

Relationships between forms of financing enterprises as part of banking group activities in Poland in 2009-2019

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Abstract

The article aims to analyze the mechanism explaining the causal relationships between the values of loans to enterprises in banks, assets of factoring companies, and assets of leasing companies in the short and long term, on the Polish financial market in the period 2009-2019. The following research methods were used as part of the study: cross-elasticity of demand, ordinary least squares regression (OLS), the Granger causality analysis was carried out, which was preceded by tests for the presence of unit roots, the Johansen test based on the matrix trace test and the maximum matrix eigenvalue test, and the vector autoregression model with an inbuilt error correction mechanism was used (VECM) with analysis of the impulse response function. The examined financial products are substitutable. Econometric models were developed to enable planning of future values of business loans at banks, assets of factoring and leasing companies. The study complements the pecking order theory by presenting the dynamics of the order of financing sources from the creditor's side. The low level of equity in factoring and leasing companies can be a challenge for regulators. As part of the study, the presence of cointegration between the studied variables was established. Based on the obtained results, postulates were formulated for the directions of the cross-distribution policy and the pricing policy of products financing the activities of enterprises within banking capital groups.

JEL: C10, G10, G21, G23, G30

Keywords: VECM, Granger causality, Johansen test, cross-elasticity of demand, banking, leasing, factoring, price management

Introduction

In addition to granting loans, which is the basic form of supplying businesses with capital, banks use several other solutions that include leasing and factoring (Wiatr & Niedziółka, 2018). The findings of research on the profitability of banks in the EU-27 focus on recommendations which, in addition to credit risk indicators, signalize the need for monitoring

liquidity, improving competitiveness and cost optimization, as well as diversifying sources of income, all of which have a significant impact on banks' profitability (Petria, Capraru, & Ihnatov, 2015). Diversification in banking activity, achieved through wider use of the opportunities offered by financial intermediation, can be a source of significant benefits (Brewer III, 1989; Elsas, Hackethal, & Holzhäuser, 2010; Gallo, Apilado, & Kolari, 1996). Banks undertake such activities to survive (Allen & Santomero, 2001). It should be noted that there may be conflicts between different forms of financing within the same capital group, but those banks that will be able to at least mitigate the effects of such conflicts and achieve a state in which individual types of business complement each other and can benefit from significant economies of scale (Allen & Santomero, 2001). The expansion of non-bank activities in the years 1978–1986 on the US market significantly reduced the risk of bank-holding companies, which leads to the conclusion that limiting further expansion in the non-bank activity of bank holding companies would reduce their ability to engage in risk diversification (Brewer III, 1989). Nevertheless, a completely different view, based on research on the US banking sector may be found in the literature. According to this view, diversification does not provide benefits; at the general aggregate level, aggregate non-interest income is much more volatile than traditional net interest income (Stiroh, 2004). Banks are increasingly involved in leasing and factoring activities, as evidenced by aggregated data on European and American banks. In 2018 in Poland, leasing companies associated with banks financed 78.1% of the total value of fixed assets, according to the data of leasing companies associated with the Polish Leasing Association (ZPL, 2018). As for factoring activities, according to the 2018 data published by the Polish Factors Association, the share of factoring companies associated with banks, calculated based on the turnover value, amounted to 86.9% (PZF, 2018). The reason for taking up the subject of this article is limited amount of research on the interrelationships between various forms of financing enterprises within banking capital groups, and in particular the relationships between funding provided by banks, and that made available by leasing and factoring companies. Given the large presence of banks on the leasing and factoring market, it is possible to discuss the model of financing enterprises within banking capital groups. This structure has a positive impact on the measures of banks' efficiency (increase in commission and interest income, improvement of customer relations thanks to a comprehensive financing service included in many forms of financing, increased customer satisfaction and number of transactions).

According to research based on regression analysis, the leasing activity of banks may reduce the level of credit risk and have a positive impact on the reduction of provisions for non-

performing loans (although it should be noted that Hansen's statistics show very low validity of this instrument) (Bülbül, Noth, & Tyrell, 2014). It is also noteworthy that banks and leasing companies associated with car, vehicle, and road transport dealers remain leaders (e.g. in terms of the number of concluded deals) of the leasing market in Poland (In 2018 Volkswagen Leasing GmbH Sp. z o. o. Branch in Poland was the leader of the Polish market in terms of the number of concluded deals according to the Polish Leasing Association), but banking capital groups successfully manage to supplement this market (many producers of PP&E are still unable to offer their own financing services for their products). Entities associated with banking capital groups dominate the national and European rankings (according to Leaseurope). The same phenomenon is also observed in the American market. A study of the 1992-2012 data published by the US community banks showed that the community banks which engaged in the financing of equipment leasing achieved better results than those that did not lease equipment (Kelly, Khayum, & Price, 2013). On the one hand, increased financing capacity, adaptation to unstable operations and maximization of the current value of tax breaks are important factors when choosing a lease to finance an investment, but, on the other hand, tax breaks and accounting policy solutions have little impact on taking advantage of the operating lease (Caskey & Ozel, 2019). According to a study conducted in China on the relationship between a financial lease and the process of interest rate liberalization, based on the dynamic panel model and quantile estimation assessment, financial lease helps streamline and promote the process of interest rate liberalization, and regulatory arbitrage is an important feature of financial lease since the financial lease is essentially a typical loan and focuses on serving the same financial channels, thus financial lease can widen the use of a bank loan which contributes to the development of the real economy (Xu & Shi, 2019). According to a study conducted in Bangladesh, out of 46.67% of entities surveyed in the sector of small and medium-sized enterprises that obtained formal access to financing from financial institutions, only 7.14% use leasing (Hossain, 2013). Factors such as tax benefits connected with personal and corporate income tax as well VAT, quick granting procedures, the assistance offered by employees of leasing companies, the strong and reliable capital base of banks cause that the popularity of leasing is systematically growing. Given that it is currently one of the main forms of financing investments in Poland, it does not come as a surprise that banks have become the main distributors of leasing products (Cirin, 2009). Banks have undergone a significant evolution in entering the leasing market. They had difficulty integrating corporate and leasing activities (Remolona & Wulfekuhler, 1992), were not able to quickly acquire detailed knowledge of the market, in particular of machines and devices considered to be less liquid (Gavazza, 2010).

Banks played a major role in the consolidation of the market of leasing services in Poland (e.g. Credit Agricole acquired the European Leasing Fund, which was not previously affiliated with any bank, and the largest bank in Poland PKO Bank Polski bought its leasing company from the Austrian Raiffeisen Bank operating on the Polish market). Existing tax conditions and applicable accounting rules cause numerous discrepancies between the factoring and leasing models used by banks and those applied by factoring and leasing companies, which in turn leads to the financing of various customer groups and therefore is beneficial for enterprises, (the global scale and scope of external financing are increasing). Leasing has been perceived as an essential alternative to bank loans for a long time (Adedeji & Stapleton, 1996; Ang & Peterson, 1984; Bowman, 1980; Deloof, Lagaert, & Verschueren, 2007; Eisfeldt & Rampini, 2009; Finucane, 1988; Kraemer-Eis, Botsari, Gvetadze, Lang, & Torfs, 2018; Krishnan & Moyer, 1994; Schmit, 2004). The importance of leasing is growing, and in recent years banks have become important market players offering leasing services through their subsidiaries specializing not only in leasing (leasing companies) but also in long-term rental, real estate leasing. It is not uncommon for leasing companies to grant loans, which makes them direct competitors of their parent banking companies. Currently, with the rapidly growing e-commerce sector, one can also observe a dynamic increase in sales of leasing services financing purchases in online stores. Such services work as a substitute for installment sales and constitute yet another area of competition with the parent banks and their banking competitors. Leasing companies strongly stimulate the development of insurance sales as well as additional products (e.g. fuel cards or maintenance services). Leasing can increase one's debt service capacity (Eisfeldt & Rampini, 2009). Research based on the example of German regional banks shows that offering leasing services allows banks to gain some freedom in dealing with their clients. One observes a significant positive impact of leasing activity on banks' profitability, which, to a great extent results from the fact that they gain additional commission acting as intermediaries in the sale of leasing services and potential risk of a default on the part of the customer does not affect the bank (Bülbül et al., 2014). Significant changes in the Basel III regulatory framework (called Basel IV) will come into effect in the years 2022-2027. Leasing companies operating on the Czech market would probably not have difficulty meeting the potential tightening of capital requirements (Svítal, 2019). Since the majority of leasing companies belong to large financial groups and their financial statements are consolidated, these companies must comply with regulatory requirements, including the capital adequacy requirements currently listed in Basel III. Leasing companies are to some extent in a similar position to their parent banks although their risk status and risk management, particularly credit risk, are fundamentally

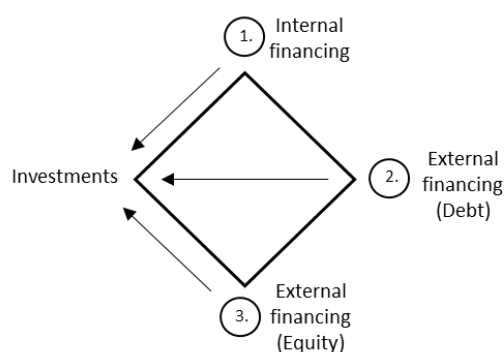
different (Svítil, 2019). A report prepared for Leaseurope by the University of Cologne in December 2019, based on a set of detailed contract level information coming from twelve major European leasing companies operating in 25 countries, shows the appropriate calibration of leasing exposures compared to the actual risk profile based on the current CRR principles. In the case of all three credit risk regulatory approaches, capital requirements are significantly higher than unexpected losses in the slowdown simulation (the standard approach indicates the highest regulatory capital requirements, followed by the F-IRB approach, with the A-IRB approach leading to the lowest regulatory capital requirements). Due to the expected increase in capital required from banks in Europe, lessors who use bank loans may expect that their financing will be limited and more expensive in the future, which will reduce the ability of the leasing industry to provide businesses and consumers with leasing services (Leaseurope, 2019).

Factoring activity is becoming increasingly important for the Polish economy, which results from the increase in factoring turnover and the number of companies using factoring services (Sieradzka, 2012). Banks played a key role in the development of factoring services (e.g. The First National Bank of Boston or Mittelrheinische Kreditbank Dr. Horbach & Co. KG), gradually merging with specialized factoring companies and creating actual factoring associations operating on a regional and international scale (Jando, 2016). Short-term structured trade financing was traditionally given preferential treatment by regulators and financial agencies, based on the premise that it was one of the safest, most secure, and self-financing forms of banking assets (Auboin & Blengini, 2014). The results indicate that, in comparison with other banking products, reverse factoring, used in the financing of the supply chain, may be subject to preferential regulatory treatment both in terms of capital adequacy requirements and liquidity regulations (Elliot & Lindblom, 2018). As the competition among factoring companies increases, the cost of factoring will gradually decrease compared to the cost of a bank loan (Podedworna-Tarnowska, 2005). Factoring is one of the most popular forms of financing business operations (Czerwińska-Kayzer & Bieniasz, 2008). It is used by enterprises that already make full use of funds offered by a bank, or those that have limited access to bank loans (no collateral and no credit history) (Sieradzka, 2012). Profitability surveys conducted in the German factoring sector, which is dominated by banks, show that the profitability of factoring entities operating within financial holding companies (owned by banks) is lower than that of companies operating outside of the bank financial holding companies (Koch, 2015). T. Hartmann-Wendels and A. Stöter show that companies, especially those with a higher level of risk, use factoring for short-term financing or to diversify their funding sources, and the need for independence from banks plays an important role in making factoring decisions (Hartmann-

Wendels & Stöter, 2012). M. Barowicz and K. Kreczmańska-Gigol emphasize the positive impact of factoring on the capital structure of enterprises (Barowicz, 2006; Kreczmańska-Gigol, 2013), and D. Korenik defines it as the strategy of the future (Korenik, 2007). M. Czyż indicates that factoring is an important tool for supporting entrepreneurship, mainly because it eliminates payment gridlocks and has a positive impact on the financial liquidity of enterprises (Czyż, 2011). Low popularity of factoring among Polish companies is a complex and multi-threaded issue, and the underlying cause is not the cost of the service, but entrepreneurs' knowledge of factoring (Grzywacz, 2017). Factoring not only enables long-term financial planning, and, but also helps businesses improve relations with contractors by extending payment dates for delivered products or services (Nowak & Przybylski, 2017). According to a study based on the TOPSIS method (The Technique for Order of Preference by Similarity to Ideal Solution), in which the 2009-2016 financial statements of seven leasing and factoring companies listed on the Istanbul Stock Exchange (BIST) were analyzed based on eight financial indicators, only one enterprise achieved a result close to a positive ideal with a TOPSIS value of above 0.50, and six companies scored below 0.50 recording negative values (0.40 being the average score). These enterprises should increase their profitability, improve liquidity and effectively use their assets to improve financial results (Özçelik & Küçükçakal, 2019). Growing turnover dynamics and an increasing number of financial institutions offering factoring services cause that the popularity of factoring is growing and entrepreneurs increasingly perceive it as a more effective form of liquidity management (Wejer-Kudęłko & Ogrodnik, 2018). According to research, overdraft and factoring are complementary forms of financing, however, because factoring will not be the most optimal form of financing in all conditions. Choosing the optimal financing source should always be preceded by a profitability analysis (Ogrodnik & Wejer-Kudęłko, 2018).

