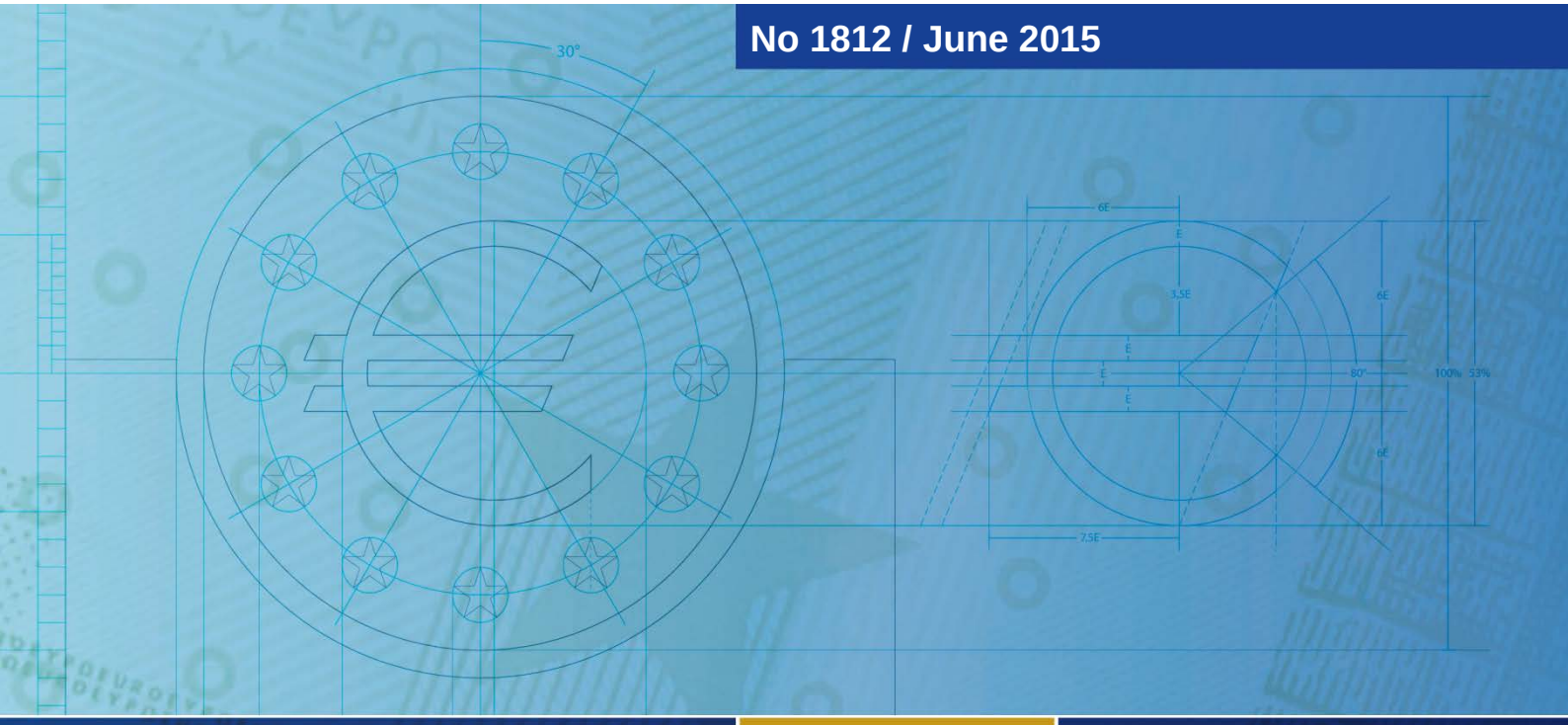
EUROPEAN CENTRAL BANK

EUROSYSTEM

Working Paper Series

Hanno Stremmel and
Balázs Zsámboki

The relationship between structural and cyclical features of the EU financial sector



No 1812 / June 2015

ABSTRACT

In this study, we explore the relationship between certain structural features of the banking sectors in EU Member States and the performance of the respective banking sectors over the financial cycle. Using the financial cycle indicator developed by Stremmel (2015), we estimate the impact of the structural features of the banking sector on the amplitude of the financial cycle. Our results suggest that the concentration of the banking sector, the share of foreign banks, the size and stability of financial institutions, the share of foreign currency loans and financial inter-linkages contribute to the amplitude and hence the variability of financial cycles. This study provides important insights into the appropriate design of various structural and cyclical policy instruments as well.

