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Financial cycle – A critical analysis of the methodology for its identification[1]

Abstract: While the legitimacy of the concept of the financial cycle (as distinct from the business cycle) in research and economic policy after the experience of the global financial crisis raises no concerns, the methodology for its application has become a subject of discussion. The purpose of this article is to indicate which research methods dominate in identifying a financial cycle and which methodological traps accompany them. The low level of critical perspective on the methods used to identify cycles often results in conclusions that have no economic justification and may result in erroneous decisions in economic policy and central bank practice. The case study carried out in the article confirms that the key elements in identifying a financial cycle are part of a long-term series covering at least two lengths of the financial cycle. In addition, because the results may be sensitive to the type of filter used, it is important not to rely on a single variable but rather to build indexes that take into account a number of them (including those obtained using filtration methods).

Key words: financial cycle, macroprudential policy, financial stability, filtration methods.

JEL classifications: C22, E32, E61, G01.

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1. Introduction

The global financial crisis has highlighted a gap in the analysis of financial stability, in particular the analysis of the reasons for the emergence of crises and the possibility of predicting them. It has also become apparent that current economic policies (including monetary and microprudential policies) are not enough to ensure the stability of the financial system, which is why there is a need for macroprudential policy. The development of macroprudential policy instruments has become a main reason for ongoing analytical work on the concept of the financial cycle. Just as the business cycle is a determinant of monetary policy, the financial cycle has become one of the main determinants of macroprudential policy. The business cycle maps the situation in the real economy, while the financial cycle is a quantification of the cyclical dimension of systemic risk.

The concept of the financial cycle is present in several areas of the current literature. The first and most important of these is the determination of the level of financial imbalances (e.g. Borio, 2012 or Aikman, Lehnert, Liang, & Modugano, 2016). Another area is the synchronization between the financial cycles of different countries, or the synchronization between the financial and business cycle (e.g., Cleassens, Kose, & Terrones, 2011 or Kurowski and Rogowicz, 2018). This type of approach makes it possible to assess the links between the real and the financial economies from both the internal (in each country) and external (between countries) perspectives. In addition, identifying the degree of synchronization of financial cycles allows for the identification of the global (or European) financial cycle (e.g., Habibb and Vendetti, 2018). In addition to its value for research, the financial cycle is also a crucial factor in economic policy. In accordance with the recommendations of the Basel Committee on Banking Supervision, the financial cycle determines the level of the countercyclical capital buffer (BCBS, 2010). The high applicative value of the financial cycle in macroprudential policy makes the subject extremely important. Considering the recommendations presented later in this article regarding methods of measuring the financial cycle will help policymakers correctly identify the moment of activation of macroprudential instruments.

Compared to the business cycle, the degree of sophistication of analyses and methods required for the financial cycle identification is much lower. In addition, based on the often-incorrect methods of financial cycle determination, some researchers have drawn 'hard' conclusions for macroprudential policy and links between the financial sphere and the real sphere of the economy. In this article, I draw attention to the methodological traps accompanying the procedure for identifying the financial cycle and its synchronization with the business cycle or

other financial cycles. These traps relate to i) the length of a time series, ii) the filtering method used, and iii) the omission of important financial cycle features in research. In addition, we indicate ways to avoid making unwarranted assumptions that could ultimately result in erroneous analysis results.

The next part of the article reviews the literature on the most commonly used measures of the financial cycle and its areas of application. The third part shows how sensitive the patch of the financial cycle is depending on the method used in the research. Failure to take into account sensitivity to the financial cycle in the research method may significantly affect the reliability of the study and the interpretations of its results. The last part of the paper contains a summary of the most important findings from the analysis.

2. Literature review

The main measure of the business cycle is the output gap (GDP gap), which is the difference between the actual output of the economy, (i.e., the quantity of goods it produced) and its potential output (i.e., the quantity of goods the economy is able to produce at full capacity). But there is no single universal measure for the financial cycle. In the literature, the following factors are used to identify the financial cycle: real estate prices (e.g., Geipele and Kauskale, 2013), stock prices (Punzi, 2016), debt service ratio (Drehmann, Juselius, Borio, & Disyatat, 2017) and lending (e.g. Skare and Porada -Rochoń, 2019). However, the most commonly used measure is the credit gap (e.g. Kurowski et al., 2019), which is the deviation of the current ratio of credit-to-GDP from its long-term trend. Therefore, the financial cycle is often referred to as the credit cycle. According to the research reported in Table 1, the credit gap is the measure with the best prognostic value for the financial crisis in early warning models. Thus, it is considered as the best measure of the financial cycle.