Bank loans, leasing, and factoring are currently the most popular forms of financing business operations. Given the de facto model of financing, an important research topic revolves

Figure 1. General concept of the Pecking Order Theory.

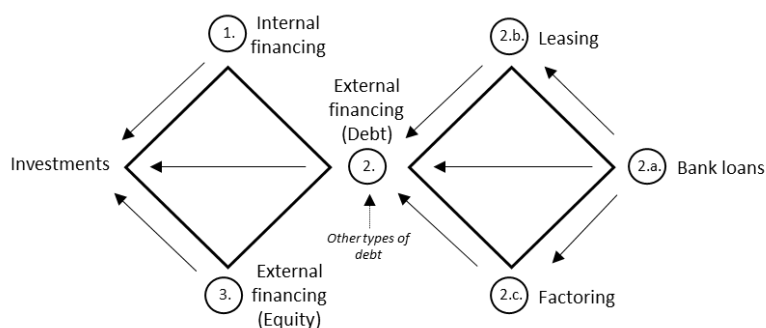


Source: own study.

around the question of whether under this model there are significant relationship building correlations, and whether it is possible to determine a regression function based on these phenomena, which could provide the basis for making business decisions or setting directions for future strategies or tactics. From a practical point of view (practitioners and managers in banks, leasing and

factoring companies), there is also a question of whether one form of financing can stimulate the growth of others and what the direction and level of this stimulation may be. One of the reasons for analyzing the activity of banks within the presented forms of financing is the dynamics of the increase in the assets of factoring and leasing companies, which has been very high in recent years. This kind of analysis, however, requires broader research on the policy of enterprise financing policy implemented by the banking sector. The analysis conducted in this article is based on the financial results for the years 2014 to 2018 when the domination of banking capital groups in the field of factoring and leasing activities was visible. Another practical issue is the extent to which a change in the level of lending results in a change in the level of factoring and leasing assets in companies associated with banks. In addition to the aforementioned matters, research focuses on the issue and nature of the synergy effect, aiming to determine whether leasing and factoring services offered along with

Figure 2. The model of financing enterprises within the banking capital group vs. The Pecking Order Theory.

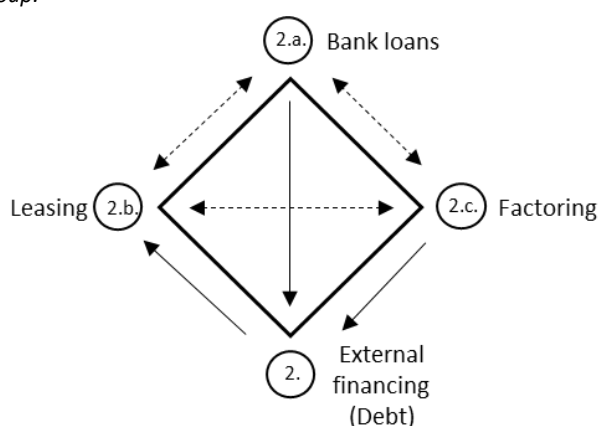


Source: own study.

loans within the same banking capital group are forms of financing that affect each other and if so, in what way, or whether they are completely unrelated and follow their own rules. Finally, which form of financing is more sensitive to changes in the others (what is the coefficient of variation), and what kind of outcomes can be expected from the enterprise financing policy implemented by banking capital groups? Factoring and leasing activities are subject to much less strict regulatory requirements than highly regulated banking activities, which may be the reason why banks willingly pursue their business objectives in the field of leasing and factoring within their capital groups. The following theses were formulated in the article with the purpose of illustrating the trends in the field of enterprise financing policies implemented by banking capital groups: 1) there is a strong positive correlation between the stream of corporate loans granted by banks and the stream of assets of factoring and leasing companies, which confirms a synergy effect in the financing model within banking capital groups (lending activity provides an opportunity to obtain additional profits from factoring and leasing activities) as well as cross-selling, 2) a strong increase in factoring and leasing assets is stimulated by an increase in the loan portfolio of banks, 3) factoring and leasing contracts are highly susceptible to changes in the dynamics of loan growth, 4) factoring and leasing companies implement aggressive revenue

growth strategies that require involvement of external financial sources compared with the moderately conservative strategy implemented by banks, 4) a common feature of the analyzed activities is that currently both banks and factoring and leasing companies are facing a compression of profits due to the fact that the incremental nature of asset growth is not accompanied by a corresponding increase in revenue (assets grow faster than revenue). It is emphasized in the literature that large companies have easier access to various sources of financing, while SMEs rarely can obtain financing on the market (Rossi, 2017). Nevertheless,

Figure 3. Relationships between the main forms of financing enterprises within the financing model within the banking capital group.



Source: own study.

creativity in raising capital, but also leads to the diversification of the capital structure, and thus affects the level of financial risk (Filip & Kata, 2017). Despite the wide range of services offered by banks and financial institutions, Polish entrepreneurs finance their business activities primarily with their own funds, which shows that Polish enterprises are still reluctant to use foreign sources of financing (Pracodawców, 2018). It is puzzling that a study based on a synthetic evaluation index of Polish factoring companies calculated for the years 2010-2015, indicated that throughout the entire analyzed period the factoring companies surveyed were characterized by low liquidity and profitability, as well as a high level of debt, and the synthetic development index even showed a slight downward trend (Misztal, 2017). The theory of order of financing sources (*Pecking Order Theory*) (Stewart & Majluf, 1984), formulated by S. Myers and N. Majluf in 1984 aims to determine a company's preferred order of capital raising sources (Figure 1). According to research, this order is as follows: (internal) equity, bond issue, convertible securities, and share issue (Jarzemowska, 1999, p. 9). Nevertheless, the theory formulated in this way requires updating and analyzing the contemporary system of enterprise financing adopted by banking groups, as well as identifying factors that affect it from the perspective of fund providers (creditors). For the above-mentioned reasons, it is worth

this article attempts to discuss the financing of both SMEs and large companies, as defined by the EU. The analyzed credit items refer to receivables to the non-financial sector. A review of selected theoretical issues indicates that e.g. the leasing market is particularly sensitive to changes in the economic situation and the regulatory environment (Jabłońska, 2016). Expanding sources of financing not only proves a company's

examining the issue of financing enterprises by banks and related factoring and leasing companies. The conclusions drawn from such an analysis may serve not only practitioners but also regulators. The article also aims to develop the research conducted on the German market by D. Bülbül, F. Noth, and M. Tyrell (Bülbül et al., 2014), whose objective was to determine why banks lease. It is worth supplementing the theses in that study by analyzing not only leasing but also factoring in relation to the basic lending activity, which is yet another milestone in the process of operationalizing the practical and theoretical assumption that constitutes the model of financing enterprises within banking capital groups (Figure 2 and Figure 3).

Methodology and data

From a practical point of view (for the purposes of managing the sale of products within a banking capital group), it is important to determine whether the products are complementary or substitutable - for this purpose, we examined the cross-elasticity of the demand of the researched products. The established levels of cross-elasticity of the demand enabled the development of postulates as to the directions of the conducted acquisitions and the directions of the pricing policy. The aim of the study is to develop three econometric models (using the method of the ordinary least squares (OLS) regression) supporting the processes of planning assets in banks financing enterprises in the form of loans and assets in bank subsidiaries, specializing in financing enterprises in the form of leasing and factoring. The research hypothesis assumes the existence of a mechanism that explains the changes in the value of corporate loans and factoring and leasing in the long-term and short-term perspective. In the case of similar behavior of variables, to build a model that describes the long-term and short-term relations, the original values of the studied variables should be used and the concept of cointegration should be addressed. For this purpose, a linear combination of non-stationary but integrated variables is sought that will be integrated at the downstream level. Finding this linear combination allows one to build a model in which the cointegrating coefficients reflect long-term relations between the examined variables, while the error correction mechanism takes into account the adjustment processes. Thus, the occurrence of cointegration confirms the existence of a permanent, long-term relationship between the analyzed time series. Moreover, it is assumed that the tested products are substitutable (with the simultaneous lack of arguments indicating complementarity). Mutual relations in the short and long term allow one to determine the strength and direction of interaction between the variables, which allows for the formulation of postulates for the distribution policy and the policy of shaping the prices of individual

products. In order to verify the hypothesis about the existence of cointegration and causality in the sense of Granger, the analysis was carried out in the following stages:

- 1) examine the basic properties of variables (descriptive statistics, correlation matrix, analysis of trends in the interaction of variables),
- 2) examine the degree of integration of selected variables by conducting tests for the presence of unit elements: the ADF test (the extended Dickey-Fuller test developed by D. A. Dickey and W. A. Fuller) and the KPSS test (developed by P. C. B. Phillips, P. Schmidt, and Y. Shin),
- 3) use the Akaike, Schwartz-Bayesian, and Hannan-Quinn information criteria to determine the maximum number of delays,
- 4) use the Johansen method to test the cointegration order, based on the matrix trace test and the maximum matrix eigenvalue test,
- 5) build a vector autoregression model with a built-in error correction mechanism (VECM), which allows one to explain short-term relations, taking into account deviations from long-term relations,
- 6) based on the results of the VECM model, the impulse response function analysis will be conducted and
- 7) the Granger causality analysis.

The study covers data for the period 2009 to 2019 (annual data): the value of loans to enterprises in the banking sector based on the data of the Polish Financial Supervision Authority (KNF, 2020) and data on the assets of factoring and leasing companies according to the Polish Statistics data. In the case of the data from the banking sector, the items of business loans were added to the loans granted to individual entrepreneurs and farmers to capture the broadest possible policy of financing enterprises (the activities of factoring and leasing companies also include the companies of individual entrepreneurs and farmers) (Ganc & Domanska, 2016). The calculations were made with Gretl and MS Excel.

Results

Selected financial data of banks, leasing and factoring companies, constituting the basis of the research, are presented in the appendix to the article. For the purposes of the study, Table 1 groups the analyzed variables (selected financial data) into four groups: 1) data for the banking sector together, 2) summarized data for factoring and leasing companies, 3) data for factoring companies and 4) data for leasing companies. In the first step, descriptive statistics for the studied variables were calculated - the results are presented in Table 1.