JEL Classification: E44, E61, G18, G21, G28
Keywords: banking sector characteristics, financial cycle, financial regulation, financial structure.

Non-technical Summary

The analysis of systemic risks associated with changes in the cyclical and structural features of financial sectors gained growing importance in recent years. At the same time, the global financial crisis of 2007-2008 has also triggered a range of policy actions and regulatory measures that aim to address cyclical and/or structural risks in the financial system. Both Basel III and the new European regulatory framework include a new set of macro-prudential tools.

This paper explores the relationship and potential interactions between certain structural features of the banking sectors in the EU Member States and the performance of the respective banking sectors over the financial cycle, with the aim of providing guidance to policy makers on the proper implementation of cyclical and structural measures to address the associated risks.

In this paper, we follow Stremmel (2015) in creating a financial cycle indicator for 21 European countries. Based on this indicator we derive two amplitude measures to describe the main characteristics of the financial cycles at the country level. We then relate the amplitude measures to structural banking sector indicators. Our analytical findings provide evidence that certain structural banking sector characteristics, such as the concentration of the banking sector, the share of foreign banks as well as the amount and composition of banks loans and financial integration, are important drivers of the financial cycle amplitude.

Moreover, this paper also investigates whether monetary policy contributes to the financial cycle amplitude. While our findings are supportive of the hypothesis that monetary policy plays a role in influencing financial cycles, we also find that the banking sector characteristics tend to override the explanatory power of the monetary policy stance.

Our study complements recent literature by providing insights in the longer-term relationship between cyclical and structural features of the banking systems across EU countries. Thereby, our paper contributes to the ongoing discussion on the implementation of macro-prudential policy measures. Based on the identified differences in financial cycles across EU countries and the impact of certain structural banking characteristics on the amplitude of the financial cycle, we conclude that the implementation of macro-prudential measures should be differentiated across EU Member States. The timing of activation and the relative calibration of the policy measures should take into consideration the differences both in financial cycles and banking structures.

1 Introduction

The global financial crisis that erupted in 2007 has drawn particular attention to the analysis of systemic risks associated with changes in the cyclical and structural features of financial sectors around the world. At the same time, the crisis has also triggered a range of policy actions and regulatory measures that aim to address cyclical and/or structural risks. A key regulatory initiative in this regard was the development of the new Basel capital and liquidity framework (Basel III), the implementation of which is accomplished through the Capital Requirements Regulation (CRR) and Capital Requirements Directive (CRD IV) in the EU. Both Basel III and the new European regulatory framework include a new set of macro-prudential tools, such as the capital conservation buffer, the counter-cyclical capital buffer, the capital surcharge for systemically important financial institutions as well as other instruments, such as the systemic risk buffer in Europe. Although the combined impact and possible interactions of these buffers and the underlying risk factors are highly relevant from a macro-prudential policy perspective, the empirical evidence of these interactions is limited.

The objective of this paper is to explore the relationship and potential interactions between certain structural features of the banking sectors in the EU Member States and the performance of the respective banking sectors over the financial cycle, with the aim of providing guidance to policy-makers on the proper implementation of cyclical and structural measures to address the associated risks.