Table 1: Financial variables in early warning models

Literature	Lending	Stock prices	DSR	Real estate prices
Bańbuła and Pietrzak (2017)	X		X	X
Alessi and Detken (2014)	X	X		X
Drehmann and Juselius (2013)	X	X	X	X
Demirguc-Kunt and Detragiache (2005)	X			
Hutchison and McDill (1999)	X	X		

Source: Author`s research

In addition to its role in early warning models, the financial cycle concept is used to study the relationship between the real economy and the financial system. According to the research by Kurowski and Rogowicz (2018), the synchronization between financial and business cycles in any given country reached the lowest historical level following the global financial crisis. However, the influence of global factors on domestic financial cycles is growing. Scharnagl and Mandler (2016) came to similar conclusions and confirmed that the synchronization between the financial variables observed in a given country is lower than the synchronization of the same variables internationally. In turn, Kurowski and Smaga (2018) examined how changes in interest may affect the financial cycle. The main conclusion of their study is that monetary policy could have a significant procyclical effect on the financial cycle, especially in the expansive phase. Also noteworthy is that the nature of the interactions between business and financial cycles depend on the group of countries analysed. However, in most studies, the financial cycle has a greater impact on the business cycle (e.g. Kalemli-Ozcan, Papaioannou, & Peydr´o, 2009 or Akar, 2017). At the global level, the U.S. financial cycle has the greatest impact on the financial and business cycles of various countries (Kurowski and Rogowicz, 2018).

From the point of view of economic policy, the financial cycle is a determining factor in undertaking actions under macroprudential policy. One of the goals of macroprudential policy is to limit the procyclicality of the financial system, and thus the cyclical dimension of systemic risk. Indeed the financial cycle is the most common measure of the cyclical dimension of systemic risk. The countercyclical capital buffer (CCyB) is the main instrument of macroprudential policy for reducing cyclical imbalances in the financial system. According to the recommendations of the Basel Committee on Banking Supervision, the credit gap should be used to calibrate the level of CCyB (BCBS, 2010). Financial cycle measures are also useful for the sectoral usage of prudential instruments. For example, the activity on the real estate market can be determined by the deviation of current property prices from their long-term trend (Hartmann, 2015).

Various methods are used to identify the trend underlying the financial cycle. The most popular of these are time series filtering methods. The dominant filter in the application of these methods is the Hodrick-Prescott filter (Hodrick and Prescott, 1997), whose utility has been confirmed—see for example Drehmann and Yetman (2018) and Gonzalez, Lima, & Marinho (2015). The HP filter for the financial cycle is also recommended by the Basel Committee on Banking Supervision. This filter is not without its flaws and is often criticized in various studies on filtration methods (e.g. Hamilton, 2017). Therefore, other filters (e.g., Christiano-Fitzgerald or Hamilton filter) are used to identify the financial cycle.

In recent years, wavelet analysis (e.g., Scharnagl and Mandler, 2019) has become an increasingly popular but a demanding method. This method avoids making ex-ante assumptions about the minimum cycle length, which makes it superior to filtering methods.