Table 1. Summary Statistics, using the observations 2009 – 2019

Variable	Mean	Median	Minimum	Maximum	Std. Dev.	C.V.	Skewness	Ex. kurtosis
<i>Data for the banking sector in total (DB)</i>								
X_1 Business loans (<i>banks</i>) (Y_1)	342.47	336.52	222.08	449.87	75.661	0.2209	-0.0523	-1.1624
X_2 Assets (<i>banks</i>)	1524.3	1532.0	1057.4	2000.1	304.30	0.1996	0.0356	-1.1286
X_3 Equity (capital) (<i>banks</i>)	162.63	166.00	103.80	209.33	36.469	0.2242	-0.2044	-1.2031
X_4 Revenues (<i>banks</i>)	86.387	84.488	78.298	99.344	5.9622	0.0690	0.8681	0.0627
X_5 Net profit (<i>banks</i>)	13.405	13.806	8.2785	15.877	2.3202	0.1731	-0.9577	0.0985
<i>Summarized data for factoring and leasing companies (SDL&F)</i>								
X_6 Assets (<i>leasing&factoring</i>)	112.40	97.317	68.565	176.87	37.496	0.33360	0.50445	-1.0731
X_7 Current Assets (<i>leasing&factoring</i>)	47.659	54.541	4.9773	79.295	24.355	0.51103	-0.7079	-0.5170
X_8 Equity (capital) (<i>leasing&factoring</i>)	11.795	8.3769	7.5802	30.667	6.8104	0.57742	2.1294	3.5650
X_9 Revenue (<i>leasing&factoring</i>)	15.584	14.437	9.2652	32.005	6.6269	0.42523	1.4869	1.5041
X_{10} Net profit (<i>leasing&factoring</i>)	0.96683	0.97074	-0.85866	3.0510	0.94352	0.97589	0.3621	1.2574
<i>Data for factoring companies (DF)</i>								
X_{11} Assets (<i>factoring</i>) (Y_2)	14.629	13.420	4.6413	28.612	8.0255	0.5486	0.4203	-1.0197
X_{12} Current Assets (<i>factoring</i>)	17.054	17.411	4.4197	28.244	9.0460	0.5304	-0.1634	-1.4126
X_{13} Equity (capital) (<i>factoring</i>)	0.7965	0.7611	0.6486	1.3736	0.2074	0.2604	2.1298	3.6938
X_{14} Revenue (<i>factoring</i>)	0.877	0.8805	0.6508	1.1718	0.1680	0.1915	0.2134	-1.0562
X_{15} Netprofit (<i>factoring</i>)	0.0609	0.1134	-0.5082	0.1556	0.1915	3.1430	-2.7022	5.6090
<i>Data for leasing companies (DL)</i>								
X_{16} Assets (<i>leasing</i>) (Y_3)	97.768	82.971	63.924	148.25	29.783	0.3046	0.5042	-1.1425
X_{17} Current Assets (<i>leasing</i>)	30.606	31.589	0.5576	51.051	16.474	0.5383	-0.8959	-0.1573
X_{18} Equity capital (<i>leasing</i>)	10.998	7.4827	6.8486	30.018	6.8758	0.6252	2.1179	3.5210
X_{19} Revenue (<i>leasing</i>)	14.707	13.765	8.6144	31.048	6.5498	0.4453	1.5274	1.6036
X_{20} Netprofit (<i>leasing</i>)	0.9059	0.8485	-0.9690	2.9020	0.8980	0.9913	0.2361	1.8085

Source: Own study based on data from the Polish Financial Supervision Authority and Polish Statistics.

The result of the study are three models where the dependent variables (endogenous variables) are the following data: loans to enterprises in banks (Y_1), assets of factoring companies (Y_2) and assets of leasing companies (Y_3). As part of the study, 3 econometric models will be developed to capture the main three-way relations between banks and leasing and factoring companies, where the explained variables and explanatory variables will be categories, indicated according to the order presented in Table 2.

Table 2. The structure of the analysis within the models - types of explained variables and the scope of explanatory variables.

Model No.	Explained variable (Y_n)	Explanatory variables (range of selected financial data)	
(1)	Assets (<i>leasing</i>) (Y_3)	DL (X_{16} - X_{20})	DB (X_1 - X_5)
(2)	Assets (<i>factoring</i>) (Y_2)	DF (X_6 - X_{10})	DB (X_1 - X_5)
(3)	Business loans (<i>banks</i>) (Y_1)	DB (X_1 - X_5)	SDL&F (X_6 - X_{10})

Source: Own study based on data from the Polish Financial Supervision Authority and Polish Statistics.

Based on the Equity-To-Asset ratio (Figure 4), there is clearly a very large difference between the high level of equity in banks (regulatory requirements) and very low values of equity in factoring and leasing companies (no regulatory requirements). While the value of equity in

banks remains constant, the value of equity in factoring and leasing companies decreases. On the other hand, the dynamics of asset growth in factoring and leasing companies in relation to the dynamics of the loan portfolio is characterized by strong convergence (Figure 5).

Figure 4. Equity-To-Asset ratio.

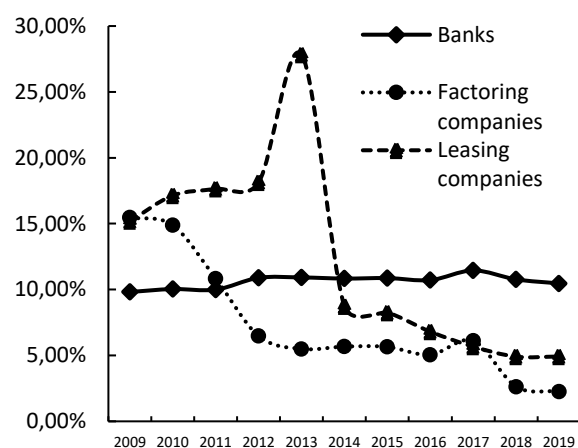
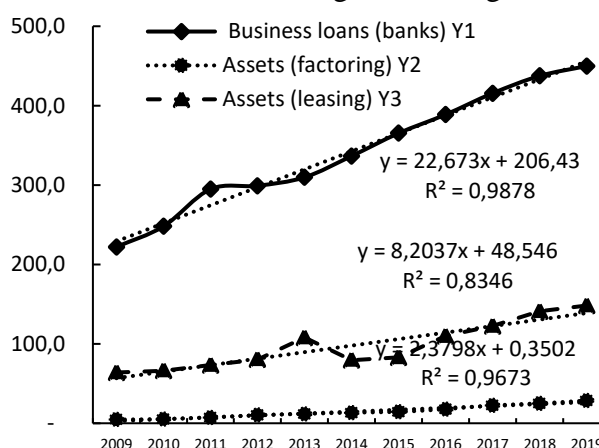


Figure 5. Loans to enterprises granted by banks and assets - factoring and leasing.



Source: own study based on data published by: Polish Financial Supervision Authority, Statistics Poland.

The value of the indicators obtained as part of the descriptive statistics, in particular the value of the variability index, does not indicate any obstacles to further analysis. The correlation matrix indicates a strong correlation between the studied variables. Table 3 presents the data.

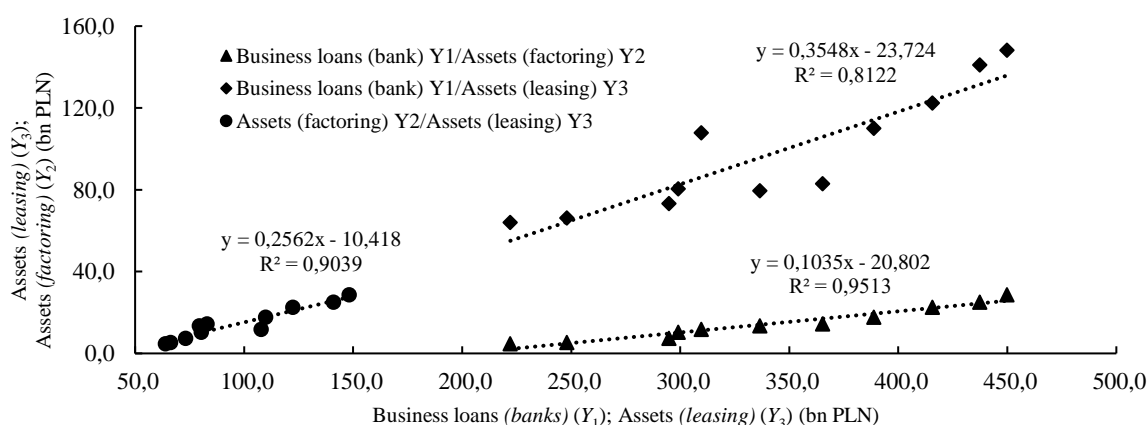
Table 3. Correlation analysis.

Pearsona r	Business loans (banks) (Y_1)	Assets (factoring) (Y_2)	Assets (leasing) (Y_3)
Business loans (banks) (Y_1)	1		
Assets (factoring) (Y_2)	0,9766	1	
Assets (leasing) (Y_3)	0,9749	0,9849	1

Source: own study based on data published by Polish Financial Supervision Authority, Statistics Poland.

To determine trends, the formation of mutual relations of the studied variables used the OLS method (data presented in Figure 6).

Figure 6. Mutual relations of the studied variables – the ordinary least squares (OLS).



Source: own study based on data published by Polish Financial Supervision Authority, Statistics Poland.

Cross-elasticity of demand

To measure the strength and direction of the impact of variables in the short-term and long-term perspective, an approach based on the cross-elasticity of demand of the products under study can also be used. The flexibility approach is an important alternative to Granger causality. Elasticity is a general term referring to the percent change of one variable divided by the percent change of a related variable; this approach is effective in studying economic relationships. The cross-elasticity of demand of two products can be expressed by the following formula:

$$XE_{dx(dy)} = \pm \frac{\Delta d_x}{d_x} : \frac{\Delta d_y}{d_y} \quad (1.0.)$$

where:

$XE_{dx(dy)}$ – cross-elasticity of product demand x and y ,

$\frac{\Delta x}{x}$ – the percentage change in demand for the product x ,

$\frac{\Delta d_y}{d_y}$ – the percentage change in demand for the product y .

To extract a long-term perspective, the mean value of $XE_{dx(dy)}$ was calculated over the whole period considered. However, to identify the short-term perspective, the mean $XE_{dx(dy)}$ from the last two years was calculated. The results are presented in Table 13 and the diagram. Table 13 also presents the assessment of the established level of $XE_{dx(dy)}$ for individual products. $XE_{dx(dy)}$ indicates by how many percent the demand for product x will change if the demand for product y changes by 1%. The value of the calculated elasticity indicates the products that are substitutable with each other, then $XE_{dx(dy)} > 0$ and which products are complementary to each other - $XE_{dx(dy)} < 0$. In the case of substitute products, we put a “+” sign in front of the elasticity coefficient (an increase in the price of a goods y is accompanied by an increase in the amount of demand for goods x , provided that its price remains unchanged, it falls. or grows slower than the price of goods y), changes in the demand for the product x and product y are unidirectional. In the case of complementary products, we put the sign “-” in front of the elasticity coefficient (an increase in the price of y product is accompanied by a decrease in demand for product x , and changes in the demand for product x and y are multidirectional).

Table 4. Cross-elasticity of the demand of the researched products.

Direction	XE	Average	Average	Equilibrium (E=1)	Difference (lt)-(st)	Assessment of the relationship	
		(lt)	(st)			(lt)	(st)
$dY_2 \leftarrow dY_1$	$XE_{dY_2(dY_1)}$	4,2	3,3	1	0,9	strongly positive	strongly positive
$dY_3 \leftarrow dY_1$	$XE_{dY_3(dY_1)}$	2,1	2,2	1	0,6	strongly positive	strongly positive
$dY_2 \leftarrow dY_3$	$XE_{dY_2(dY_3)}$	1,8	1,6	1	0,3	positive	positive
$dY_1 \leftarrow dY_3$	$XE_{dY_1(dY_3)}$	0,8	0,5	1	0,5	negative	negative
$dY_1 \leftarrow dY_2$	$XE_{dY_1(dY_2)}$	0,5	0,4	1	- 0,1	negative	negative
$dY_3 \leftarrow dY_2$	$XE_{dY_3(dY_2)}$	0,4	0,8	1	0,1	negative	negative

Explanations: (lt) - long-term perspective, (st) - short-term perspective (the last 2Y).

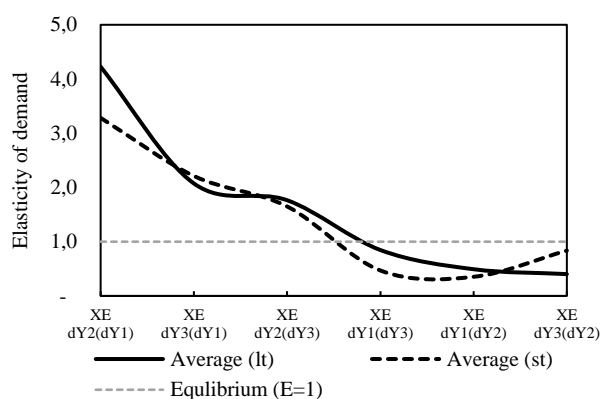
If $E \geq 2$ it means a "strongly positive" relation, $E \geq 1 \Rightarrow$ it means a "positive" relationship, $E \geq 0$ it means a "negative" relation, $E < 0$ it means a "strongly negative" relation.

