



Original article

received 02.01.2025; accepted 05.06.2025; published 30.06.2025

doi: 10.12775/EiP.2025.07


Synchronization of the business and financial cycle in Poland

ŁUKASZ MARKOWSKI

corresponding author

Department of Theory of Economics, Faculty of Economic Sciences, University of Warmia and Mazury in Olsztyn, Prawocheńskiego 3, 10-720 Olsztyn

✉ lukasz.markowski@uwm.edu.pl

 ORCID: 0000-0001-8791-1285

Abstract

Motivation: Nowadays, financial factors increasingly determine the functioning of the real sector. The assessment of the synchronization and interdependence of fluctuations in business and financial activity can be a kind of criterion for assessing the balance between the real and financial spheres.

Aim: The aim of the research is to assess the degree of synchronization of the business and financial cycle in Poland and the changes in the degree of this synchronization over time.

Results: In the adopted research period, financial cyclical fluctuations of the dynamics of the stock market index and credit for the non-financial private sector did not clearly and unequivocally determine cyclical fluctuations of the GDP growth rate in Poland. However, this does not mean that financial cycles in Poland are not related to the business cycle. The research results indicate clear symptoms of dependence upon cyclical changes in the financial sphere and real economic activity. The degree of synchronization of the business and financial cycle in Poland is also variable over time.

Keywords: business cycle; financial cycle; financialization

JEL: E32; E44; G10



1. Introduction

The financialization means autonomization and growth of the financial sphere. Currently, this process may also cause financial factors to increasingly determine the functioning of the real sector, which means that the variability and scale of financial activity affect the variability and scale of economic activity. In other words, the cyclicity of processes in the financial sphere may determine the cyclicity of processes in the real sphere (Borio, 2014; Cerutti et al., 2017). Although the aspect of the financial activity fluctuations has been known in the literature for many years (Minsky, 1978), interest in the issue of the convergence of financial cycle with the business cycle has increased significantly after the global financial crisis at the end of the first decade of the 21st century (Whalen, 2008; Drehmann et al., 2012; Borio, 2014; Samarina et al., 2017; Aldasoro et al., 2020; Gammadigbe, 2022).

After the systemic transformation, accession to the European Union (EU) and the intensive economic development, the capital market in Poland is expected to significantly participate in financing activities from the real economy. Although research indicates that the scale of financialization is smaller in comparison to highly developed countries, the dynamics of growth of the financial categories means that decision-making by non-financial entities may be increasingly determined by factors outside the real sphere (Marszałek, 2013; Gołębiowski & Szczepankowski, 2015; Socha & Urban, 2019; Chmiel & Pitera, 2021; Rydzewska, 2023).

The aim of the research is to assess the degree of synchronization of the business and financial cycles in Poland and the change in the degree of this synchronization over time. The paper is a contribution to the body of research on the cyclical nature of financial and business processes in Poland. The period that has passed since the systemic transformation and accession to the EU justify undertaking a credible assessment of the fluctuations in business and financial activity. The material for research on the cyclical nature of phenomena consists of updated and new statistical data that extend the time series available for analysis. The convergence and interdependence of fluctuations in economic and financial activity and the analysis of morphology of entire cycles can be a kind of criterion for assessing the balance between the economic and financial sectors in the Polish economy. An important issue is also the assessment of the response of the level of cycle synchronization in the face of new, unprecedented crisis phenomena. The paper also constitutes added value due to the fact that the number of literature items concerning the relationships between the business and financial cycles is clearly smaller than the number of studies referring only to the convergence of business cycles. The relationship between the financial and

economic cycles is not yet fully understood, as interest in this aspect has only increased significantly in recent years. This paper is therefore an attempt to fill the research gap in this area.

The considerations in this study focus on attempting to answer the following research questions:

1. To what extent are the business and financial cycles in the Polish economy synchronized?
2. To what extent do changes in the financial cycle determine the variability of the business cycle in Poland?
3. How does the degree of synchronization of these cycles change over time?