3. Methodological traps in the financial cycle identification

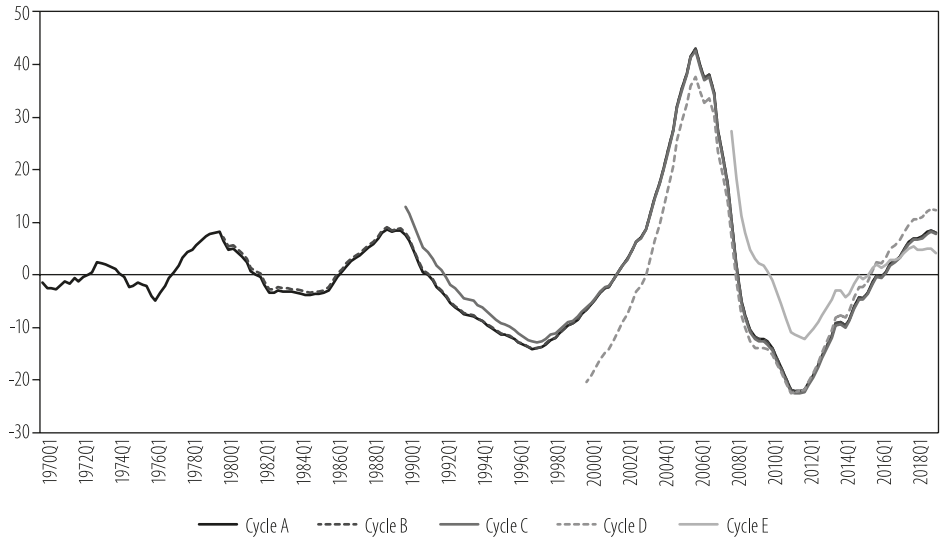
3.1. Financial cycle length and filtering methods

The main difference between the business and financial cycles is the frequency of cyclical fluctuations. The business cycle reflects situations in the real economy; hence, its frequency is greater than that of the financial cycle, which covers the cyclical dimension of systemic risk and the associated financial crises. Financial cycles are longer, deeper, with much greater amplitude than business cycles, but have a lower frequency (Hiebert et al., 2014). Financial cycles are medium and long-term phenomena, whereas business cycles are short-term. Both the duration and amplitude of financial cycles have increased since the mid-1980s, and now the length of a financial cycle ranges from 8 to even 20 years. By contrast, the length of the business cycle ranges from 2 to 8 years (Borio, 2012). This difference determines the central, though often overlooked, methodological problem. While short time series may be enough to identify the business cycle, long time series are required to determine the financial cycle. Therefore, it is not possible to correctly map the cyclical dimension of changes in the property prices for some countries. The main reason is that short time series of property prices prevent the coverage of cyclical fluctuations in the financial system. In many cases, data on real estate prices have been available since the global financial crisis of 2008. Therefore, it is a mistake to rely on a short data series to determine the long-term cycle in this market. Chart 1 below presents the U.S. housing cycle. The same time series for each cycle was shortened by 10 years. The time series for cycle E starts from 2008. Data analysis was made using an HP filter with the smoothing parameter $\lambda = 400{,}000$ (as per BCBS recommendations for quarterly data).

According to Chart 1, the shorter the time series used to identify the cycle of the U.S. real estate market, the greater the difference between the actual course of this cycle (based on the nearly 50-year time series - cycle A), and the course of the cycle determined on the same but shortened time series (cycle D and E). Cycle B (beginning of the series from 1980Q1) and cycle C (beginning of the series from 1990Q1) are very similar to cycle A. However, in the case of cycle E (which starts

from 2008Q1), the difference in the gap[2] level as compared to cycle A reaches as much as 10% in 2012. We see from the chart that in order to obtain the best mapping of the cycle, it is necessary to take into account time series covering at least two full lengths of the financial cycle, (i.e., from 16 years to 40 years) depending on the characteristics of the financial system of the analysed country. To confirm the above conclusions, credit cycles for the German economy as the largest European economy were identified in the same way (see the results in Annex 1). In this case, the differences are even more significant between the cycle based on the entire time series, (i.e. from 1960, and the series starting from 2000). This confirms earlier assumptions about the need to use series of length from at least 16 to 40 years.

Chart 1: The cycle of the U.S. real estate market depending on the length of the series



Note: the chart presents the real estate cycle gap, which is the deviation of the current value of the residential property index (RPI) from its long-term trend. We use quarterly data up to 2019Q2 for: cycle A - period from 1970Q1, cycle B - period from 1980Q1, cycle C - period from 1990Q1, cycle D - period from 2000Q1, and cycle E - period from 2008Q1.