Source: Own study based on data from the Polish Financial Supervision Authority and Polish Statistics.

The obtained results indicate that the tested products are characterized by substitutability (the tested products, as a result of similar features, functions, and properties, replace each other in meeting the need of financing the activities of enterprises), as evidenced by the lack of a negative value of $XE_{dx(dy)}$ (Figure 7). There are no grounds to consider the tested products as complementary; the tested products do not complement each other and, therefore, are not usually bought together.

In the long term, on average, factoring assets (Y_2) respond most strongly to changes in business loans (Y_2) (this relationship is also characterized by the highest difference between flexibility in the long and short term). The average impact of bank loans (Y_1) on leasing assets (Y_3) is also characterized by a strong positive relationship. In the long term, the average change in leasing assets (Y_3) has a positive effect on the average change in factoring assets (Y_2). In the long term, the average change in leasing assets (Y_3) negatively affects the average change in bank loans to enterprises (Y_1). The average change in factoring assets (Y_2) in the long term negatively affects the average changes in business loans (Y_1) and average leasing assets (Y_3)

Figure 7. Average long-term and short-term cross-elasticity of demand relationships.



Source: own study based on data from the Polish Financial Supervision Authority and Polish Statistics.

In the short term, the largest impact on average is the average change in corporate loans (Y_1) on factoring assets (Y_2) and leasing assets (Y_3). The impact of leasing assets (Y_3) on factoring assets (Y_2) is characterized by a slightly weaker level of average (positive) impact. On the other hand, in the short term, the average changes in leasing assets (Y_3) negatively affect the

average changes in corporate loans (Y_1). In the short term, the average changes in factoring assets (Y_2) also negatively affect the average changes in corporate loans (Y_1). Average changes in factoring assets (Y_2) negatively affect the average changes in assets of leasing companies (Y_3).

Based on descriptive statistics based on the volatility index, the variable X_4 representing the value of banks' revenues, for which the volatility coefficient value was below 10%, was eliminated from further calculations. Estimation of econometric models was performed separately for each tested dependent variable Y_1 , Y_2 and Y_3 , consisting in the sequential elimination of variables with the lowest level of Student's t-statistics (at the $\alpha = 0.10$). The results of the performed estimations and tests are presented in Tables 5-10.

Table 5. Model 1: OLS, using observations 2009-2019 (T = 11). Dependent variable: Business loans (*banks*) (Y_1).

	<i>Coefficient</i>	<i>Std. Error</i>	<i>t-ratio</i>	<i>p-value</i>	
constant	429.507	54.5960	7.867	0.0002	***
X_4 Revenues (<i>bank</i>)	-2.59420	0.622375	-4.168	0.0059	***
X_{11} Assets (<i>factoring</i>)	5.23617	0.863349	6.065	0.0009	***
X_{17} Current Assets (<i>leasing</i>)	2.19398	0.435291	5.040	0.0024	***
X_{20} Netprofit (<i>leasing</i>)	-7.37480	3.59793	-2.050	0.0863	*
Mean dependent var	342.4695	S.D. dependent var		75.66061	
Sum squared resid	496.8449	S.E. of regression		9.099862	
R^2	0.991321	Adjusted R-squared		0.985535	
F(4, 6)	171.3264	P-value(F)		2.60e-06	
Log-likelihood	-36.56543	Akaike criterion		83.13086	
Schwarz criterion	85.12033	Hannan-Quinn		81.87677	
rho	-0.106344	Durbin-Watson		1.861031	

Explanations: Significance level: *(10%), **(5%), ***(1%).

Source: Own study based on data from the Polish Financial Supervision Authority and Polish Statistics.

Table 6. Model verification tests for the dependent variable Business loans (*banks*) (Y_1).

<i>Test</i>	<i>Null hypothesis:</i>	<i>Test statistic:</i>	<i>p-value (α 0,05)</i>
Non-linearity test (logs)	relationship is linear	$P(\chi^2(3) > 2.56092)$	0.464382
Non-linearity test (squares)	relationship is linear	$P(\chi^2(4) > 7.83618)$	0.097767
White's test for heteroskedasticity	heteroskedasticity not present	$P(\chi^2(8) > 10.9947)$	0.201999
Breusch-Pagan test for heteroskedasticity	heteroskedasticity not present	$P(\chi^2(4) > 6.87667)$	0.142551
Test for normality of residual	error is normally distributed	$\chi^2(2) = 0.349948$	0.839479
LM test for autocorrelation up to order 1	no autocorrelation	$P(F(1, 5) > 0.122843)$	0.740254
Durbin-Watson's test for autocorrelation up to order 1	no autocorrelation	d 1.86103 dL = 0.4441 dU = 2.2833	0.0956427

Source: Own study based on data from the Polish Financial Supervision Authority and Polish Statistics.

The overall assessment of the usefulness of the econometric model was performed using the F-Snedecor test (Statistics F). The F-Snedecor test result was $F(4, 6) = 171.3264$ for the critical value of 4.5337, which means that there is no basis for rejecting the null hypothesis ($H_0: \alpha_1 = \alpha_2 = \dots = \alpha_k$), which predicts that the estimated model contains insignificant variables (therefore, we can consider that the tested model contains significant variables). Estimated equation for the explained variable Business loans (*bank*) Y_1 - (standard errors in parentheses):

$$\hat{Y}_1 = 430 - 2.59X_4 + 5.24X_{11} + 2.19X_{17} - 7.37X_{20}.$$

(54.6) (0.622) (0.863) (0.435) (3.60)

Table 7. Model 2: OLS, using observations 2009-2019 (T = 11). Dependent variable: Assets (*factoring*) Y_2 .

	<i>Coefficient</i>	<i>Std. Error</i>	<i>t-ratio</i>	<i>p-value</i>	
const	-24.0504	2.52494	-9.525	<0.0001	***
X_2 Assets (<i>bank</i>)	0.0257142	0.00128415	20.02	<0.0001	***
X_{14} Revenue (<i>factoring</i>)	7.27191	2.74031	2.654	0.0328	**
X_5 Net profit (<i>bank</i>)	-0.514379	0.194920	-2.639	0.0335	**
Mean dependent var	14.62927	S.D. dependent var		8.025504	
Sum squared resid	9.227334	S.E. of regression		1.148125	
R-squared	0.985674	Adjusted R-squared		0.979534	
F(3, 7)	160.5382	P-value (F)		8.15e-07	
Log-likelihood	-14.64184	Akaike criterion		37.28367	
Schwarz criterion	38.87525	Hannan-Quinn		36.28040	
rho	-0.058501	Durbin-Watson		2.030140	

*Explanations: Significance level: *(10%), **(5%), ***(1%).*

Source: Own study based on data from the Polish Financial Supervision Authority and Polish Statistics.

Table 8. Model verification tests for the dependent variable Assets (*factoring*) (Y_2).

<i>Test</i>	<i>Null hypothesis:</i>	<i>Test statistic:</i>	<i>p-value (α 0,05)</i>
Non-linearity test (logs)	relationship is linear	$P(\chi^2(3) > 7.86949)$	0.0487874
Non-linearity test (squares)	relationship is linear	$P(\chi^2(3) > 7.4742)$	0.0582251
White's test for heteroskedasticity	heteroskedasticity not present	$P(\chi^2(9) > 8.189)$	0.515218
Breusch-Pagan test for heteroskedasticity	heteroskedasticity not present	$P(\chi^2(3) > 0.33134)$	0.95403
Test for normality of residual	error is normally distributed	$\chi^2(2) = 1.20894$	0.546364
LM test for autocorrelation up to order 1	no autocorrelation	$P(F(1, 6) > 0.0227888)$	0.884955
Durbin-Watson's test for autocorrelation up to order 1	no autocorrelation	d 2.03014 dL = 0,5948 dU = 1,9280	0.109338

Source: Own study based on data from the Polish Financial Supervision Authority and Polish Statistics.

In the case of the Durbin-Watson's test, the value of d (2.03014) indicates the presence of a negative autocorrelation. In the case of negative autocorrelation, the d statistic takes values from the range $2 < d < 4$ - in this case, the transformation $d^* = 4 - d$ should be performed, and the alternative hypothesis is then $H_1: \rho_1 < 0$ (Kufel, 2013, p. 107). In this case, $d^* = 1,9699$, and

at the level of $p = 0,1093$, there are no grounds to reject the null hypothesis (there is no autocorrelation). The overall assessment of the usefulness of the econometric model was performed using the F-Snedecor test (Statistics F). The result of the F-Snedecor test was $F(3, 7) = 160.5382$ for the critical value of 4.34683, which means that there are no grounds for rejecting the null hypothesis ($H_0: \alpha_1 = \alpha_2 = \dots = \alpha_k$) and that the estimated model contains non-significant variables (we can consider that the tested model contains significant variables). Estimated equation for the explained variable Assets (*factoring*) (Y_2) - (standard errors in parentheses):

$$\hat{Y}_2 = -37,4 - 0,205 \cdot X_1 + 0,0732 \cdot X_2 + 6,37 \cdot X_{13} + 6,64 \cdot X_{14} - 5,80 \cdot X_{15} \quad (1.2.)$$

(4,95) (0,0801) (0,0192) (2,80) (2,71) (2,47)

Table 9. Model 3: OLS, using observations 2009-2019 (T = 11). Dependent variable: Assets (*leasing*) (Y_3).

	<i>Coefficient</i>	<i>Std. Error</i>	<i>t-ratio</i>	<i>p-value</i>	
const	-54.7604	14.9905	-3.653	0.0107	**
X_1 Business loans (<i>bank</i>)	0.330410	0.0414947	7.963	0.0002	***
X_{18} Equity capital (<i>leasing</i>)	-5.39176	1.98916	-2.711	0.0351	**
X_{19} Revenue (<i>leasing</i>)	5.97556	1.75453	3.406	0.0144	**
X_{20} Netprofit (<i>leasing</i>)	11.9082	4.85977	2.450	0.0498	**

Mean dependent var	97.76809	S.D. dependent var	29.78324
Sum squared resid	373.3844	S.E. of regression	7.888646
R^2	0.957907	Adjusted R-squared	0.929845
F(4, 6)	34.13518	P-value(F)	0.000289
Log-likelihood	-34.99425	Akaike criterion	79.98849
Schwarz criterion	81.97797	Hannan-Quinn	78.73441
rho	-0.165961	Durbin-Watson	2.259215

*Explanations: Significance level: *(10%), **(5%), ***(1%).*

Source: Own study based on data from the Polish Financial Supervision Authority and Polish Statistics.

Table 10. Model verification tests for the dependent variable Assets (*leasing*) (Y_3).

<i>Test</i>	<i>Null hypothesis:</i>	<i>Test statistic:</i>	<i>p-value ($\alpha 0,05$)</i>
Non-linearity test (logs)	relationship is linear	$P(\chi^2(3) > 8.9343)$	0.0301773
Non-linearity test (squares)	relationship is linear	$P(\chi^2(4) > 9.10719)$	0.0584753
White's test for heteroskedasticity	heteroskedasticity not present	$P(\chi^2(8) > 10.3637)$	0.240419
Breusch-Pagan test for heteroskedasticity	heteroskedasticity not present	$P(\chi^2(4) > 2,61838)$	0.623571
Test for normality of residual	error is normally distributed	$\chi^2(2) = 1.24451$	0.536733
LM test for autocorrelation up to order 1	no autocorrelation	$P(F(1, 5) > 0.28713)$	0.615035
Durbin-Watson test for autocorrelation up to order 1	no autocorrelation	d 2.25921 dL = 0,4441 dU = 2,2833	0.350794

Source: Own study based on data from the Polish Financial Supervision Authority and Polish Statistics.