The paper is structured as follows. The introduction is followed by a review of the literature on the definition of the financial cycle, the nature of the convergence and interdependence of business and financial fluctuations, and a presentation of the research results available in the literature on this phenomenon. The next section presents a description of the research methods used, followed by the results of the research. The article ends with conclusions.

2. Literature review

2.1. The financial cycle, financialization and the business cycle

According to the classical approach, the financial sector plays a “servient” role to the real sphere in the economy. The importance of credit money is generally omitted, and the foundation of this approach is the concept of the “Veil of Money” and the “Neutrality of Money” (Roncaglia, 2022). The idea that activity in the real economy should not be analyzed in isolation from the financial sector, and that the financial sector itself is prone to regular boom-and-bust cycles, harks back to H.P. Minsky’s (1978) financial instability hypothesis and the so-called Minsky moment. Although this concept is reflected in reality, e.g. in relation to the financial crisis in Russia in 1998 or the global financial crisis of 2007 (Whalen, 2008), the concept of the “financial cycle” is not precisely defined in the contemporary literature and there is no consensus on its interpretation. The description of the financial cycle depends on the economic category that is taken as the determinant of this phenomenon. An image of the cycle can be created by analyzing changes in the credit market, prices in the stock market, prices in the real estate market, interest rates or various indexes of total asset prices (Drehmann et al., 2012; Jordà et al., 2019; Tsallas & Monokroussos, 2018; Kunovac et al., 2018; Oman, 2019; Škare & Porada-Rochoń, 2019; Ha et al., 2020; Aldasoro et al., 2020; Gammadigbe, 2022; Trotta Vianna, 2023).



Currently, the most widely accepted definition is one that has been proposed by C. Borio (2014), who defined the financial cycle as self-reinforcing interactions between value and risk perceptions and financing constraints, which translates into booms followed by busts. The financial cycles are linked to the growth of imbalances in the financial system and the booms and busts that cause them. T. Ng (2011) points out that financial cycles are also created by changes in the perception and attitude towards financial risk. They depend on the existing regimes of financial policy, monetary policy, the real sector and they are related to systemic banking crises.

Similarly to business cycles, financial cycles therefore include both boom and bust phases. Financial cycle expansions are associated with rising asset prices and rapid credit growth, which can be driven by rational or irrational optimism about overall macroeconomic conditions or the future prospects of a given asset class. Importantly, the process can be reinforced by high liquidity in the market, the inflow of foreign capital, or financial innovations. The cycle enters a downward phase when the bubble bursts, which is manifested by falling asset prices, reduced credit activity and widening spreads. These phenomena may be accompanied by investors' flight to safe assets (selling overvalued positions), bank panic and interbank market contagion (Adarov, 2020). Imperfect information may also contribute to the aggravation of the financial crisis (Moszyński, 2009). The accumulation of these issues further causes a reduction in credit activity. In this way, changes in the financial sphere are transferred to the real sphere.

Currently, financial markets are of great importance in the process of transferring expansionary and recessionary impulses to the production sphere. This is particularly dangerous in the case of a collapse due to a sudden limitation of the inflow of capital to a given real sector. The most recent examples of financial market disruptions being transmitted to the real sector include the crash on the New York Stock Exchange on 19 October 1987 (although the US economy ultimately grew), the dotcom crisis and the economic recession of 2000–2001 (also in the US) and the global financial crisis of 2007 (Drozdowicz-Bieć, 2009). Studies have shown that recessions accompanied by financial market disruptions are, on average, longer and more severe than those without such problems (Claessens et al. 2009). The relationship between the financial sector and the production sector is also bilateral. Most often, a financial market collapse is the source of a crisis in the real sector. It is worth emphasizing, however, that this sector later experiences the negative effects of an economic collapse (Drozdowicz-Bieć, 2009).