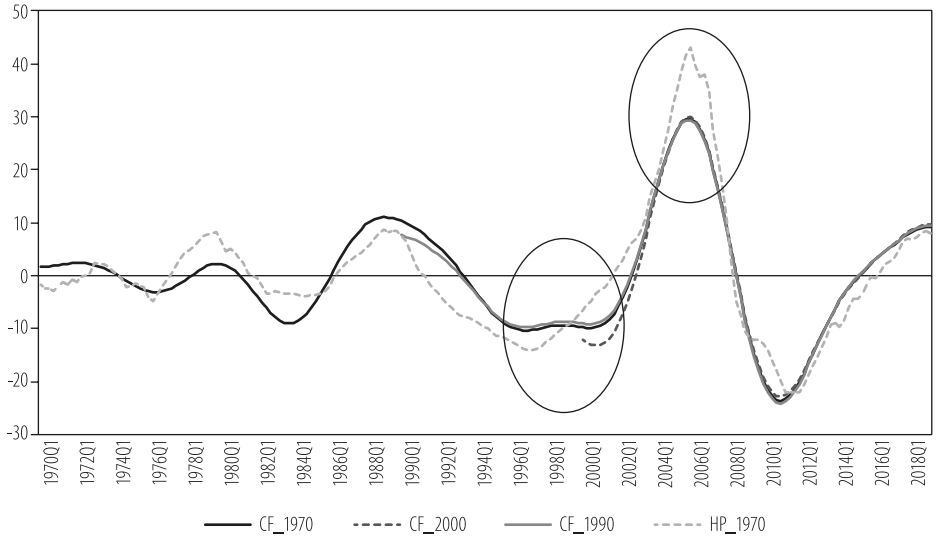
Source: Author`s calculations

Chart 1 shows a cycle in which the trend was identified using an HP filter. In the next stage, the same cycle was analysed using a different type of filter (See

[2] The gap is defined as the deviation of the current value of the property price index from its long-term trend.

Christiano-Fitzgerald, 1999), and assuming different lengths of time series. The results are shown in Chart 2.

Chart 2: Cycle sensitivity of the U.S. real estate market depending on the type of filter used



Note: The CF filter cycle was determined assuming the length of the financial cycle in the range of 8 to 20 years (i.e., a length 4 times greater than fluctuations in the business cycle).
Source: Author`s calculations

According to Chart 2, the conclusions that can be drawn for the U.S. housing cycle using both filters are similar. The cycles obtained with both the CF and the HP filters indicated the peak of the U.S. real estate market at the beginning of 2007 — although the size of the gap using the HP filter is 10% larger. The largest differences between the cycles determined using the two filters are observed mainly in the initial years for which the cycle is identified (see the period 2000Q1-2002Q1 in Chart 2). Annex 2 shows similar calculations for the German credit cycle. The differences between the two cycles obtained in Annex 2 using different filters are much larger than the differences in the case of real estate cycles in the USA (Chart 2). At the same time, it is worth noting that the largest differences in the estimation of the cycle of the real estate market between the applied filters occur at the time of phase changes, (i.e. in the transition from the recovery phase to expansion) and from the expansion phase to the collapse phase. At the same time, these are key moments for changing the parameters of the macroprudential policy instruments.

Examples of cycles identification depending on the adopted assumptions have shown that in order to draw conclusions regarding the current situation in the financial cycle, it is necessary to use the long time series and assess how significantly the results differ depending on the filter used. The designated cycle should: a) allow for economic interpretation and b) be resistant to the type of filter used. Otherwise, the results obtained may have limited reliability. The mere fact of extending the time series can significantly improve the resistance of the results to the type of filter used. In some studies, such as Kovačić and Vilotić (2017), we can find, for example, that the path of Poland's business cycle calculated using filtration methods is very similar to Malta's business cycle and significantly different than Germany's business cycle. In this case, it can be pointed out that next to the method used to extrapolate the cycle, it is worth presenting the economic justification for the results obtained. If the economic justification is far from reality, one should consider whether the chosen research method is correct.

In addition, in studies using the concept of the financial cycle, the length of this cycle is assumed in advance by determining the appropriate value of the lambda parameter (for the HP filter) and by different intervals of cyclic fluctuations in the CF filter. However, the fact that the length of the financial cycle is not constant but changes over time is ignored. Moreover, the length of the financial cycle varies depending on the country analysed and the variable used (Schuler, Hiebert, & Peltonen, 2020). Therefore, if we want to apply specific assumptions in a given filter (lambda parameter in the HP filter and the range of cyclical fluctuations in the CF filter), we should first ascertain the length of the country-specific cycle. This means that each separate variable requires the use of different parameters in the filtration method.