Our investigation is related to different strands of literature. Recent literature has revealed the importance of the financial structure for lending and economic growth. Gambacorta et al. (2014) show that the financial structure is an important driver for output volatility, notably bank-based systems tend to be more resilient than market-based systems in economic downturns. However, in cases when the economic downturn coincides with a financial crisis, output losses for bank-based systems are higher than for market-based financial systems. ESRB ASC (2014) finds that bank-based systems have a more volatile credit supply and amplify the business cycle. Further, Bolton et al. (2013) elaborate on the lending of different types of banks in crisis periods and show that banks involved in relationship lending continue to lend in more favourable terms during financial crises.

In addition, there is an emerging strand of literature focusing on the analysis of the financial cycle, trying to capture its main characteristics (e.g. Aikman et al. (2010, 2014), Claessens et al. (2011a,b), Drehmann et al. (2012), Stremmel (2015)). Stremmel (2015) provides an overview of the various approaches used in the literature to construct the financial cycle. In this study, we will rely on the financial cycle measure developed by Stremmel (2015).

Our study is closely related to analytical work on the macro-prudential policy framework as well. Borio (2013) elaborates on the relevance and implications of understanding the financial cycle for macro-prudential policy purposes. Recent literature mainly links patterns

of financial indicators to the implementation of the counter-cyclical capital buffer (CCB). Bush et al. (2014), Detken et al. (2014), and Drehmann and Tsatsaronis (2014) provide a detailed overview of the relevant studies and investigate the effectiveness and adequacy of cyclical measures, such as the credit-to-GDP gap, for defining and calibrating the counter-cyclical capital buffer rate. Although results at the country level are mixed, the suitability of using the cyclical movements in credit variables as an early warning tool to identify the build-up of financial vulnerabilities is generally not challenged (e.g. Detken et al. (2014)).

Our study complements the literature by providing insights in the longer-term relationship between cyclical and structural features of the banking systems across EU countries as well as by drawing relevant policy conclusions with regard to the design and implementation of cyclical and structural policy measures, such as the counter-cyclical capital buffer (CCB) and the systemic risk buffer (SRB).

The remainder of the paper is organised as follows: Section 2 elaborates on the financial cycle measure applied in the analysis. Section 3 discusses the motivation and the estimation strategy to investigate the relationship between the financial cycle and the structural characteristics of the banking sectors. Section 4 describes the data used in the paper, whereas Section 5 provides the econometric analysis and offers estimation results. Section 6 provides various robustness checks. Section 7 explores the impact of monetary policy on the financial cycle. The last section concludes and provides policy implications.

2 Financial Cycles

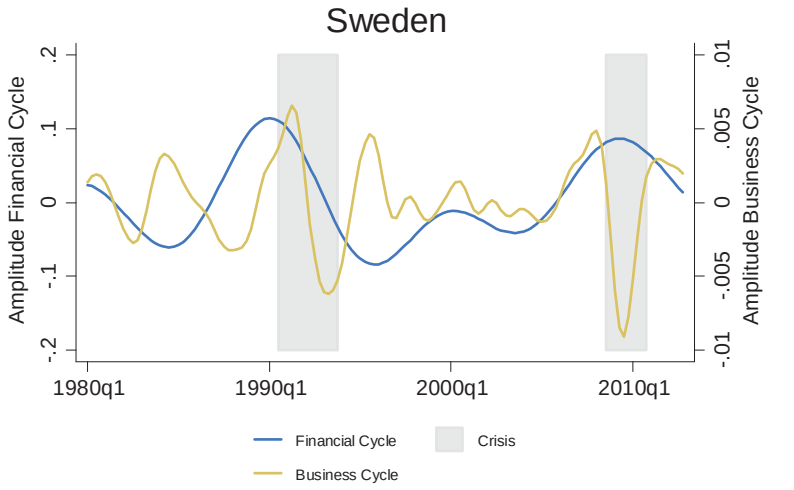
For the analysis of the impact of structural features of the banking sector on financial cycles, we need an indicator that appropriately captures cyclical movements in the financial sector since no natural measure is available. Although previous literature provided insights in the development of financial cycles, it fell short of developing a commonly accepted medium-term financial cycle measure. Indeed, the literature diverges both as regards the construction techniques and the ingredients of the cycle.