It is therefore currently believed that financial cycles play an important role in the course of business cycles (Borio, 2014; Cerutti et al., 2017). One of the most important phenomena determining the relationship between these two categories is the financialization of economies. Financialization means the growing importance of financial markets and financial institutions

for the functioning of the real economy. G. Epstein (2005) generally defined financialization as an „increasing role of financial motives, financial markets, financial actors and financial institutions in the operation of the domestic and international economies”. G. Krippner (2005) defines financialization as a form of accumulation in which profits are increasingly achieved through financial channels rather than through trade and production. Financialization also affects the activities of financial supervision institutions and determines the consideration of the financial market situation in fiscal and monetary decision-making (Ratajczak, 2012). The causes of financialization in the global economy include deregulation of markets, the expansion of the offer of new financial instruments, and the growing importance of institutional investors (Gostomski, 2014).

On the one hand, the financialization of economies means an increase in the autonomy of the financial market in relation to the real economy. However, growing autonomy goes hand in hand with the growing influence of financial markets on the process of managing the non-financial sphere. This means that the financial sphere, which according to the classical approach was to support the production sphere, is increasingly beginning to determine its functioning.

In general, it can be assumed that the financialization of developed economies inevitably leads to the phenomenon of “financialization of cycles”, which means a sharp increase in the importance of financial factors in generating and shaping economic fluctuations. Its consequences include changes in the shape of the traditional business cycle, as well as increased susceptibility to macroeconomic shocks and financial crises (Szunke, 2014). In other words, the phenomenon of “financialization of the cycle” means an increase in the impact of financial fluctuations on the volatility of fluctuations in economic activity.

2.2. Research review

The interest in studying the morphology of the financial cycle and its convergence with the business cycle has increased significantly after the financial crisis of the late first decade of the 21st century. Samarina et al. (2017) analyzed credit cycles in sixteen eurozone countries from 1990 to 2013, taking into account mortgage credit and private credit. The results of the study showed that credit cycles differed across countries after the introduction of the common currency. Ahmed et al. (2018) included data for nine eurozone countries. The authors concluded that there is a strong synchronisation between business and financial fluctuations. G. Rünstler and M. Vlekke (2018) found that in France, Germany, Italy, Spain, the United Kingdom, and the United States; financial cycles are longer than business cycles and last from thirteen to eighteen years. Moreover, financial cycles are heteroge-



neous across European countries. Oman (2019) analyzed the synchronization of the business and financial cycles of the twelve founding countries of the eurozone. The author provided many interesting conclusions, indicating that the credit-to-GDP ratio was procyclical in the years preceding the recession. M. Škare and M. Porada-Rochoń (2020b) prove that in ten-year intervals (medium term) there is a strong synchronisation between financial and business cycles in Great Britain (between the years 1270–2016). Modifying the research method, the authors note, however, that this convergence is time-varying (Porada-Rochoń & Škare, 2020). S. Lv et al. (2023) in their research present the characteristics of financial cycles and the network of mutual contagion in 24 countries around the world. The results indicate that developed countries are characterized as having shorter financial cycles and greater volatility than developing countries. Ł. Markowski and A. Ostrowska (2024) examined the synchronization of business and financial cycles in the European Union countries. The research results indicate that the EU countries are characterized by diversification in terms of the degree of impact of financial variables on the business cycle. The group of “new” and “old” EU countries differs from each other in a statistically significant way in terms of the average level of synchronization of the business and stock market cycle.