A good way to get results that are not sensitive to filtration methods is to combine multiple variables into one index, such as the financial condition index (Iwaniczˇ-Drozdowska, Bongini, Smaga, & Witkowski, 2018), the financial stability index (Manolescu and Manolescu, 2017) or the financial cycle index (Plasil, Seidler, Hlaváč, & Konečný, 2014). These indexes include several variables, which are often the standardized variables of many types of financial cycles (credit, real estate, or DSR ratio). Application of different filtration method for several variables in the indexes should not cause significant differences in the interpretation of the results. This confirms the legitimacy of replacing single variable filtration methods with indexes that aggregate many variables, including those obtained using series filtration methods.

3.2. Financial cycles synchronizaion

The concept of the financial cycle is used to study the synchronization of financial systems between individual countries or groups of countries. Just as in the case of the business cycle, the real convergence of economies is examined, (i.e. how highly business cycles are synchronized with each other). Therefore, it is also possible in the case of the financial cycle to examine how highly financial systems are synchronized between different countries (e.g., Claessens, Kose, & Terrones, 2012; Meller and Metiu, 2017; or Akar, 2017). As a measure of synchronisation, many studies use the concordance index (CI) proposed by Harding and Pagan (2002). CI compares the gap changes in one cycle to the gap changes in the second cycle as follows:

$$CI = \frac{1}{T}\left[\sum_{t=1}^{T} C_t^y C_t^x + \sum_{t=1}^{T}(1 - C_t^y)(1 - C_t^x)\right]$$

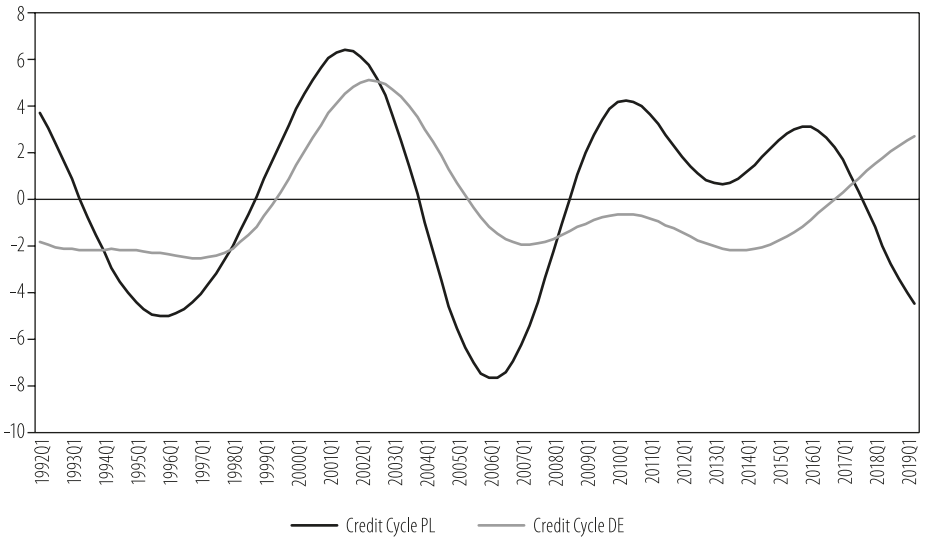
where:

C_t^y and C_t^x are changes in the gap in cycle Y and in cycle X in period t, respectively.

This indicator, therefore, determines the share of observations in which the gap changes have the same sign. This is the dominant method of testing two-cycle synchronization (e.g., Claessens, Kose, & Terrones, 2012; Kovačić and Vilotić, 2017; Ioannou, 2018; or Oman, 2019). However, it should be noted that the CI indicator is based only on changes in the gap level. Another feature of cycles is omitted, which seems to be more crucial in the interpretation of the results, viz., the size of the gap. If the gap changes in the same direction, the CI indicator will indicate that the cycles are synchronized even if the gap is significantly negative in one cycle (e.g. -30%) and significantly positive in the other (e.g. + 30%) . This seems to be an incorrect indication, because both cycles characterize financial systems in two different situations (i.e., expansion and depression) and the inference that both financial systems are synchronized with each other is incorrect. Chart 3 below presents the Polish and German credit cycles (using the CF filter).