In our analysis, we borrow the synthetic financial cycle measure developed by Stremmel (2015). A synthetic measure allows us to analyse the joint behaviour of different factors influencing the financial cycle. Following Stremmel (2015) we employ frequency-based filter techniques to isolate cyclical movements from the trend in each of the underlying time series.[1] We obtain the cyclical movement of different potential indicators, including credit, asset price and banking sector indicators, and combine the resulting cyclical movements to construct seven different synthetic financial cycles. Table A1 in the Appendix provides an

[1] We use the band-pass filter developed by Christiano and Fitzgerald (2003). This is basically a two-sided moving average filter isolating certain frequencies in the time series. Using this band-pass methodology, the duration of a financial cycle spans from 32 to 120 quarters (or 8 to 30 years). We also cross-checked our results using other settings. For more details, see Stremmel (2015).

overview of the potential financial cycle measures. Stremmel (2015) finds that the synthetic financial cycle measure containing the credit-to-GDP ratio, house prices-to-income ratio and credit growth offers the best fit. We refer to this measure as the "financial cycle" in our analysis. However, in the robustness checks we cross-check our results with the other six potential financial cycle measures considered by Stremmel (2015) which combine various asset prices and credit aggregates as well as banking sector variables. For the effective conduct of macro-prudential policy the understanding of the cyclical behaviour of financial variables, their main features and drivers, is essential. For this purpose, we compare financial and business cycles and investigate the synchronicity of the financial cycle over time. Both applications are reproduced from Stremmel (2015).

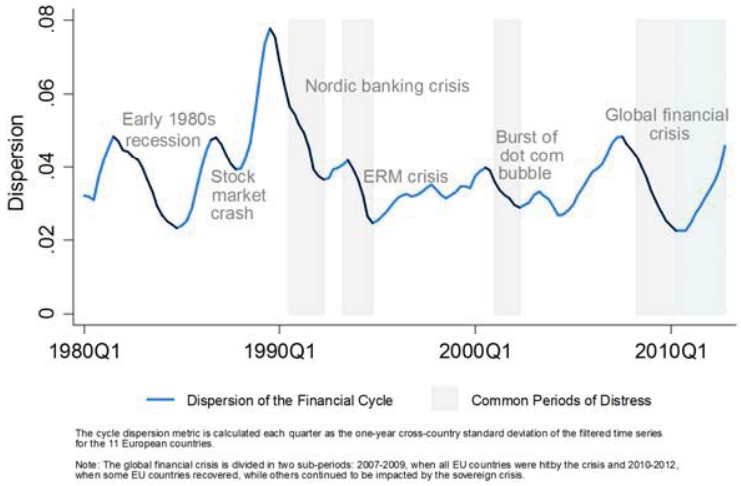
Figure 1: Comparison of Business and Financial Cycles



Source: Stremmel (2015)

As an example, Figure 1 compares the financial and the business cycles over time in Sweden. Other countries are pictured in Stremmel (2015). This figure confirms recent literature which suggests that the cyclical patterns of both series share certain similarities, but the duration of the financial cycles is longer while business cycles appear to be more volatile.

Figure 2: Synchronicity of Cycles



Source: Stremmel (2015)

Following Stremmel (2015), Figure 2 shows the synchronicity of financial cycles across 11 European countries.[2] The synchronicity is measured as the one-year cross-country standard deviation of the individual countries' cycles. This metric can be used to evaluate convergence (lower dispersion) and divergence (higher dispersion) of financial cycles.