In the case of the Durbin-Watson's test, the value of d (2.25921) indicates the presence of a negative autocorrelation. In the case of negative autocorrelation, the d statistic takes values from the range $2 < d < 4$ - in this case, the transformation $d^* = 4 - d$ should be performed, and the alternative hypothesis is then $H_1: \rho_1 < 0$. In this case, $d^* = 1,7408$, and at the level of $p = 0,3508$, there are no grounds to reject the null hypothesis (there is no autocorrelation). The overall assessment of the usefulness of the econometric model was performed using the F-Snedecor test (Statistics F). The result of the F-Snedecor test was $F(4, 6) = 34,1352$ for the critical value of 4,53368, which means that there are no grounds for rejecting the null hypothesis ($H_0: \alpha_1 = \alpha_2 = \dots = \alpha_k$), and that the estimated model contains non-significant variables (we can consider that the tested model contains significant variables). Estimated equation for the explained variable - Assets (*leasing*) (Y_3) - (standard errors in parentheses):

$$\hat{Y}_3 = -54,8 + 0,330 * X_1 - 5,39 * X_{18} + 5,98 * X_{19} + 11,9 * X_{20}. \quad (1.3.)$$

(15,0) (0,0415) (1,99) (1,75) (4,86)

Multicollinearity of explanatory variables

The multicollinearity of explanatory variables found in model 3 is an undesirable feature in the estimated model.

Table 11. Linear correlation coefficients for observations from the 2009-2019 sample. Critical value (with a two-sided 5% critical area) = 0.6021 for $n = 11$.

X_1 Business loans (<i>bank</i>)	X_{18} Equity capital (<i>leasing</i>)	X_{19} Revenue (<i>leasing</i>)	X_{20} Netprofit (<i>leasing</i>)	
1,0000	-0,3962	-0,3044	-0,0875	X_1 Business loans (<i>bank</i>)
	1,0000	0,9490	0,5739	X_{18} Equity capital (<i>leasing</i>)
		1,0000	0,3834	X_{19} Revenue (<i>leasing</i>)
			1,0000	X_{20} Netprofit (<i>leasing</i>)

Source: Own study based on data from the Polish Financial Supervision Authority and Polish Statistics.

If there is exact collinearity, the model will not be evaluated because the determinant of $X^T X$ is zero. The high correlation of the explanatory variables causes the value of the determinant to be close to zero, and thus the estimated standard errors of the parameter estimates, resulting from the variance and covariance matrices, relatively large values, which reduces the value of the Student's t -statistic when assessing the significance of the parameter (Kufel, 2013, p. 65). The assessment of the degree of multicollinearity of the explanatory variables can be done using the VIF measure (variance inflation factors), defined as the variance inflation factor. We find the formula for VIF from the following equation:

$$VIF_j = \frac{1}{1 - R_j^2}. \quad (1.4.)$$

For $j = 1, 2, \dots, k$, where R_j^2 is the multiple correlation coefficient between the variable x_j and other variables of the model. If the value of VIF_j is equal to one, it means that the variable x_j is orthogonal (uncorrelated) in relation to the other explanatory variables in the model. It is assumed in the literature that the value of $VIF_j > 10$ is a sign of collinearity that permanently disturbs the quality of the constructed econometric model (Gruszczyński, Kuszewski, & Podgórska, 2009, p. 58).

Table 12. VIF for observations from the 2009-2019 sample for $n = 11$.

Position	R^2	VIF
X_1 Business loans (<i>bank</i>)	0,368634	1,6
X_{18} Equity capital (<i>leasing</i>)	0,966733	30,1
X_{19} Revenue (<i>leasing</i>)	0,952877	21,2
X_{20} Netprofit (<i>leasing</i>)	0,673267	3,1

Source: Own study based on data from the Polish Financial Supervision Authority and Polish Statistics.

In the case of the regression equation (model No. 3) for the dependent variable Assets (*leasing*) (Y_3), the value of the coefficient VIF_j , takes the value 30.1 for the explanatory variable X_{18} Equity capital (*leasing*) and 21.2 for the explanatory variable X_{19} Revenue (*leasing*), which are strongly correlated with each other $r = 0.9490$, which means that these are values that permanently disturb the quality of the constructed model.

Assessment of the degree of fit of the presented models using the V_e coefficient

The assessment of the degree of model fit to empirical data is performed by estimating the standard error of the residuals, otherwise the standard error of the model assessment $S_e =$

$\sqrt{\sum_{i=1}^n e_i^2 / (n - k - 1)}$, and the coefficient of residual variation $V_e = S_e / \bar{y}$. The coefficient of residual variation V_e requires the calculation of the quotient S_e by the mean of the dependent variable Y . If the estimated V_e is less than the acceptable limit V^* , the error value S_e is then small and the model is suitable for practical use.

Table 13. Assessment of the degree of fit of the presented models using the V_e coefficient.

Dependent variable (Y_n):	Business loans (<i>banks</i>) Y_1	Assets (<i>factoring</i>) Y_2	Assets (<i>leasing</i>) Y_3
Mean dependent var	342,4695	14,6293	97,7681
S.E. of regression	9,0999	1,1481	7,8886
V_e	2,66%	7,85%	8,07%

Source: Own study based on data from the Polish Financial Supervision Authority and Polish Statistics.

In the literature it is assumed that the limit and permissible value of V_e , which enables the practical use of the model, is $V^* = 10\%$ (Kufel, 2013, p. 59). The calculations of V_e are presented in Table 12. The value of V_e for all developed models is below 10%, which means

that the models can be used in practice (however, one should take into account the collinearity of data in model 3, which may disturb the quality of the results obtained).

Granger causality analysis

Stationarity test

To investigate causal relationships in the Granger sense and to establish an appropriate model for the test implementation, first the stationarity analysis of variables was performed based on two tests for unit roots: the ADF test and the KPSS test.

Table 14. Stationarity tests of the time series of the analyzed variables.

Variable	ADF test		KPSS test (including trend) Test statistics for $\alpha = 0,05\%$ (0.1510)	Decision
	t-Student statistics	p-value		
Business loans (banks) (Y_1)	(a) -0.8945 (b) -2.5212	0.7447 0.3150	0.0626	Non-stationary
Assets (factoring) (Y_2)	(a) 1.9510 (b) -0.9763	0.9990 0.8967	0.2241	Non-stationary
Assets (leasing) (Y_3)	(a) -0.2708 (b) -2.0756	0.8977 0.4954	0.1290	Non-stationary

Explanations: (a) test with constant, (b) with constant and trend.

Source: own study based on data from the Polish Financial Supervision Authority and Polish Statistics.

Estimates of variables in the ADF test indicate a negative t-Student statistic in the ADF model with a constant (except for Y_2) and in the ADF model with a constant and trend. The indicated empirical significance levels $p > 0,05\%$ indicate the presence of process cumulative non-stationary), so there are no grounds to reject the null hypothesis: $H_0: a = 0, Y_t \sim I(1)$ in favor of the alternative hypothesis $H_1: a < 0$, czyli $Y_t \sim I(0)$. The KPSS test verifies the null hypothesis $H_0: Y_t \sim I(0)$, i.e. $d = 0$, which indicates that the process is stationary $I(0)$, with the alternative hypothesis $H_1: Y_t \sim I(1)$, i.e. $d = 1$, that is, the process is first-order integrated. Therefore, the non-stationarity of the tested time series was determined. Data differentiation procedures proved futile, as the main obstacle is the limited amount of data ($T = 11$).

The number of lags for the tested pairs of variables

To estimate the VECM model, it is necessary to determine the number of lags for the studied variables. In the next step, the studied variables were compared in pairs within six groups. In the next step, the number of lags for each pair was calculated (data are presented in Table 15). To calculate the number of delays, two delays were assumed (the maximum possible value due to the limited range of variables). The calculated number of delays for each pair was adopted based on information criteria: AIC (Akaike), BIC (Bayesian information criterion), and HQ (Hannan-Quinn). The delay values were adopted for the smallest values of the information

criteria. The obtained recommended lag 2 corresponds to a period of two years. The lag 2 was assumed for further calculations.

Table 15. Selection of the order of the delay for the tested pairs of variables.

Model	Maximum lag	AIC	BIC	HQC
Business loans (<i>banks</i>) (Y_1), Assets (<i>factoring</i>) (Y_2)	2	10,2543*	10,5173*	9,6868*
Business loans (<i>banks</i>) (Y_1), Assets (<i>leasing</i>) (Y_3)	2	13,8758*	14,1388*	13,3083*
Assets (<i>leasing</i>) (Y_3), Business loans (<i>banks</i>) (Y_1)	2	12,7352*	12,8544*	11,9315*
Assets (<i>leasing</i>) (Y_3), Assets (<i>factoring</i>) (Y_2)	2	9,4170*	9,6800*	8,8496*
Assets (<i>factoring</i>) (Y_2), Business loans (<i>banks</i>) (Y_1)	2	10,2543*	10,5173*	9,6868*
Assets (<i>factoring</i>) (Y_2), Assets (<i>leasing</i>) (Y_3)	2	9,4170*	9,6800*	8,8496*

An asterisk (*) indicates the best (i.e. minimum) value for the respective information criteria, AIC = Akaike criterion, BIC = Bayesian information criterion i HQC = Hannan-Quinn criterion.

Source: own study based on data from the Polish Financial Supervision Authority and Polish Statistics.

Testing the occurrence of cointegration - Johansen test

The study of time series cointegration was performed using the test with trace and the Johansen maximum eigenvalue test. The results are presented in Table 16. The Johansen test allows the identification of more than one cointegrating relationship, so it has a wider application than the Engle-Granger test, which is based on the Dickey-Fuller (or augmented) test for unit roots in residuals from a single (estimated) cointegrating relationship. An approach with an unlimited linear trend was used, but without explanatory (exogenous) variables for the lag equal 2. For the cointegration study in the Johansen test, the Π matrix order is used, which is equal to the number of independent cointegrating vectors (Kusideł, 2000, pp. 123-124; Majsterek, 1998). The fact that the number of non-zero characteristic roots of a matrix is equal to its order is used.

Two characteristics of the matrix estimator Π - λ_{trace} i λ_{max} can be the test statistic:

$$\lambda_{trace}(R) = -N \sum_{i=R+1}^m \ln(1 - \lambda_i), \quad (1.5)$$

$$\lambda_{max}(R) = -N \ln(1 - \lambda_{R+1}), \quad (1.6)$$

where:

λ_i – estimated eigenvalues,

N – number of observations.

The first λ_{trace} statistic is used to test the null hypothesis that the number of equal cointegration vectors is less than or equal to R , against the alternative hypothesis that the number of cointegration vectors is greater than R . The second λ_{max} statistic is used to test the null hypothesis that the number of cointegration vectors is R , against the alternative hypothesis that they are $R + 1$. In both cases, the critical area is located on the right. This test is iterative. The eigenvalues of the Π matrix estimator are ordered in descending order. In the first step, the null hypothesis is that $R = 0$. If it is rejected, then in the next one it is assumed that $R = 1$, etc.,

until the null hypothesis cannot be rejected, or $R = m - 1$, which determines the order of the matrix and the number of cointegration vectors.

Table 16. The results of the Johansen test for the studied pairs of variables.

Variable pairs	Null Hypothesis	Eigenvalue	Test with trace λ_{trace}	p -value	Test with eigenvalue λ_{max}	p -value
Business loans (<i>banks</i>) (Y_1), Assets (<i>leasing</i>) (Y_3)	$R = 0$	0,9841	41,5530	(0,0000)	37,3100	(0,0000)
	$R \geq 1$	0,3759	4,2430	(0,0394)	4,2430	(0,0394)
Business loans (<i>banks</i>) (Y_1), Assets (<i>factoring</i>) (Y_2)	$R = 0$	0,9149	23,0690	(0,0091)	22,1780	(0,0070)
	$R \geq 1$	0,0943	0,8913	(0,3451)	0,8913	(0,3451)
Assets (<i>leasing</i>) (Y_3), Business loans (<i>banks</i>) (Y_1)	$R = 0$	0,9842	41,5530	(0,0000)	37,3100	(0,0000)
	$R \geq 1$	0,3759	4,2430	(0,0394)	4,2430	(0,0394)
Assets (<i>leasing</i>) (Y_3), Assets (<i>factoring</i>) (Y_2)	$R = 0$	0,9589	29,9780	(0,0006)	28,7200	(0,0004)
	$R \geq 1$	0,1305	1,2585	(0,2619)	1,2585	(0,2619)
Assets (<i>factoring</i>) (Y_2), Business loans (<i>banks</i>) (Y_1)	$R = 0$	0,9149	23,0690	(0,0091)	22,1780	(0,0070)
	$R \geq 1$	0,0943	0,8913	(0,3451)	0,8913	(0,3451)
Assets (<i>factoring</i>) (Y_2), Assets (<i>leasing</i>) (Y_3)	$R = 0$	0,95887	29,9780	(0,0006)	28,7200	(0,0004)
	$R \geq 1$	0,13050	1,2585	(0,2619)	1,2585	(0,2619)

Source: Own study based on data from the Polish Financial Supervision Authority and Polish Statistics.