The achievements of the scientific discipline in the area of assessing the morphology of the financial cycle and its convergence with the business cycle in Poland are not yet rich, although there are several studies that constitute an important element in the debate on this topic. Ł. Lenart and M. Pipień (2015) attempt to characterize the financial cycle in Poland based on the series of credit and equity. The authors conclude that the amplitude and length of the credit and capital cycle in the Polish economy are different than in the analyzed reference countries (USA and Great Britain). The length of the financial cycle in Poland is longer than the production cycle (it does not exceed a decade), but is much shorter than the length of financial cycles in well-developed economies (which are even 20–25 years). M. Pipień and D. Tymoczko (2024) analyze credit cycles in Poland individually for banks. The results prove their diversity in terms of period, turning points and amplitudes. However, the authors observe a decrease in the amplitude of fluctuations (also in aggregate terms), the reason for which is, among others, the development of the financial system. G. Ho and Y. Lu (2013) estimated the financial conditions index for Poland and examined its relationship with real economic activity. The results indicate a strong correlation with GDP growth, which confirms the importance of the financial sector in the Polish economy. Research in the area of synchronization of the financial and real spheres was also undertaken by M. Porada-Rochoń (2020), who identified the financial cycle in Poland based on the credit-to-GDP gap. The author observed that there was no synchronization between the financial and business cycles using the Hodrick–Prescott, Baxter–King and Hamilton filters (cor-

relations at the level of 0.00029, -0.0746 and -0.03, respectively). However, a strong convergence occurred using the asymmetric Christiano-Fitzgerald filter (correlation at the level of 0.88).

According to the research available in the literature, business cycles usually show a greater frequency, while financial cycles have greater amplitudes, although the length of the financial cycle depends on the adopted fluctuation band in the research procedure (Claessens et al., 2012; Drehmann et al., 2012; Hiebert et al., 2014). The results prove that there is no single correct method for measuring financial cycles. Experience in the analysis of this phenomenon is still relatively small, although several methods can be distinguished. M. Porada-Rochoń (2020) indicates that these include, for example, classical turning point analysis (Burns & Mitchell, 1946; Claessens et al., 2012), structural trend-cycle decomposition (Bonis & Silvestrini, 2013), univariate and multivariate spectral analysis (Škare & Porada-Rochoń, 2020c; Strohsal et al., 2018), wavelet analysis (Ardila & Sornette, 2016) or bibliometric analysis (Qin et al., 2021).

3. Methods

The first stage of the study was the selection of variables representing the business and financial cycle. The first one was assumed to be a time series representing the quarterly dynamics of real GDP year-on-year. The selection of a variable representing the financial cycle creates many dilemmas. This study focuses primarily on the capital market. Due to the fact that the most important segment of the capital market is the stock exchange, the main variable representing the financial cycle was the WIG20 stock exchange index (closing data on the last day of the quarter). Although it includes only the 20 largest companies, and in some of them the government has a large share, it is considered a benchmark.

Most articles on the study of financial cycles, however, are based on data on the supply and dynamics of credit. This results from the structure of the financial market (also in Poland), where credit is the main source of financing for both households and enterprises. Therefore, in this study, the dynamics of credit for the non-financial private sector, including both loans and debt securities, was adopted as another measure of the financial cycle.

In this study, a set of common and recognized methods for cycle identification and synchronization was used. The chosen concept of studying cycles is the “growth” method, which involves analyzing the growth rate of a given phenomenon on an annual basis. In this approach, all time series (business, credit and stock exchange) have the same titers. The use of time series representing year-to-year dynamics eliminates the problem of seasonality to some extent. However, the series were subjected to the TRAMO/SEATS procedure



(Gomez & Maravall, 2001), which allows a smoothing the time series and the elimination of random fluctuations¹.

