-B_c) + B_i \end{cases}$$

Source: own study in the field and plane program.

<sup>4</sup> The opposite of an attractor, in dynamical systems theory.

<sup>5</sup> An attractor is a set of states (points in the phase space), invariant under the dynamics, towards which neighbouring states in a given basin of attraction asymptotically approach in the course of dynamic evolution (Mathworld Wolfram, 2020).



initial conditions are the original market share. In regard to the Polish banking system, it can be concluded that its market share is the same as ‘banking’, which World Bank data indicate amounted to approximately 87% in 2018. At the same time, challenger banks (then functioning as neobanks), competing with traditional banking, had only just appeared in Poland.

If traditional banks have a relatively large market share, the entry of the challenger bank will lead to a decline in the market share of a traditional institution, but not to its destruction. The system will follow the equilibrium point B (0.66222; 1.1184), which is an attractor (stable node). The analysis of the time path shows that ultimately the market will be a duopoly (Fig. 5). However, if the initial market share is small (this solution is excluded in the examined case), then the starting point may be in the orbit of the A equilibrium point (0.30376; 1.0575), which is the saddle point. There is only a small chance of hitting a stable path, while much more probable is hitting an unstable path. Each of the instances of the unstable path will lead to the disappearance of traditional banking and the complete monopolization of the market

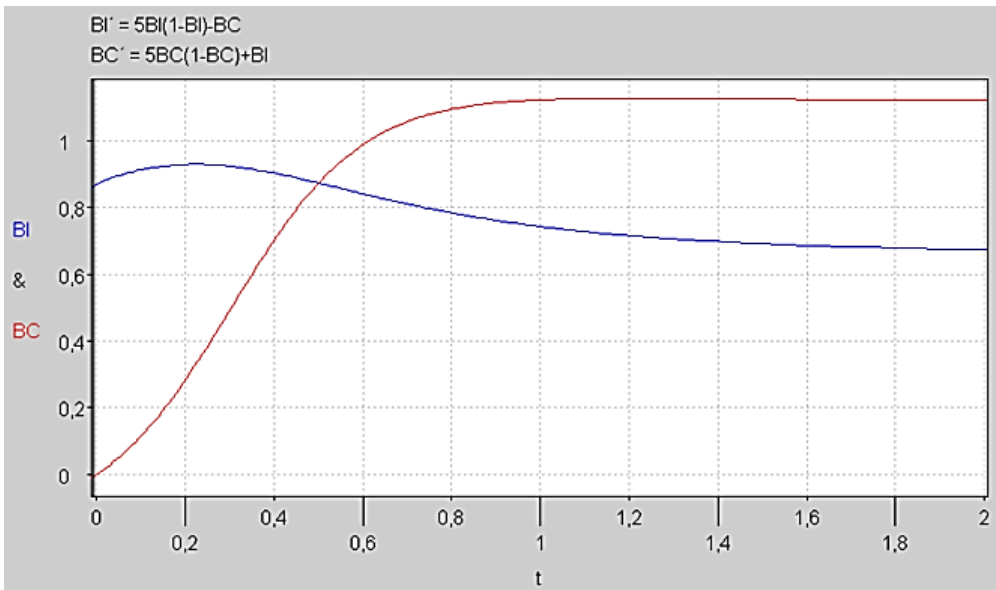


Fig. 5. Time paths for  $\begin{cases} \frac{dB_i}{dt} = 5B_i(1-B_i) - B_c \\ \frac{dB_c}{dt} = 5B_c(1-B_c) + B_i \end{cases}, B_c = 0, B_i = 0,87. B_c = 0, B_i = 0,87.$

Source: own study in the dfield and pplane program.

by challenger banks<sup>6</sup>. This is due to the unilateral gain in the positive feedback ( $B_i$  induces strong positive linear network effects on  $B_c$ ) and the unilateral weakening of the positive feedback ( $B_c$  induces negative linear network effects on  $B_i$ ).

The presented model is an attempt to capture the dynamic market conditions accompanying the competition of traditional banks and fintechs in the form of challenger banks. As the study shows, the direction of changes depends largely on the starting point, as well as the intensity of the feedbacks. With the appearance of strong network effects related to new technological standards, which are the basis for the functioning of innovative enterprises challenging the market, there may be radical changes in the functioning of the financial sector, and it may be monopolized by new players and new standards. The stronger the network effects, the more likely the scenario of a market takeover and monopolization by challenger banks.