Figure 2 reveals that in periods of common financial stress (darker shaded line) financial cycle dispersion decreases. In other words, in good times financial cycles are less synchronized, whereas in stress periods the financial cycles tend to move together. This increased divergence in boom periods calls for differentiated and well-targeted policy responses that are properly tailored to individual jurisdictions in order to address specific emerging risks in those countries. At the same time, in stress periods when countries seem to be impacted in a similar manner (as reflected in the increased co-movement of financial cycles), a higher level of coordination and harmonisation of policy actions may be warranted.

Both applications show that the policy-makers' awareness of the characteristics of the financial cycles across countries is essential for taking adequate macro-prudential policy actions. Against this finding, we now turn to the investigation whether structural features of the banking sectors influence the financial cycle in individual jurisdictions and whether they act as potential drivers of the financial cycle amplitude.

[2] The following countries are included in the analysis: Belgium, Denmark, Finland, France, Germany, Ireland, Italy, the Netherlands, Spain, Sweden and the United Kingdom.

3 Estimation Approach

In general, several structural features of the banking sector may have an impact on the financial cycle and its amplitude. Banking sector depth and size are possible contributors to the variations in the financial cycle. Other influencing factors may include the concentration of the banking sector or the structure of the financial system (bank- vs. market-based system). Furthermore, the stability of financial institutions, the activity of foreign banks and the amount of foreign currency loans may also be seen as potential factors impacting on the amplitude of the financial cycle. In our analysis we incorporate several potential influencing factors to accommodate for a range of possible impacts on the financial cycle.

Our estimation strategy to explore the relationship of banking sector features and the financial cycle involves the following steps:

i. We construct the financial cycle for each country based on Stremmel (2015).
ii. We identify the tuning points of the financial cycle for each country. The determination of the local minima and maxima of each cycle allows us to define the peaks (local maxima) and troughs (local minima) of the financial cycle and to calculate the amplitude.
iii. We define the financial cycle phases. An upswing or expansion phase lasts from a trough to a peak point, whereas a downswing or contraction phase lasts from a peak to a trough point.
iv. We calculate the dependent and independent variables for the corresponding financial cycle phases accounting only for the developments in the specific financial cycle phase.
v. Lastly, we employ Generalized Linear Model (GLM) estimation techniques to analyse the relationship between the financial cycle amplitude and banking sector characteristics.

In our analysis, we use the amplitude of the financial cycle instead of a continuous financial cycle measure as a dependent variable. This has various reasons: A continuous measure (e.g. variance) requires higher data frequency and hence sufficiently long time series that are not available for most European countries. The financial cycle phase approach however enables us to include more than 20 European countries in the sample.

Furthermore, given that for many newly joined European Member States available data starts only in the early 2000s, we are not able to consider complete financial cycle movements. By using the financial cycle phase measure we can incorporate at least one phase of the financial cycle and consequently we are able to analyse more countries and financial cycle movements.

Another argument for using the phase measures is that structural banking characteristics are relatively stable over time in comparison to the quickly changing financial cycle. On that

account, a continuous financial cycle measure may misinterpret the influence of the structural features by overestimating their potential impact on the financial cycle. Against this background, a discrete measure seems to be more appropriate to capture the variation in the financial cycle.

4 Data and Variables

In this study, we attempt to include as many European countries in the analysis as possible. We create a data set for 21 European countries spanning the potential period of 1980Q1 to 2012Q4. The list of countries and the detailed coverage of the variables are listed in Table A2 in the Appendix. The total number of observations across the different indicators groups is 266 financial cycle phases.