To estimate the cyclical factor from the smoothed time series, the Christiano-Fitzgerald filter was chosen as a method to extract growth cycles (Christiano & Fitzgerald, 2003). This filter (CHF) is often used by researchers to extract not only business cycles but also financial cycles² (e.g. Drehmann et al., 2012; Hiebert et al., 2014; Aldasoro et al., 2020; Adarov, 2020). The CHF filter is a band-pass filter. The filtering process eliminates both short-term fluctuations and long-term fluctuations (trend). The choice of the fluctuation band for the business and financial cycles remains a controversial issue in the study. In the case of separating financial cycles, it is possible to use two types of cyclical patterns. The first concept focuses on the same periodicity as the business cycle. In this approach, a fluctuation band corresponding to the typical length of the business cycle is determined for series representing financial variables. The second concept concerns the medium-term perspective (8-30 years) (Drehmann et al., 2012; Aldasoro et al., 2020). Estimating cycles longer than the range of available data is technically impossible. In this study, the focus is therefore only on the short-term perspective and, in accordance with the literature, the same fluctuation band was adopted for financial cycles as for business cycles (2–8 years).

The business cycle was taken as the reference cycle. The convergence of fluctuations was measured using spectral analysis; in particular the coherence coefficient and cross-correlation. Coherence is a measure of fit of R^2 in the regression of the dependent variable on the independent variable for a given frequency. It makes it possible to answer the question to what extent the variability of one time series is determined by the second time series. The value is in the interval $<0; 1>$. The closer to unity the coherence value, the more interdependent the analyzed series are. Cross-correlations take into account the lag or lead values of time series relative to the reference cycle.

The procedure for determining turning points was based on the Bry-Boschan method³ (1971). Analysis of cycle morphology (the measurement of intensity and amplitude of phases and entire cycles) was conducted based on volatility measures. As part of the analysis of morphological features, phase shifts of turning points of the credit and stock market cycles were determined in relation to the business cycle. The measurement of changes in the degree of synchronization of the financial and business cycles over time was performed using the recursive correlation coefficient.

The time scope of the research depended on the availability of statistical data. The synchronization of the economic and stock market cycles cov-

¹ The procedure was performed in the GRETl package.

² The procedure was performed in the EViews package.

³ The procedure was performed in the BUSY package.

ered the period 1Q1996 – 2Q2024 (114 observations), and the economic and credit cycle: 4Q2004 – 1Q2024 (78 observations). The data was obtained from Eurostat⁴ (GDP dynamics time series), the European Central Bank⁵ (dynamics of credit for the non-financial private sector) and the stooq.pl platform⁶ (WIG20 stock exchange index).

4. Results

The first stage of the study is a spectral analysis of the stock market cycle relative to the business cycle (reference cycle). The measurement results are presented in Table 1. The coherence coefficient should be considered low, which can be interpreted as a low interdependence between the course of business and financial fluctuations in Poland. According to the theory, stock market indicators should be leading in relation to the real economy. This is confirmed by the positive value of the average shift, which indicates that the stock market cycle in Poland led the business cycle by 1.33 quarters on average. However, the correlation without a shift should be considered low. However, it reaches a clearly higher value when the financial cycle is 2 quarters ahead of the business cycle⁷.

In order to deepen these observations, an analysis of turning points was conducted (Table 2). The average shift (lead) of the peak of the stock market cycle relative to the peak of the business cycle is 1.17 quarters. The average shift in the trough of the cycle is 1.5 quarters. This suggests that growth phases may be characterized by a slightly greater degree of convergence than decline phases. In the entire period under study, 1 more stock market cycle than business cycles were identified. This means that in the range of fluctuations adopted in the study, the stock market cycle was usually shorter than the business cycle. This is confirmed by the results of calculations presented in Table 3. The average duration of the stock market cycle in the analyzed period was shorter than the business cycle, both in terms of “Peak to Peak” and “Trough to Trough”. Stock market cycles are also characterized by a shorter growth phase and a longer decline phase.

An analogous research procedure was carried out for the business and credit cycle. The cyclical factor statistics are presented in Table 4. The debt on loans and their dynamics is usually a lagging variable in relation to the business cycle⁸. This relationship was confirmed in the research. The busi-

⁴ <https://ec.europa.eu/eurostat/data/database>.

⁵ <https://data.ecb.europa.eu/>.

⁶ <https://stooq.pl/>.

⁷ The correlations are statistically significant at the level of $\alpha=0.01$.