The results show that (in the case of the 0 order), for the significance level of $\alpha = 0,05$ adopted in the study, there are no grounds to reject the null hypothesis of the cointegration occurrence for the variables (there is a long-term dependence of all variables - the data are cointegrated), which is confirmed by the obtained $p > 0,05$ in Table 5. However, in the case of the order equal to 1, the cointegration occurs for the pair Y_1, Y_3 and Y_3, Y_1 (and, therefore, for the value of loans to enterprises in banks and assets of leasing companies), in other cases, the long-term relationship for order 1 was not identified - the value $p > 0,05$.

VECM model (Vector Error Correction Model)

In order to establish causality based on the impulse response function, the VECM model needs to be calculated. For non-stationary time series that are cointegrated, the traditional Granger causality tests should not be used (Osińska, 2008, p. 86). The VECM model belongs to the category of models used in multi-time series analysis processes, and it is used for data whose underlying variables share a common long-term stochastic trend in the form of cointegration. The VECM model belongs to the class of dynamic models, which describes how the explained variable is adjusted to the long-term relationship. We can use it if the two-time series x_t and x_t are non-stationary and cointegrated. Time series integration implies the existence of a common long-term equilibrium path for these series. In practice, cointegration occurs when time series are not stationary (most often they are integrated into the first stage) and there is a stationary linear combination thereof. In research on the phenomenon of cointegration, the most commonly used is the test with trace, the maximum eigenvalue test, or the Engle-Granger procedure. The VECM model can be written as follows (Johansen, 1995; Salamaga, 2015):

$$\Delta X_t = \Psi_0 D_t + \sum_{i=1}^{k-1} \Pi_i \Delta X_{t-1} + \Pi X_{t-1} + \xi_t \quad (1.7.)$$

where:

Π – a matrix of coefficients containing the effects of short-term adjustments and long-term cointegrating relationships, $\Pi = \sum_{i=1}^k A_i - I$,

Ψ_0 – matrix of coefficients with deterministic components of a vector D_t ,

Π_i – matrix of autoregression coefficients, $\Pi = -\sum_{i=j+1}^k A_i - I$,

ξ_t – white noise process.

The complexity of the structure of the model in question and the mutual interactions of variables may make it difficult to interpret the parameters. Accordingly, an impulse response function is used to selectively analyze the effect of one variable on another variable. Therefore, the vector autoregression model is reduced to the moving average process, which also takes into account the effects of random disturbances:

$$X_t = \sum_{i=1}^{\infty} \Phi_i \xi_{t-1}, \quad (1.8.)$$

where:

$\Phi_i = A_1^i B^{-1}$, B – the matrix of parameters at the non-lagging values of the vector components X_t .

The elements of the matrix Φ_i can be interpreted as responses of any variable of the vector X_t to an impulse from another variable of this vector, assuming the remaining conditions are unchanged (*ceteris paribus*). A method that supplements the analysis of interactions between variables is the decomposition of the variance of errors in forecasts of individual components of the vector X_t . It makes it possible to determine the share of each component of this vector in the explanation of the forecast error of the highlighted forecast variable (Papież & Śmiech, 2012). The limited amount of data ($T = 11$) makes it impossible to estimate three variables simultaneously. Therefore, an estimation was performed for each pair of variables separately (it was one possibility of using the VECM model). The vector parameters are presented in Table 17.

Table 17. Values of vectors in the equations of the VECM model.

VECM system, lag order 2 Maximum likelihood estimates, observations 2011-2019 (T = 9) Cointegration rank = 1, Unrestricted constant		
Variable pairs	β (cointegrating vectors, standard errors in parentheses)	α (adjustment vectors)
Business loans (<i>banks</i>) (Y_1)	1.0000 (0.0000)	-0.2773
Assets (<i>factoring</i>) (Y_2)	-8.2372 (1.0537)	0.0588
Business loans (<i>banks</i>) (Y_1)	1.0000 (0.0000)	-0.0840
Assets (<i>leasing</i>) (Y_3)	-2.6870 (0.4475)	0.4912
Assets (<i>factoring</i>) (Y_2)	1.0000 (0.0000)	0.3901
Assets (<i>leasing</i>) (Y_3)	-0.2886 (0.0210)	6.8449
Assets (<i>leasing</i>) (Y_3)	1.0000 (0.0000)	-1.9754
Assets (<i>factoring</i>) (Y_2)	-3.4652 (0.2541)	-0.1126
Assets (<i>factoring</i>) (Y_2)	1.0000 (0.0000)	-0.4848
Business loans (<i>banks</i>) (Y_1)	-0.1214 (0.0132)	2.2844
Assets (<i>leasing</i>) (Y_3)	1.0000 (0.0000)	-1.3199
Business loans (<i>banks</i>) (Y_1)	-0.3722 (0.0575)	0.2258

Source: own study based on data from the Polish Financial Supervision Authority and Polish Statistics.

The estimated parameters of the α (refers to a short-term perspective) and β (refers to a long-term perspective) vectors confirm the presence of cointegration (there is at least one cointegrating vector). Table 18 presents the estimated characteristics of the equations together with the results of the performed significance tests. To identify the regression function parameters, the results of the estimation of three equations in pairs ($Y_1:Y_2$, $Y_1:Y_3$, $Y_3:Y_2$) were presented instead of six equations reflecting the full range of combinations, as the equations for pairs of variables in the VECM model are symmetrical (except for the inverse sign (+/-) for the Student's t-statistics for the explanatory variable $EC^1(1)$). While the order is important for the value of vectors, it is not important for the parameters of the estimated regression function (of course, the vector parameters indicated in Table 17 are presented based on estimates of six equations reflecting all possible combinations of the studied variables). Tables 18, 19, and 20 present the regression equation coefficient and standard errors, while Table 21 presents the value of the Student's t-statistic and p -value for the explanatory variables in the estimated regression equations for the studied variables.

¹ One of the main features of the VECM model that it appears as an explanatory variable (delayed by one period) of the deviation of the actual value of the variable from that resulting from the long-term relationship. The difference ($y_{t-1} - y^*$) is, thus, a measure of the "equilibrium error" committed in the previous period and is, therefore, called the error correction term, ECT, and the corresponding equations where it occurs are called the error correction model (ECM) or the equilibrium correction model (ECM). The error is subject to not only correction here, but also most of all it is a correction factor (explained variable). If the system is dynamically balanced and at the same time $y_t - y^* \neq 0$, then forces will bring it to the long-term equilibrium trajectory, so the parameter ($\alpha - 1$) related to the ECT component should be negative. Because the random term ξ_t is white noise, the variable ($y_{t-1} - y^*$) is not correlated with it, which allows the use of classical estimation methods (Welfe, 2018).

Table 18. Characteristics of the equation in the VECM model for a pair of variables Y_1 and Y_2 (coefficient of regression equation and standard errors) and the results of significance tests.

Explanatory variables	Explained variables			
	Δ Business loans (<i>banks</i>) (Y_1)		Δ Assets (<i>factoring</i>) (Y_2)	
	<i>Coefficient</i>	<i>Std. Error</i>	<i>Coefficient</i>	<i>Std. Error</i>
constant	92.6337	85.7822	-11.0113	6.4722
Δ Business loans (<i>banks</i>) (Y_1) (1)	-0.0175	0.4854	-3.2508	0.0366
Δ Assets (<i>factoring</i>) (Y_2) (1)	-3.0032	4.0541	0.1039	0.3059
EC (1)	-0.2773	0.4146	0.0588	0.0313
Mean dependent var	22.4318		2.5875	
RSS	931.9447		5.3052	
R^2	0.2508		0.5406	
ρ	0.1133		-0.1432	
S.D. dependent var	12.4698		1.2014	
S.E. of regression	13.6524		1.0301	
Adjusted R-squared	-0.1987		0.2649	
Durbin-Watson	1.5306		2.0179	
Autocorrelation test – <i>p-value</i>	0.2342			
Effect test ARCH – <i>p-value</i>	0.4166			
Doornik-Hansen test – <i>p-value</i>	0.4040			
Cross-correlation coefficient for residual equations (determinant)			58.2381	

Source: own study based on data from the Polish Financial Supervision Authority and Polish Statistics.

Table 19. Characteristics of the equation in the VECM model for a pair of variables Y_1 and Y_3 (coefficient of regression equation and standard errors) and the results of significance tests.

Explanatory variables	Explained variables			
	Δ Business loans (<i>banks</i>) (Y_1)		Δ Assets (<i>leasing</i>) (Y_3)	
	<i>Coefficient</i>	<i>Std. Error</i>	<i>Coefficient</i>	<i>Std. Error</i>
constant	34.5385	19.9223	-26.3528	17.0667
Δ Business loans (<i>banks</i>) (Y_1) (1)	-0.1108	0.5084	-0.4072	0.4355
Δ Assets (<i>leasing</i>) (Y_3) (1)	-0.2586	0.4044	0.3371	0.3464
EC (1)	-0.0840	0.2092	0.4912	0.1792
Mean dependent var	22.4318		9.1172	
RSS	1130.6420		829.7475	
R^2	0.0911		0.6238	
ρ	-0.0856		0.1475	
S.D. dependent var	12.4698		16.6040	
S.E. of regression	15.0376		12.8821	
Adjusted R-squared	-0.4542		0.3981	
Durbin-Watson	1.6543		1.5673	
Autocorrelation test – <i>p-value</i>	0.0388			
Effect test ARCH – <i>p-value</i>	0.1547			
Doornik-Hansen test – <i>p-value</i>	0.6043			
Cross-correlation coefficient for residual equations (determinant)			10964.1000	

Source: own study based on data from the Polish Financial Supervision Authority and Polish Statistics.

Table 20. Characteristics of the equation in the VECM model for a pair of variables Y_3 and Y_2 (coefficient of regression equation and standard errors) and the results of significance tests.

Explanatory variables	Explained variables			
	Δ Assets (<i>leasing</i>) (Y_3)		Δ Assets (<i>factoring</i>) (Y_2)	
	<i>Coefficient</i>	<i>Std. Error</i>	<i>Coefficient</i>	<i>Std. Error</i>
constant	91.2991	26.1125	7.2498	2.2305
Δ Assets (<i>leasing</i>) (Y_3) (1)	0.6387	0.3557	0.0969	0.0304
Δ Assets (<i>factoring</i>) (Y_2)	2.0857	3.0013	-0.1001	0.2564
EC (1)	-1.9754	0.5446	-0.1126	0.0465
Mean dependent var	9.1172		2.5875	
RSS	477.7418		3.4857	
R^2	0.7834		0.6982	
ρ	0.0906		-0.4474	
S.D. dependent var	16.6039		1.2014	
S.E. of regression	9.7749		0.8349	
Adjusted R-squared	0.6534		0.5170	
Durbin-Watson	1.6582		2.4908	
Autocorrelation test – <i>p-value</i>	0.2434			
Effect test ARCH – <i>p-value</i>	0.3243			
Doornik-Hansen test – <i>p-value</i>	0.7267			
Cross-correlation coefficient for residual equations (determinant)			19.4295	

Source: own study based on data from the Polish Financial Supervision Authority and Polish Statistics.

Table 21. The value of the Student's t-statistics and p-value for the explanatory variables in the estimated regression equations for the studied variables.