Table 1: Description of the Variables

Variable	Description	Source
	Left-hand side	
$FinCyclPhaseAmp_A$	Non-Time-Adjusted Amplitude Measure	Authors Calculation
$FinCyclPhaseAmp_B$	Time-Adjusted Amplitude Measure	Authors Calculation
	Right-hand side	
Concentration	Assets of the Three Largest Banks as a Share of Total Banking Assets (%)	GFDD / Bankscope
Foreign_Banks	Foreign banks among total banks (%)	Claessens and van Horen (2014)
Credit/Deposits	Bank credit to bank deposits (%)	IMF IFS
Deposits/GDP	Bank deposits to GDP (%)	IMF IFS
Bank_Assets/GDP	Deposit money banks' assets to GDP (%)	IMF IFS
Market_Cap/GDP	Stock market capitalization to GDP (%)	IMF IFS
FX_Loans/Loans	Share of foreign currency loans to total loans (%)	ECB SDW
Credit/GDP	Domestic credit to private sector (% of GDP)	IMF IFS
Foreign_Claims/GDP	Consolidated foreign claims of BIS reporting banks (% of GDP)	BIS CBS/ IMF IFS

Table 1 provides an overview of the variables used in the analysis as well as their underlying source. We employ two amplitude measures of the financial cycle as left hand-side variables. As explanatory variables, we consider nine banking sector characteristics. The explanatory variables are sourced through different established databases. We use time series from World Bank Global Financial Development Database (GFDD), International Monetary Fund International Financial Statistics (IMF IFS), European Central Bank Statistical Data Warehouse (ECB SDW) as well as the Bank for International Settlements Consolidated Banking Statistics (BIS CBS). Many variables are used as standard metrics to benchmark financial systems (Cihak et al, 2013).

Financial Cycle Amplitude

The left-hand side variable is designed to capture the magnitude of the movements in the financial cycle. We obtain the financial cycle measure consisting of credit-to-GDP ratio, (ii) the house prices-to-income ratio, and (iii) credit growth for each of the 21 European countries using the methodology described in Stremmel (2015). The obtained financial

cycles are illustrated in Figure A1 in the Appendix. In the next step, we identify the time series' peaks and troughs to determine the financial cycle phases.[3]

We employ two different concepts for measuring the amplitude of each financial cycle phase. The non-time-adjusted amplitude measure ($\mathrm{FinCyclPhaseAmp_A}$) reflects the absolute difference of the start ($\mathrm{FinCyclPhase_{START}}$) and end values ($\mathrm{FinCyclPhase_{END}}$) of the financial cycle phase

$$\mathrm{FinCyclPhaseAmp_A} = |\mathrm{FinCyclPhase_{START}} - \mathrm{FinCyclPhase_{END}}|$$

The absolute difference reflects the magnitude of the cyclical movements and quantifies the expansion or contraction of each cycle phase.

The time-adjusted amplitude measure ($\mathrm{FinCyclPhaseAmp_B}$) is calculated as follows:

$$\mathrm{FinCyclPhaseAmp_B} = \frac{|\mathrm{FinCyclPhase_{START}} - \mathrm{FinCyclPhase_{END}}|}{\mathrm{FinCyclPhase_{Duration}}}$$

The numerator is equivalent to the non-time-adjusted amplitude measure. The denominator represents the duration of the financial cycle phase ($\mathrm{FinCyclPhase_{Duration}}$). In doing so, the time-adjusted amplitude measure accounts for the intensity of changes in amplitudes and thus incorporates the time dimension in the analysis of the financial cycle phase.

To illustrate the intuition behind the amplitude measures, we plot Sweden's financial cycle and its turning points in Figure 3, comparing two financial cycle phases, their amplitudes and corresponding durations. The light red coloured cycle phase names represent contraction or downswing phase, whereas green coloured phase names correspond to expansions or upswing cycle phases.

[3] Further, we make an assumption on the end point of the final financial cycle phase. If the last phase is not completed, we consider the last observation of the final financial cycle to be a turning point so that we are able to complete the corresponding financial cycle phase. Of course, this final turning point may not be an accurate estimation as the phase might last longer. However, this assumption allows us to incorporate the structural banking sector characteristics after the 2007 Global Financial Crisis.