According to Chart 3, in 80% of observations, the change in the Polish credit cycle gap (this value is assumed by the CI ratio) has the same direction as the change in the German credit cycle gap. However, in 2009-2016 the gap levels have opposite signs. The gap in Germany's credit cycle is negative, while in Poland's credit cycle the gap is positive. Because changes in the gaps have the same direction during this period, the CI indicator treated the period 2009–2016 as years

Chart 3: The Polish credit cycle and the German credit cycle



Note: The green fields mark the periods in which the cycles are synchronized as indicated by the CI indicator.

Source: Author`s calculations

of synchronization between both cycles. Therefore, the CI indicator is not an entirely good indicator because, as mentioned earlier, the gap levels in this period have opposite signs. To include both cycle features (gap level and its changes) in the cycle synchronization, Kurowski and Rogowicz (2018) proposed a measure called distance index (DI).

$$DI = \frac{1}{T}\sum_{t=1}^{T} C_t^y C_t^x \sqrt{y_t^2 + x_t^2}$$

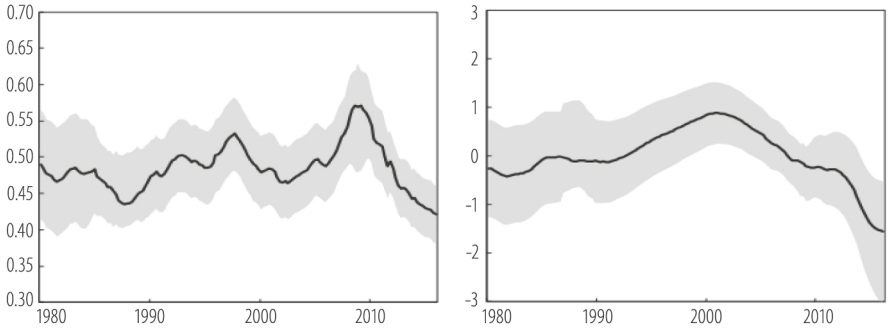
where:

y and x are the gap sizes in the cycle y and the cycle x, respectively.

The DI indicator can be visualized by postponing the gap size on the OX axis and the gap change on the OY axis. The sum of the distance of the resulting points, considering the appropriate sign, is equal to the DI indicator. The authors of the study present a comparison of CI and DI values obtained for business and credit cycle synchronization in a sample of the 27 largest global economies. For their

study, both CI and DI showed that the average synchronization between the business and financial cycles is currently low when viewed historically.

Chart 4: Comparison of synchronization between business and financial cycles using the CI (left panel) and DI (right panel) indicators



Note: the black line represents the median of synchronization between cycles, while the grey field indicates the interquartile range. Calculations were made in a rolling window of 10 quarters.

Source: Kurowski, Rogowicz 2018.

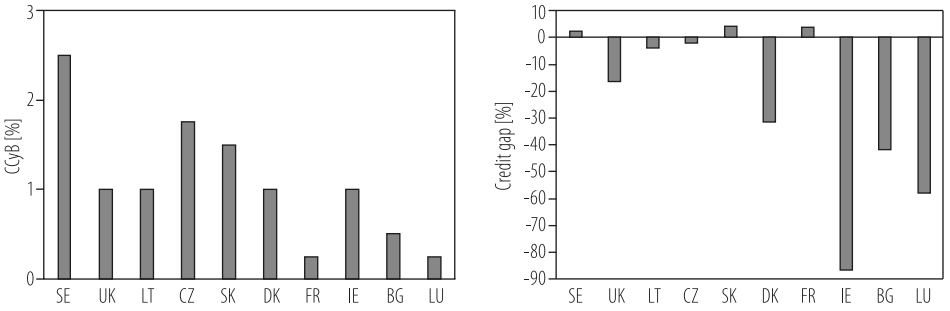
3.3. Application of filtration methods in macroprudential policy

Filtration methods are used to identify the credit cycle for the purpose of making decisions about setting a countercyclical capital buffer (CCyB). If the credit cycle gap were positive and exceeded 2%, then there would be a reason for setting a countercyclical capital buffer (BCBS, 2010). In this case, the question arises whether the relevant institutions (i.e., designated authorities) are deciding on the level of CCyB by relying on the size of the gap, the calculation of which may prove sensitive to the filtration method used, the length of time series and the different characteristics of financial systems in individual countries. Dobrzańska and Kurowski (2019) analysed the experiences in this area. They compared the size of the credit gap in each country with the announced or effective CCyB (Chart 5).