⁸ G. Calvo et al. (2006) estimate that the credit dynamics after the collapse returns to the pre-crisis level after 3 years of economic recovery.



ness cycle was ahead of the credit cycle by 1.85 quarters. The correlation coefficient r_0 should be considered low. This value can be assessed as moderate with a 3-quarter lag of the credit cycle relative to the business cycle⁹. In the adopted time frame, cyclical fluctuations of the empirical series of credit dynamics explained cyclical fluctuations of the reference series to a small extent, which is suggested by the coherence coefficient. It is worth emphasizing that it was even lower than in the case of the analysis of the stock market and business cycles.

In the course of economic fluctuations in the real economy, five peaks and five troughs were identified (table 5). The turning point of the credit cycle was usually delayed relative to the business cycle. The delay was most often 2 quarters, although in two cases it was almost 2 years (Q4-2006 and Q1-2016). Since 2017, the turning points of both cycles have mostly overlapped. The average shift (lag) of the peak point in the credit cycle was 3.25 quarters, and the trough was 3.33 quarters. In the entire period under review, 1 fewer credit cycles were identified than business cycles.

In both the Peak to Peak and Trough to Trough approaches, the credit cycle turned out to be longer than the business cycle (table 6). It is worth noting that while the downward phase of the credit and business cycles is similar (Peak to Trough), the upward phase (Trough to Peak) in the case of the credit cycle is definitely longer.

The intensity of the empirical series indicates the strength of the upward or downward trends of the economic values studied. The summary of intensity measures for all the types of cycles analyzed is presented in Table 7. The analysis shows that the stock market cycle is characterized by the greatest intensity of changes, followed by the credit and business cycles. It is worth noting that in the case of financial cycles, a positive amplitude of the entire cycle was noted, in contrast to the business cycle. The amplitude of the growth phases was higher in the case of financial cycles, and lower in the case of the business cycle.

The last stage of the study is to verify the variability of the degree of synchronization of economic and financial fluctuations over time. The course of the distinguished cycles is presented in graphical form in Chart 1. It can be stated that the degree of convergence of the distinguished cycles is not the same in the period under study. A more precise analysis may therefore be to examine the values of the recursive correlation coefficients (Charts 2 and 3).

Based on the forward-expanding correlation, we can speak of a downward trend in the degree of convergence of business and stock market fluctuations. This is confirmed by the correlation coefficient with the moving window, the values of which generally decreased until the second half of 2016. The period

⁹ The r_0 correlation is statistically significant only at the level of $\alpha=0.2$, and the r_{\max} correlation is statistically significant at the level of $\alpha=0.01$.

2017-2021 was characterized by high convergence of the stock market and business cycles. However, desynchronization was observed after 2022.

From the analysis of the course of the correlation coefficient with the expanding sample forward concerning the economic and credit cycle, it can be seen that after the period 2005-2009, which was characterized by a moderate degree of convergence, there was a decline and then stagnation in this respect. This was caused by large fluctuations of the moving correlation.

The above observations show that the synchronization of business and financial fluctuations is influenced by the nature of macroeconomic events. In some sub-periods, the cycles are convergent, and in others – clearly desynchronized (e.g. financial crisis, pandemic, war in Ukraine). It also depends on the adopted variable representing the financial cycle.