	Δ Business loans (<i>banks</i>) (Y_1)		Δ Assets (<i>factoring</i>) (Y_2)	
	<i>t-ratio</i>	<i>p-value</i>	<i>t-ratio</i>	<i>p-value</i>
Constant	1.0800	0.3295	-1.7010	0.1496
Δ Business loans (<i>banks</i>) (Y_1) (1)	-0.0361	0.9726	-0.0009	0.9993
Δ Assets (<i>factoring</i>) (Y_2) (1)	-0.7408	0.4921	0.3397	0.7479
EC (1)	-0.6689	0.5332	1.8810	0.1187
	Δ Business loans (<i>banks</i>) (Y_1)		Δ Assets (<i>leasing</i>) (Y_3)	
	<i>t-ratio</i>	<i>p-value</i>	<i>t-ratio</i>	<i>p-value</i>
Constant	1.7340	0.1435	-1.5440	0.1832
Δ Business loans (<i>banks</i>) (Y_1) (1)	-0.2180	0.8360	-0.9350	0.3927
Δ Assets (<i>leasing</i>) (Y_3) (1)	-0.6396	0.5506	0.9730	0.3752
EC (1)	-0.4018	0.7045	2.7410	0.0407**
	Δ Assets (<i>leasing</i>) (Y_3)		Δ Assets (<i>factoring</i>) (Y_2)	
	<i>t-ratio</i>	<i>p-value</i>	<i>t-ratio</i>	<i>p-value</i>
Constant	3.2500	0.0227**	3.4960	0.0174**
Δ Assets (<i>leasing</i>) (Y_3) (1)	1.7950	0.1326	3.1910	0.0242**
Δ Assets (<i>factoring</i>) (Y_2) (1)	0.6949	0.5181	-0.3906	0.7122
EC (1)	-3.6270	0.0151**	-2.420	0.0601*

Explanations: Asterisks *, **, *** indicate significance at the 10%, 5% and 1% levels respectively.

Source: own study based on data from the Polish Financial Supervision Authority and Polish Statistics.

Table 22. Parameters of the estimated VECM models.

Variable	Short-term perspective (st)			Long-term perspective (lt)
	Δ Business loans (banks) (Y_1) (1)	Δ Assets (factoring) (Y_2) (1)	Δ Assets (leasing) (Y_3) (1)	EC (1)
Δ Business loans (banks) (Y_1)	-0.0361	-0.7408 (0.4921)	-0.6396	-0.6689
	(0.9726)		(0.5506)	(0.5332)
	-0.2180	-0.0009	-0.9350	-0.4018
	(0.8360)	(0.9993)	(0.3927)	(0.7045)
Δ Assets (factoring) (Y_2)	-0.0009	0.3397	0.6949	1.8810
	(0.9993)	(0.7479)	(0.5181)	(0.1187)
	-0.7408 (0.4921)	-0.3906 (0.7122)	3.1910	-2.420 (0.0242**)
			(0.0242**)	
Δ Assets (leasing) (Y_3)	-0.9350	3.1910 (0.0242**)	0.9730	2.7410
	(0.3927)	0.6949	(0.3752)	(0.0407**)
	-0.6396 (0.5506)	(0.5181)	1.7950	-3.6270 (0.0151**)
			(0.1326)	

Explanations: Asterisks *, **, *** indicate significance at the 10%, 5%, and 1% levels respectively.

Source: own study based on data from the Polish Financial Supervision Authority and Polish Statistics.

Granger causality analysis²

The results and the direction of Granger causality are presented in Table 23 (in order to reduce the negative effect of the stability of the studied variables, calculations were made for three levels of lags). In the Granger causality test, we assume that the past value of one variable determines the value of the other variable in the present. The causality test is based on the following model:

$$y_i = \alpha_0 + \sum_{j=1}^m \alpha_j y_{i-j} + \sum_{j=1}^m \beta_j x_{i-j} + \varepsilon_i \quad (1.9.)$$

Here, the α_j and β_j are the regression coefficients and ε_i is the error term. The test is based on the null hypothesis:

$$H_0: \beta_1 = \beta_2 = \dots = \beta_m = 0 \quad (1.9.)$$

The variable x is the Granger cause of the variable y when the null hypothesis is rejected.

We use the usual F test to determine if there is a significant difference between the regression model shown above (full model) or the reduced model, based on the null hypothesis, with no β_j conditions (i.e. where all $\beta_j = 0$). We can use two equivalent forms of the test:

$$F = \frac{SS'_E - SS_E/m}{MS_E} \sim F(m, df_E); F = \frac{(R^2 - R_r^2)df_E}{(1 - R^2)m} \sim F(m, df_E). \quad (2.0.)$$

All parameters are based on the full model except SS'_E i R_r^2 , which are based on the reduced model. If the p -value for the test is less than the projected value of α , we reject the null hypothesis and conclude that x causes y (in terms of Granger causality). The Granger causality

² The approach and tool (add-on to MS Excel) intended to be used from the website: <https://www.real-statistics.com/time-series-analysis/time-series-miscellaneous/granger-causality/> (access: 2021-05-03)

test assumes that both the x and y time series are stationary. If this is not the case, differentiation, trend reversal, or other techniques must first be applied before using the Granger causality test. The number of lags, i.e. the value of m , is critical as different values of m may lead to different test results. One way to select an appropriate value for m is to choose the value that gives the complete model with the lowest AIC or BSC value. A causal relationship can only be in one or both directions (x Granger causes y and y Granger causes x) or neither.

Table 23. Granger causality test.

The direction of causality in the sense of Granger						
The number of lags	$Y_1 \rightarrow Y_3$	$Y_1 \rightarrow Y_2$	$Y_2 \rightarrow Y_1$	$Y_2 \rightarrow Y_3$	$Y_3 \rightarrow Y_1$	$Y_3 \rightarrow Y_2$
1,0	0,0346**	0,0479**	0,6237	0,0212**	0,9562	0,9387
2,0	0,1587	0,3297	0,6488	0,0436**	0,9459	0,1055
3,0	0,2454	0,8204	0,4464	0,3854	0,1502	0,2332
Conclusion						
1,0	$Y_1 \rightarrow Y_3$	$Y_1 \rightarrow Y_2$	$Y_2 \nrightarrow Y_1$	$Y_2 \rightarrow Y_3$	$Y_3 \nrightarrow Y_1$	$Y_3 \nrightarrow Y_2$
2,0	$Y_1 \nrightarrow Y_3$	$Y_1 \nrightarrow Y_2$	$Y_2 \nrightarrow Y_1$	$Y_2 \rightarrow Y_3$	$Y_3 \nrightarrow Y_1$	$Y_3 \nrightarrow Y_2$
3,0	$Y_1 \nrightarrow Y_3$	$Y_1 \nrightarrow Y_2$	$Y_2 \nrightarrow Y_1$	$Y_2 \nrightarrow Y_3$	$Y_3 \nrightarrow Y_1$	$Y_3 \nrightarrow Y_2$

Explanations: \rightarrow causality (x is the cause of y), \nrightarrow no causality. The presented values correspond to the p -values for the F statistic. Asterisks *, **, *** indicate significance at the 10%, 5%, and 1% levels respectively.

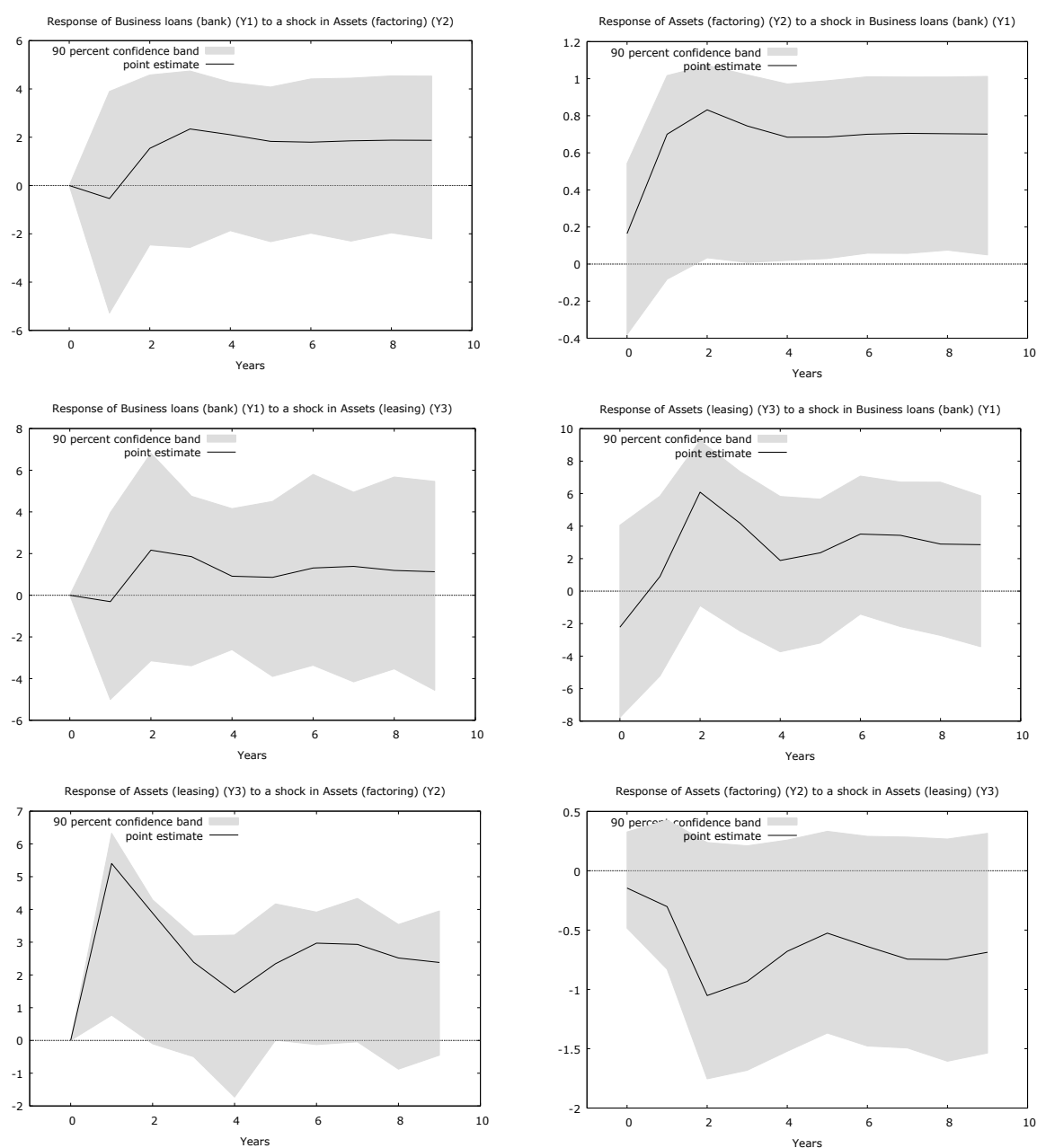
Source: own study based on data from the Polish Financial Supervision Authority and Polish Statistics.

The results show that in the short term: delayed values of factoring assets (Y_2) have a significant impact on leasing assets (Y_3), and banking loans (Y_1) influence for factoring assets (Y_2) and for leasing assets (Y_3), at a significance level of $\alpha < 0,05$. For the remainder, no significant causal relationships were identified (causality relationships in the sense of Granger).

Impulse response function

To study the influence of one variable on another, an impulse response analysis is performed based on the data from the VECM model. The results of the generalized impulse response function (IRF) are shown in Figure 8. In the figures provided, the horizontal axis represents the number of impulse response periods, the vertical axis represents the response intensity, and the solid line is the impulse response curve.

Figure 8. Impulse response function of the studied variables.



Source: own study based on data from the Polish Financial Supervision Authority and Polish Statistics.

Figure 8 presents graphs that demonstrate the intensity of one variable's response to another with a 90% confidence level bootstrap. In the short term (two years), the strongest (positive) response to the shock caused by the second variable occurs in the case of the response of leasing assets (Y_3) to the shock caused by factoring assets (Y_2). We observe a very similar high level in the short term in the lease asset response (Y_3) caused by the business loans shock (Y_1). We observe a strong negative response in the short term in the response of factoring assets (Y_2) to a shock caused by lease assets (Y_3) with a variable amplitude in the longer term. For the answers: business loans at banks (Y_1) to shocks caused by factoring assets (Y_2) as well as factoring assets

(Y_2) to shocks caused by business loans at banks (Y_1) and business loans at banks (Y_1) to shocks caused by leasing assets (Y_3), we can speak of a relatively moderate intensity of the response to the impulse.

Discussion

The Granger causality test allows one to examine the causality relationships between variables with the VECM model and to determine the direction of causality according to short- and long-term relationships. One of the disadvantages of the Granger test is that it only provides information about linear relationships between variables. Thus, it only provides information about linear relationships between variables. This means that in relationships where the dependencies are non-linear, this test will be useless. Another disadvantage of the Granger causality test is that it is completely dependent on an appropriate selection of variables and their delays. The omission of causal factors from the construction of the model means that these factors are not represented in the output. Despite these drawbacks, the Granger causality test is a popular method for identifying relationships between variables.