According to the analyses above, the credit gap is in practice only one of many indicators that is considered when making decisions about the level of CCyB. Many other indicators are considered, including the dynamics of lending, real estate prices and the global environment. A good example is Ireland, which as of February 1, 2019 announced CCyB at 1% even though the gap was significantly negative (-87%). The main premise for establishing CCyB in Ireland was the high

levels of housing loans, consumer loans and loans granted to large enterprises (Dobrzańska and Kurowski, 2019).

Chart 5: Gap size and CCyB level announced or effective as of February 1, 2019



Source: Author`s calculations based on Dobrzańska and Kurowski (2019).

A summary of the most important methodological traps in identifying the financial cycle with the proposed solution to the problem is presented in Table 2.

Table 2: Methodological traps in the financial cycle identification

The level of analysis	Methodological trap	Possible solution
Financial cycle length and filtration methods	Sensitivity of results to the length of time series	Extending time series (at least two financial cycle lengths)
	Sensitivity of results to the type of filter	Using not only one type of filter (robustness check using other types of filters)
		Construction of an index consisting of several variables in place of one "filtered" variable
	No economic interpretation of the results	The use of other, more reliable research methods, (e.g. wavelet analysis)
	Assumption of the same cycle length in different countries	Own or literature studies checking cycle length in different countries (e.g., Schuler, Hiebert, & Peltonen, 2020)
Synchronization between cycles	Use of research methods that ignore important cycle features (e.g., gap size)	Adopting various synchronization indicators based on both the size of the gap and its changes, (e.g., distance index) (Kurowski and Rogowicz, 2018)
	Ignoring the fact that synchronization changes over time	Checking (e.g., in a rolling window) changes in synchronization.
The use of the financial cycle in macroprudential policy	Sensitivity of results to the filtering method used and length of time series	Making decisions about the CCyB based on many variables and other models (e.g., early warning models)
	The length of the financial cycle depends on the characteristics of the country and varies over time	Macroprudential authority has to constantly verify the length of the financial cycle in order to calculate the current gap level, which is the reference value for the CCyB

Source: Own work.

Conclusions

The 2008 global financial crisis has highlighted the legitimacy of macroprudential policy. For monetary policy, the fundamental factor is the condition of the real economy (reflected in the business cycle, among other things), while for macroprudential policy it is the level of financial imbalances which plays a prominent role. Along with the development of macroprudential policy instruments, there emerged the concept of a financial cycle, which is a determinant, for example, of the countercyclical capital buffer. In addition, the financial cycle has become one of the more popular representations of the cyclical dimension of systemic risk, which is a central element in early warning models for financial crises.

Because the concept of the financial cycle is an important factor in decisions about macroprudential policy, it is important to correctly designate it. The aim of this article was to draw attention to the most popular methodological traps related to the financial cycle. The case study shows how sensitive the path of the financial cycle is to the length of time series and the method used to filter the series. Unfortunately filtering methods still dominates in literature and policy practice. Based on the analysis presented here, the time series used to identify the financial cycle should cover at least two lengths of the cycle, (i.e. between 16 and 40 years) depending on the characteristics of the country. In addition, it may turn out during the analyses that the designated cycle is significantly sensitive to the type of filter used. That is why it is justified to build financial indices composed of several variables (often also transformed by means of series filtering methods) that can reduce the sensitivity of the results obtained to the type of filter used. The lack of a critical approach towards the methodology used to identify the cycle often results in conclusions that are not susceptible of a sound economic interpretation.