5. Conclusion

The first conclusion from the conducted research is that in the adopted research period, financial cyclical fluctuations of the dynamics of the stock exchange index and credit for the non-financial private sector did not clearly and unambiguously determine cyclical fluctuations of the growth rate of the real economy in Poland. Stock market and credit cycle fluctuations explained economic fluctuations by 16% and 7%, respectively. It should be noted, however, that it is difficult to unequivocally assess the degree of the financialization phenomenon because the theory does not indicate a limit beyond which such a degree can be considered low, high or too high. However, it can be assumed that the phenomenon of “financialization of the cycle” occurs to a limited extent. The reasons for such an observation include a floating exchange rate, an autonomous monetary policy, a relatively lower level of investment banking than in highly developed countries, a lack of complex financial instruments in the Polish financial system and/or, generally speaking, a relatively low level of financialization of the Polish economy compared to highly developed economies. This does not mean, however, that financial cycles in Poland are not linked to the business cycle. There are clear signs of dependence between cyclical changes in the financial sphere and real economic activity. Although the degree of impact on the real economy has not turned out to be high, the correlation with the shift can be considered moderate. Certain properties and “behaviors” of cycle convergence are also consistent with the theory (leading/lagging the stock market/credit cycle relative to the real sector). The development of the Polish economy, reflected in financial categories, therefore encourages taking into account the risk of increased financialization and, as a result, increasing the impact of financial fluctuations on the business cycle in the future.



Another important conclusion from the conducted research is that the degree of synchronization of the economic and financial cycles in Poland varies over time, and the degree of this convergence seems to be influenced by the nature of macroeconomic events, which is confirmed by the recursive correlation with a moving window. In the face of recent crisis phenomena, i.e. the pandemic and monetary easing, the convergence of the business cycle with the stock market and credit cycles has increased. In the face of the war in Ukraine, high inflation and restrictive monetary policy, the synchronization decreased in the case of the business and stock market cycles and increased in the case of the business and credit cycles.

Comparison of the morphological features of the cycles leads to conclusions that correspond with the results of other studies on this subject. The greatest intensity of changes and the highest amplitude are characteristic of the stock market cycle, followed by the credit and business cycles. The amplitude of the growth phases was higher in the case of the financial cycles than in the case of the business cycle. The growth phases of the cycles are characterized by a slightly greater degree of convergence than the downward phases, and the stock market cycle is characterized by a greater degree of synchronization with the business cycle than the credit cycle.

At this point, although it was not the aim of the research, it is impossible to ignore the issue of practical implications. Currently, monitoring financial cycles in order to adjust macroprudential policy seems necessary. When a new economic shock appears, a very important issue from the perspective of systemic risk is to pay attention to the phase of the financial cycle, which may be different from the phase in which the business cycle resides. It is also important to track different categories representing the financial cycle and detect signs of transmission and contagion of the real economy by changes in the financial market. This may allow for adjusting macroprudential policy to specific disturbances in the financial market.

The conducted research and the literature review lead to the conclusion that in the analysis of the synchronization of business and financial fluctuations, the selection of research tools and the method of measuring cycles are very sensitive issues. The use of different methods may therefore lead to slightly different conclusions. For this reason, it is justified to continue research in the area of synchronization of business and financial cycles. This results from the need to verify the robustness of the obtained results to the modification of the research method and the selection of other variables representing the financial sector. The tools and variables used in this study are recognized in the economic literature, but each empirical analysis is based on certain assumptions. Future research directions should therefore take into account the above issues.

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Acknowledgements

Author contributions: author has given an approval to the final version of the article. Author's total contribution to the manuscript: 100%.

Note: the results of this study were presented in another form, such as a poster/abstract at a conference.

Appendix

Table 1. Statistics of the cyclical factor of the dynamics of the WIG20 stock exchange index in relation to the business cycle

Coherence coefficient	Average shift * (quarters)	Cross correlation**		
		r_0	r_{\max}	t_{\max}
0.16	1.33	0.31	0.51	2

* The +/- sign indicates a lead/lag relative to the reference series (applies to all tables).

** " r_{\max} " denotes the value of the cross-correlation coefficient at lead (+)/lag (-) " t_{\max} " periods.

Source: Own research.