#### 4. Strategies for responding to changes accompanying competition

Naturally, it cannot be assumed that in these dynamic conditions traditional banking will remain passive towards new technologies (Folwarski, 2019). Nowadays, banks are increasingly trying to defend their market position against fintechs by implementing several popular strategies.

The most common strategy of Polish banks in acquiring innovative solutions is the purchase of external services developed by technology companies. Pursuing this strategy allows them to quickly reduce deficiencies in their range of services, while also rationalizing the banks' back offices and reducing operating costs.

Another strategy is using the banks' own resources in attempting to maintain market advantage through intensive investment in new technologies and the process of modernization of their product offers. Current research shows enormous interest in investments in innovative solutions among the management of traditional banks. There is also widespread awareness that institutions that had previously focused on modernization coped better with the effects of the pandemic (Banking Exchange, 2020). The Polish market is also seeing the growing importance of this strategy for financing banking innovations.

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<sup>6</sup> Each portrait trajectory represents the evolution of an object's state from a specific initial condition. If the system is stable, it tends to the point of equilibrium; if it is unstable, it moves away from this point. The direction of changes (time arrow on the trajectory) is clearly defined on the basis of the properties of the derivative function: if the derivative is positive, the function grows; if the derivative is negative, the function decreases; a derivative of 0 means the maximum or minimum of the function. Phase portraits of nonlinear systems can have one or more equilibrium points – depending on the solution to the static equation. A nonlinear system can be stable/unstable globally, but if the system has more equilibrium points it can be stable at some points and unstable at other points, and then one distinguishes between local and global stability/instability. The determination of the phase portrait of a nonlinear system in a sufficiently large vicinity of the equilibrium points enables the determination of the areas of stable initial conditions (stability areas).

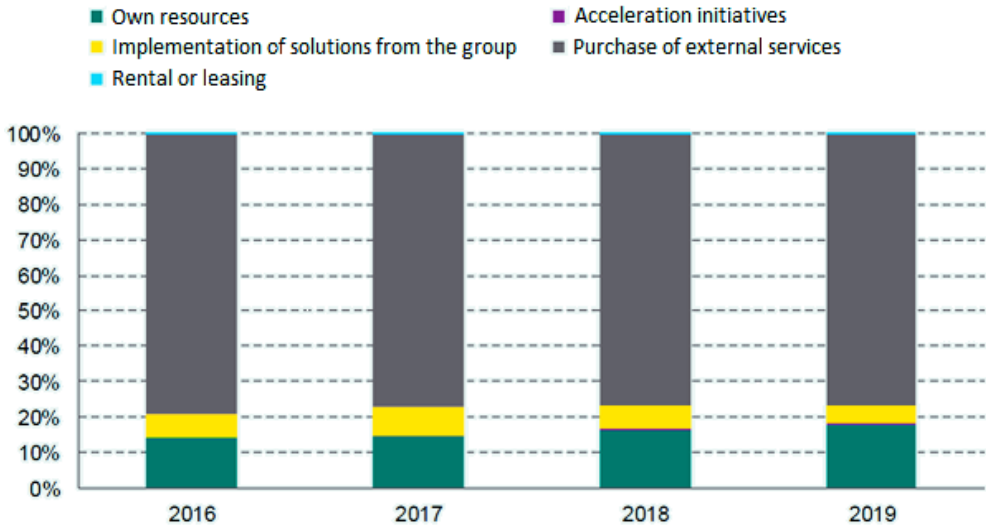


Fig. 6. Paths of acquiring innovative solutions by Polish banks

Source: findings of the survey for (NBP, 2019).

The third strategy entails searching for competitive advantage through acquisitions within the fintech market. In this case, traditional banks invest in the shares of prospective fintechs. Examples can be found both on the Polish<sup>7</sup> and global markets (Medium, 2020).

The fourth scenario is to create strategic alliances with technology companies, including fintechs. An example of such activities may be startup support programmes tied to the opportunity for priority implementation of emerging innovative solutions.<sup>8</sup> There are also alliances with financial companies already offering their services to clients, and thanks to the cooperation, both sides expand their range of services.<sup>9</sup>

Naturally, the largest banks often feature hybrid strategies combining elements of the foregoing strategies.