Competition on the corporate banking market in Poland increases entrepreneurs' awareness of the available financial instruments and helps them select those appropriate for the current economic and trading situation (Bielawa, 2019). Analyses of the Italian financial market (one of the largest factoring and banking markets in Europe) demonstrated that the competition in the Italian credit sector was greater in factoring than in banking, and factoring companies were (on average) more stable than banks. The stability of factoring companies increases with decreased competition (indicating instability in competition) and competition instability is weaker in the factoring industry than it is in the banking industry (Degl'Innocenti, Fiordelisi, & Trinugroho, 2020). Assessment of the impact of eight different financing sources (internal funds, bank loan, credit line, trade credit, subsidies, equity, leasing, and factoring) on the innovativeness and development of companies (based on an econometric study on access to enterprise financing and the impact of financing sources) found that external financing sources facilitate innovation and facilitate company growth (turnover and employment) (Santos, Cincera, & Cerulli, 2019). While the number of financing instruments used together plays a role, a single financing instrument itself has no impact on innovation. Equity financing encourages entrepreneurs to introduce innovation and has the strongest effect on increasing a company's turnover, whereas subsidies cause employment growth that is higher than increased turnover (Santos et al., 2019). Therefore, complex financing and state aid that promotes research and development and innovation must be based on a more solid integration of public and private support and, in fact, compel enterprises to pursue an integrated policy that uses

various financial instruments. In further research, it would be important to address the need to identify the factors that cause an incommensurably higher increase in assets compared to revenue growth, which is crucial for the development of enterprise financing policies within bank capital groups. Undoubtedly, far more accurate data and conclusions regarding the synergy effect under the enterprise financing model within banking capital groups could be determined by analyzing the financial results and selected financial positions of enterprises using loans or leasing and factoring. As a subject of further research, one should address the need to determine not only the required level of demand for external financing sources in factoring and leasing companies (debt capacity) but also the reasons for banks' relatively more cautious approach to building their loan portfolios. When analyzing modest capital and high leverage levels, it is important to determine whether the level of equity in subsidiaries of banks is not too low for the implemented aggressive financing policy and the potential risk exposure. Building a competitive position in banking is strongly based on trust and cyberspace security of banking services – the need to ensure cyber security, which is a notion shared by many authors (Grabowska-Powaga, 2017; Kasiewicz & Kurkliński, 2017; Nowacka & Szewczyk-Jarocka, 2017; Pitera, 2017) and which requires further costs and expenses from banks. Given the scale and size of various types of regulatory requirements, it is difficult to comply without incurring additional costs and expenditure on often sophisticated and advanced systems that support control and reporting processes for regulators (Marcinkowska, Wdowiński, Flejterski, Bukowski, & Zygierewicz, 2014; Pyka, 2014). Analyses indicate that banks' market valuations are increasingly correlated with their level of digital maturity, yet they should not be treated deterministically, and digital maturity is correlated with profitability and higher operating leverage and is associated with a higher market premium and better return on capital (Mcintyre, 2019). Despite emerging from the crisis and replenishing capital, banks are struggling with lower profits (Dietz, Lemerle, Mehta, Sengupta, & Zhou, 2017). Undoubtedly, great opportunities lie in the implementation of advanced models and price optimization processes. Adopting price optimization enables lenders to increase profitability, control risk, and, in the best-case scenario, stops them from granting too many bad loans and offering them at unreasonable terms (Phillips, 2018, p. 1). From another perspective, innovation in price management can be driven by a business model or technology (Simon, 2019, p. 426).

Conclusions

The conducted research allows to supplement the Pecking Order Theory by looking at the order of external financing sources from the creditor's side. The low level of equity in

dynamically developing leasing and factoring companies may be a challenge for regulators. The examined financial products are substitutable. Econometric models were developed to enable planning of future values of business loans at banks, assets of factoring and leasing companies. In the analyzed period (2009-2019), the Polish corporate finance market grew at a very high pace, which is confirmed by the value of the compound annual growth rate (CAGR), which for the assets of factoring companies was a record 20.40%, for assets of leasing companies 10.04%, and 7.42% for business loans in banks - this confirms the significant role of alternative forms of corporate financing to bank loans.

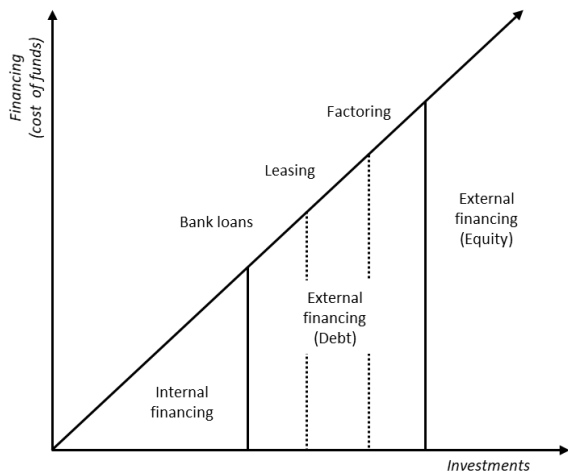
The Granger causality analysis shows that bank loans are a statistically significant (at a significance level of $\alpha < 0,05$) for the value of factoring and leasing assets (for the number of lags equal to 1), moreover, factoring assets have a statistically significant impact on leasing assets (for the number of lags 1 and 2). It follows from the above that diversified activities in the distribution of substitute products, aimed at financing the operations of enterprises, by banking capital groups, may generate significant synergy effects with minor shocks and disturbances to the core business of banks, in other words, granting loans (which is confirmed by the analysis of the functions impulse response). However, the quality of the final results is influenced by the non-stationarity of the studied time series and the cointegration between them (too little data may cause problems with the practical application of the presented VECM models).

In practice, banks, leasing and factoring companies have independent but cooperating sales networks, which creates three distribution channels. In terms of searching for the best distribution direction to maximize synergistic effects, cross-selling of products through individual channels is considered. The conducted analysis allows for the formulation of the following conclusions regarding the average interaction of the tested products:

- 1) conducting the acquisition of leasing and factoring products at the bank will result in a strong and dynamic increase in leasing and factoring sales both in the short-term and long-term (stronger in the long-term than in the short-term),
- 2) the short-term and long-term leasing channel has a positive effect on the sale of factoring and negatively on the sale of corporate loans (cannibalization) (stronger in the long term than in the short term),
- 3) the factoring channel has a negative effect on the sale of loans (stronger in the long term than in the short term), moreover, factoring has a negative effect on the sale of leasing (stronger in the short term than in the long term).

Based on the formulated conclusions, the following postulates regarding the pricing

Figure 4. Hypothetical cost of investment financing funds depending on the type of financing source.



Source: own study.

policy for individual forms of financing enterprises within the banking capital group should be formulated. Firstly, in the case of cannibalization, the cannibalizing (eating) product must provide higher profitability than the cannibalized (eaten) product, and leasing must be more expensive than loans. Moreover, while factoring must generate a higher profit than leasing (loans should be sold at the lowest price, and factoring at the highest price), only this approach ensures the most optimal structure

of the pricing policy, which will contribute to the best possible synergy effect.

Appendix

Table 1. Selected financial data used in the study. Financial data (in bn PLN) of the banking sector, factoring and leasing companies.

Variable	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
<i>Data for the banking sector in total (DB)</i>											
X_1 Business loans (<i>banks</i>) (Y_1)	222,08	247,98	294,82	299,11	309,71	336,52	365,27	388,78	415,59	437,43	449,87
X_2 Assets (<i>banks</i>)	1057,38	1155,31	1289,74	1345,49	1401,24	1531,99	1599,99	1710,90	1781,45	1893,76	2000,13
X_3 Equity (capital) (<i>banks</i>)	103,80	115,98	128,90	146,54	153,00	166,00	173,94	183,41	203,99	204,00	209,33
X_4 Revenues (<i>banks</i>)	82,60	83,42	91,20	99,34	88,39	84,49	78,30	81,54	83,79	84,85	92,35
X_5 Net profit (<i>banks</i>)	8,28	11,42	15,54	15,47	15,18	15,88	11,19	13,90	13,75	13,05	13,81
<i>Summarized data for factoring and leasing companies (SDL&F)</i>											
X_6 Assets (<i>leasing&factoring</i>)	68,57	71,52	80,44	90,64	119,66	92,89	97,32	127,65	144,85	165,98	176,87
X_7 Current Assets (<i>leasing&factoring</i>)	4,98	5,69	37,33	56,39	62,49	43,75	43,90	54,54	63,17	72,71	79,30
X_8 Equity (capital) (<i>leasing&factoring</i>)	10,43	12,14	13,70	15,24	30,67	7,71	7,66	8,38	8,32	7,58	7,94
X_9 Revenue (<i>leasing&factoring</i>)	14,44	14,98	16,54	22,65	32,00	9,62	9,27	10,29	12,23	14,12	15,29
X_{10} Net profit (<i>leasing&factoring</i>)	0,92	1,01	1,72	-0,86	3,05	0,97	0,98	0,88	0,79	0,18	1,00
<i>Data for factoring companies (DF)</i>											
X_{11} Assets (<i>factoring</i>) (Y_2)	4,64	5,32	7,29	10,26	11,80	13,42	14,35	17,72	22,47	25,05	28,61
X_{12} Current Assets (<i>factoring</i>)	4,42	5,01	6,80	24,80	28,24	13,13	14,02	17,41	20,73	24,78	28,24
X_{13} Equity (capital) (<i>factoring</i>)	0,72	0,79	0,79	0,66	0,65	0,76	0,81	0,89	1,37	0,66	0,65
X_{14} Revenue (<i>factoring</i>)	0,67	0,79	1,06	1,00	0,96	0,78	0,65	0,73	0,88	0,96	1,17
X_{15} Netprofit (<i>factoring</i>)	0,06	0,11	0,15	0,11	0,15	0,12	0,09	0,15	0,08	-0,51	0,16
<i>Data for leasing companies (DL)</i>											
X_{16} Assets (<i>leasing</i>) (Y_3)	63,92	66,20	73,16	80,38	107,86	79,47	82,97	109,93	122,38	140,92	148,25
X_{17} Current Assets (<i>leasing</i>)	0,56	0,68	30,53	31,59	34,25	30,62	29,88	37,13	42,44	47,93	51,05
X_{18} Equity capital (<i>leasing</i>)	9,71	11,34	12,91	14,57	30,02	6,95	6,85	7,48	6,94	6,92	7,29
X_{19} Revenue (<i>leasing</i>)	13,76	14,19	15,48	21,65	31,05	8,84	8,61	9,57	11,35	13,16	14,12
X_{20} Netprofit (<i>leasing</i>)	0,86	0,90	1,57	-0,97	2,90	0,85	0,88	0,73	0,71	0,69	0,84

Source: own study based on data from the Polish Financial Supervision Authority and Polish Statistics.

Abbreviations

ADF - the extended Dickey-Fuller statistical test developed by D. A. Dickey and W. A. Fuller,

CAGR - compound annual growth rate,

IFR - impulse response function,

KPSS – statistical test developed by P. C. B. Phillips, P. Schmidt, and Y. Shin,

OLS - the ordinary least squares regression,

PZL - The Polish Leasing Association,

TOPISIS - The Technique for Order of Preference by Similarity to Ideal Solution,

VECM - Vector Error Correction Model,

VIF - variance inflation factors.

Availability of data and materials

The article uses data from the following sources:

- 1) monthly data of the banking sector published by the Polish Financial Supervision Authority at: https://www.knf.gov.pl/?articleId=56224&p_id=18,
- 2) financial data contained in the annual studies of the Polish Statistics on the activity of factoring companies available at the link: <https://stat.gov.pl/obszary-tematyczne/podmioty-gospodarcze-wyniki-finansowe/przedsiębiorstwa-finansowe/działalność-faktoringowa-przedsiębiorstw-finansowych-w-2019-roku,2,15.html> (historical data is available in the "Archiwum" tab),
- 3) financial data contained in the annual studies of the Polish Statistics on the activity of leasing companies available at the link: <https://stat.gov.pl/obszary-tematyczne/podmioty-gospodarcze-wyniki-finansowe/przedsiębiorstwa-finansowe/działalność-przedsiębiorstw-leasingowych-w-2019-roku,3,13.html> (historical data is available in the "Archiwum" tab).

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I declare that I have no competing interests.

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