Figure 3: Financial Cycle Phases

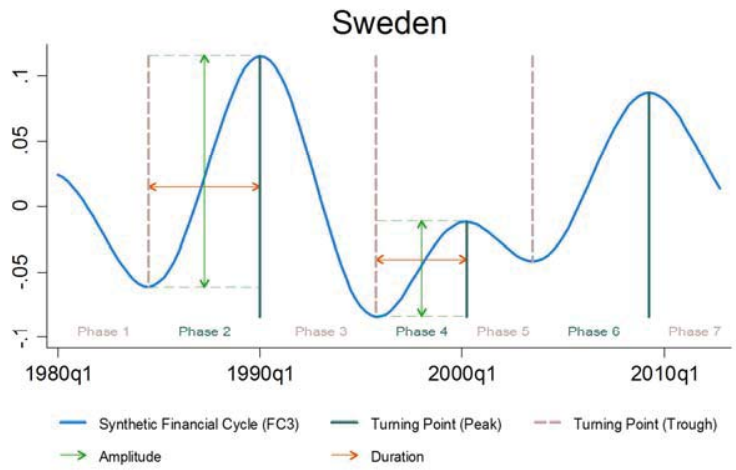


Figure 3 reveals that financial cycle phases may differ in amplitude, duration and adjustment speed. To illustrate the different metrics we focus on upwards Phases 2 and 4. Both phases are quite similar regarding their duration (22 and 19 quarters, respectively), but their amplitudes are markedly different (0.175 vs. 0.072 increase in the financial cycle measures, respectively). We believe that the relationship between the duration and the amplitude of the financial cycle also has important implications for financial stability assessment and the design of macro-prudential policy action. In particular, a rapid increase may be more of a financial stability concern than a long-term gradual build-up of the cycle as such a rapid increase, possibly supported by looser lending standards, may swiftly reveal vulnerabilities in the financial sector, narrowing the scope and shortening the available time for policy action. Nonetheless, we use both the standard and the time-adjusted amplitude measures to verify our results.

Structural Features of the Banking Sector

The explanatory variables (RHS) are based on a set of structural banking sector features which are expected to have an influence on the financial cycle and in particular on its amplitude. Overall, we employ nine structural banking sector variables grouped into six categories. To be in line with the LHS variable, the RHS variables also reflect the developments of structural banking sector features in the corresponding financial cycle phase. There is a wide variety of potential statistical methods to model these developments. We opt to use two simple approaches to capture these developments of the structural features. On the one side, for rather sluggish variables we obtain the medians across all observations in the corresponding cycle-phase. We apply this median calculation for the two market share measures. We expect that the market shares of large institutions and foreign banks change only gradually over the cycle phase. For the remaining indicators, we calculate the absolute differences in each phase (i.e. the difference between the start and end values

of each cycle phase). The interpretation is straightforward, because the units of the absolute differences are expressed in percentage points.

The RHS variables are grouped into six categories: (i) concentration of the banking system, (ii) market share of foreign banks, (iii) institution size and stability, (iv) financial depth, (v) bank loans, and (vi) financial integration. Each variable is obtained at the country level. Table A2 in the Appendix gives an overview of the coverage of the indicators regarding financial cycle phases for each variable group at the country level.

The first two categories only contain a single variable. First, we approximate the concentration of the banking sector, *Concentration*, by calculating the assets of the three largest banks as a fraction of the total banking assets. The analysis includes 60 cycle phase observations. The empirical evidence is inconclusive on the effects of banking sector concentration on financial stability (Berger et al, 2009). Recent papers suggest an inverse relationship between market concentration and financial stability (e.g. Boyd and De Nicolo (2005), Boyd et al. (2006), De Nicolo and Loukoianova (2007), Schaeck et al. (2009)).[4] According to this line of arguments, we expect higher banking sector concentration to have a positive influence to the amplitude of the financial cycle.

In the second category, *Foreign_Banks*, we consider the activity of foreign banks in the domestic market. We incorporate a measure that relates the number of foreign banks to the total number of banks in each country. This measure is based on the database by Claessens and van Horen (2014), whereas a bank is defined as foreign if 50% of its shares are hold by non-resident shareholders. We look at the number of institutions instead of foreign banks' share in total assets due to longer available time series. This way we are able to include 26 cycle phase observations for this category.