At the same time, competition between challenger banks and traditional banks is influenced by the actions taken by fintechs. Along with the increase in the number of clients, raising capital, and anchoring their market position, fintechs also take actions aimed at maximizing the sources of competitive advantage, among others, applying

<sup>7</sup> For example, the investment of three Polish banks in the Autenti company (WNP, 2020).

<sup>8</sup> For example, Let's Fintech organized by PKO Bank Polski, under which the bank together with startups establishes business cooperation and implements new technologies, provides its API and develops the area of open banking, and invests in the most promising technology companies (Fintech PKO, 2020).

<sup>9</sup> A good example is the cooperation of neobanks with traditional banks.

to regulators for further licences necessary to independently offer financial services to clients, including the most important banking licence. Enterprises basing their advantage on new technologies seem to be more aware of the role of innovation, hence their consistent search for new advances by the best managed fintechs.

As indicated above, the presented model is an introduction to further research on the behaviour of competing enterprises in dynamically changing technological conditions and the increasingly pronounced effects of positive feedback in the form of network effects.

## 5. Conclusion

The development of ICT is changing the shape of the financial sector. The emerging new types of enterprises offering financial intermediation are able to challenge traditional banking. The ability to compete on the banking market in the European Union has increased due to the implementation of the PSD2 directive through the practical introduction of the concept of open banking. As part of open banking, one can observe the formation of new entities: neobanks, challenger banks, and iBanks.

The paper analysed the theoretical foundations of competition between traditional financial institutions and financial technology innovators. A dynamic two-sector model of competition with built-in feedback mechanisms in the form of demand side economies of scale is proposed. The adjusted model shows changes in market shares after a fintech enters the market with a portfolio of services presenting substitutes for the bank's product offer. Traditional entities and new entrants do not adjust the scope of their product range over time and compete using only the products already on offer.

The model obtained three economically significant stable states. By determining the starting point close to the real point of banking, the sector will move towards the attractor which is a stable node. Further analysis of the time path shows that the sector is heading towards an oligopolistic market structure in which both entities stabilize their market shares. However, in the case of low initial market penetration by traditional banks, a new innovative entity (a challenger bank) will completely dominate the sector, creating a monopolistic market structure.

The study shows changes in financial services markets caused by weak network effects in the case of both low and high initial market penetration by traditional financial market entities. Further questions concern feedback mechanisms with strong network effects. These types of effects may result in the rapid elimination of traditional entities by new technologically innovative entities, regardless of initial market penetration.

Further issues concern dynamic competition with changing strategies (ranges of services) of both entities, a seemingly much more difficult task. In this case, the

response functions will depend on changes in market shares and the strength of the network effects. The introduction of such additional dependencies will significantly complicate the model and make it difficult to solve. Yet another challenge that must be addressed is the calibration and estimation of model parameters. The authors plan to carry out these tasks in their subsequent research.

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## KONKURENCJA POMIĘDZY TRADYCYJNĄ BANKOWOŚCIĄ A FINTECHAMI BANKOWYMI W UJĘCIU DYNAMICZNYM

**Streszczenie:** Silna konkurencja ze strony fintechów ma ogromny wpływ na konkurencję na rynku usług bankowych. Celem artykułu jest wskazanie modelowych podstaw zachodzącej w świecie bankowości gry konkurencyjnej pomiędzy tradycyjnymi instytucjami finansowymi a fintechami w ujęciu dynamicznym. Zaproponowano dynamiczny dwusektorowy model konkurencji z wbudowanymi mechanizmami sprzężeń zwrotnych w postaci popytowych korzyści skali. Model pokazuje zmiany w udziałach w rynku po wejściu na rynek challenger banku z substytucyjnym dla oferty banku portfolio usług. Tradycyjni i nowi gracze nie korygują zakresu swoich ofert w czasie, a do konkurowania jedynie używają już posiadanych w ofercie produktów. W modelu uzyskano trzy sensowne ekonomicznie stany stacjonarne. Dalsza analiza ścieżki czasowej pokazała, że gałąź dąży do oligopolistycznej struktury rynkowej, w której oba podmioty ustabilizują swoje udziały w rynku. W przypadku jednak niskiej początkowej penetracji rynku przez banki tradycyjne nowy innowacyjny podmiot (challenger bank) całkowicie zdominuje gałąź, tworząc monopolistyczną strukturę rynkową.

**Słowa kluczowe:** fintech, sektor bankowy, model dynamiczny.