Although the Basel Committee on Banking Supervision affirms the legitimacy of making the time of setting a countercyclical capital buffer dependent on the size of the gap in the financial cycle (especially the credit cycle), the countries in which the buffer is positive did not rely only the size of the credit gap. Countries decided on buffer levels by taking into account a wide range of variables, (e.g. real estate prices or external risks). Due to the significant disadvantages of filtration methods, making economic decisions by relying only on the phase of a given financial cycle could lead to an incorrect identification of the moment of buffer application, which would result in limited CCyB countercyclical effectiveness.

There is a need to develop a method in the future for determining the cycle which is not based on time series filtration methods. It would be valuable to look at the

level of equilibrium (i.e. trend) in the financial cycle from the point of view of the entire financial system as opposed to just one variable, and this would require the use of more advanced models.

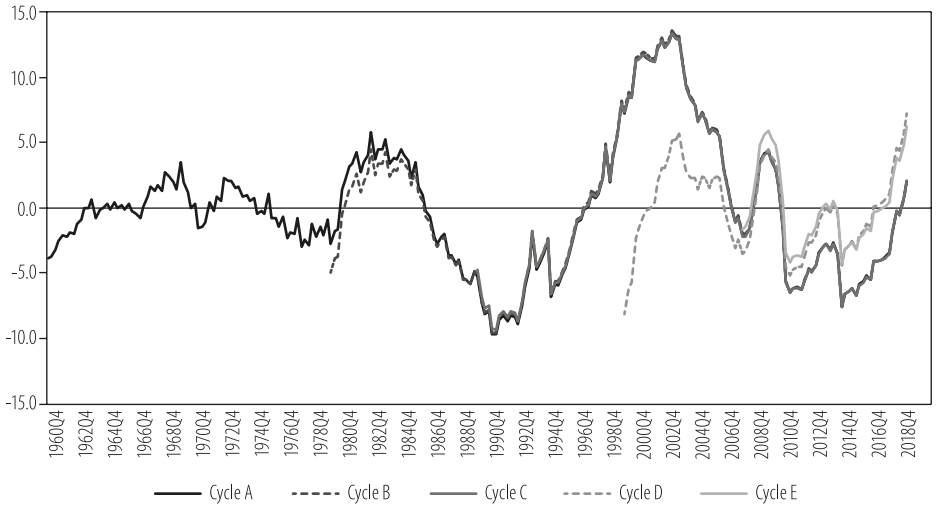
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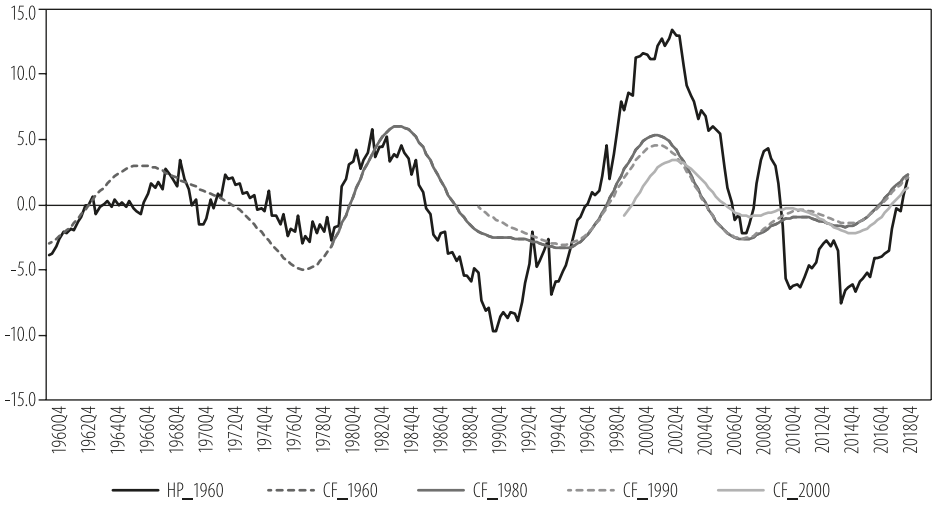
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Annex 1 - Germany's credit cycle depending on the length of time series



Source: Author`s calculations

Annex 2 - Germany's credit cycle depending on the filtration method used and the length of time series



Source: Author`s calculations