Table 2. Turning point analysis: leads and lags in the stock market cycle with respect to the business cycle

Time series	Trough	Peak	Trough	Peak	Trough	Peak	Trough	Peak
Business cycle	Q2-1998	Q4-1999	Q3-2001	Q3-2003	Q1-2005	Q4-2006	Q1-2009	Q1-2011
Stock market cycle	+1	0	+1	-2	-1	+1	+2	+4
Business cycle	Q4-2012	Q3-2014	Q1-2016	Q3-2017	Q1-2020	Q3-2021	Q1-2023	
Stock market cycle	+5	—	+1	+2	0	+2	+3	

* It was assumed that the cycle phase should last at least two quarters, and the entire cycle should last at least six quarters.

Source: Own research.

Table 3. The average duration of the phases and the entire stock market and business cycle

Time series	Peak to Trough	Peak to Peak	Trough to Peak	Trough to Trough
Business cycle	7.29	13.67	6.86	13.29
Stock market cycle	7.86	12.86	6.00	13.00

Source: Own research.

Table 4. Statistics of the cyclical factor of credit dynamics for the non-financial private sector in Poland in relation to the business cycle

Coherence coefficient	Average shift (quarters)	Cross correlation		
		r_0	r_{\max}	t_{\max}
0.07	-1.85	0.16	0.39	-3

Source: Own research.



Table 5. Turning point analysis: leads and lags in the credit cycle with respect to the business cycle

Time series	Peak	Trough	Peak	Trough	Peak	Trough	Peak	Trough	Peak	Trough
Business cycle	Q4-2006	Q1-2009	Q1-2011	Q4-2012	Q3-2014	Q1-2016	Q3-2017	Q1-2020	Q3-2021	Q1-2023
Credit cycle	-7	-4	-2	+1	-2	-7	-	-	-2	-

Source: Own research.

Table 6. Average duration of the phases and the entire credit and business cycle

Time series	Peak to Trough	Peak to Peak	Trough to Peak	Trough to Trough
Business cycle	7.60	14.00	6.75	13.25
Credit cycle	7.00	17.33	11.00	15.00

Source: Own research.

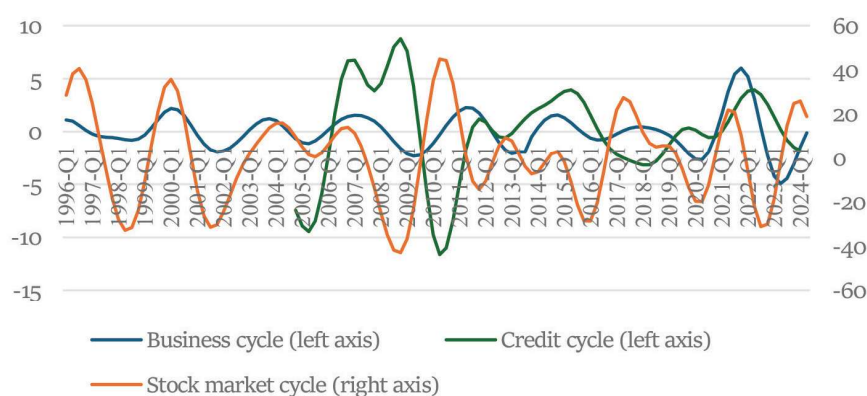
Table 7. Time series intensity measures*

Time series	Standard deviation	Average amplitude of		
		growth phases	downward phases	entire cycles
Business cycle	1.75	3.45	3.95	-0.49
Stock market cycle	20.26	45.32	44.29	1.03
Credit cycle **	4.40	7.25	6.24	1.01

* The amplitude of the phase is understood as the absolute value of the difference between the turning points. The amplitude of the entire cycle is the difference between the amplitude of the rising and downward phases.

** It is worth emphasizing that the time series representing the credit cycle is shorter. Source: Own research.

Chart 1. Cyclical component of real GDP dynamics, credit dynamics for the non-financial private sector and WIG20 index dynamics



Source: Own research.



Chart 2. Recursive correlation of the business and stock market cycles



Source: Own research.

Chart 3. Recursive correlation of the business and credit cycles



Source: Own research.