The recent global financial crisis highlighted the potential risks associated with the activity of foreign banks and cross-border lending. De Haas and van Lelyveld (2014) show that foreign banks are not a source of credit provision in times of credit tightening. Instead, foreign banks and subsidiaries adjust their lending even stronger than domestic credit institutions in response to shocks (e.g. Aiyar (2012), Popov and Udell (2012), De Haas et al. (2013), and Fungácová et al. (2013)). Therefore, we expect that a higher share of foreign banks amplifies the financial cycle.

The remaining four categories contain two explanatory variables each. The third group of variables "Institution size and stability" aims at capturing the size and the funding stability of the banking system. We follow the approach by Cihak et al. (2013) to measure the size of the banking sector. The first variable, the bank deposits-to-GDP ratio (%), *Deposits/GDP,*

[4] In addition, the same conclusions can be derived from economic theory. Berger et al. (2004), Beck (2008), Uhde and Heimsehoff (2009), and Degryse et al. (2013) provide literature reviews on the theoretical and empirical applications.

indicates the amount of deposit resources available to the financial sector for its lending activities in relation to the real economy at the country level. The second variable, the bank credit-to-bank deposits ratio (%), *Credit/Deposits*, measures the banking sector's funding stability. This ratio increases if credit creation is higher than deposit growth and decreases when deposit growth exceeds credit growth. We expect that an increasing indicator of the banking system's size as well as an increasing credit-to-deposit ratio contribute positively to the amplitude of the financial cycle. We include in the analysis 62 cycle phase observations for this group.

The fourth category, "Financial depth", accounts for the importance of various financial markets for financing the economy. The depth of the banking system is traditionally measured by the deposit money banks' assets-to-GDP ratio (%), *Bank_Assets/GDP*. The depth of the stock market, *Market_Cap/GDP*, is captured by using the stock market capitalization-to-GDP ratio (%). Recent literature argues that a certain level of financial depth is needed to sustain long-term economic growth. However, there is also evidence that a too deep financial system can also be accompanied by undesired effects on financial stability and economic growth (e.g. Arcand et al. (2012), Cecchetti and Kharroubi (2012), ESRB ASC (2014)). We expect that a deeper financial system amplifies the financial cycle. In addition, these indicators could also be used to investigate whether a financial system is more bank-, or market-based and whether these characteristics have different impacts on financial cycles. In total, we are able to include 51 cycle phase observations for this category.

The fifth category, "Bank loans", deals with the amount and composition of bank loans. We measure bank lending in the economy by using the domestic private sector credit-to-GDP ratio (%), *Credit/GDP*.[5] Additionally, we incorporate the currency composition of loans using the foreign currency loans-to-total loans ratio (%), *FX_Loans/Loans.* Foreign currency loans are an instrument that allows financial intermediaries to provide additional credit to their clients even in cases when credit origination in domestic currency could be constrained.[6] Foreign currency loans may also impose additional risks on creditors and debtors alike. We expect both indicators to increase the amplitude of the financial cycle. In total, we are able to include 34 cycle phase observations for this group.

[5] This ratio is similar to one of the components of the financial cycle measure, but the intuition for incorporating this measure as a RHS variable is different. In this section we are not interested in determining the cyclical movement of the credit-to-GDP ratio, but the indicator is rather used to capture the overall amount of credit provided by financial intermediaries relative to the level of economic development. Therefore, we look at the levels and not the filtered series. The correlation of the two series is rather low (below 0.3), therefore we are confident that employing this measure as a RHS variable is appropriate. Moreover, we use the IMF IFS credit data to define the RHS variable instead of the BIS credit data used for the LHS variable.

[6] The volume of foreign currency credit can either be driven by the demand or the supply side. For more information on foreign currency loans see Luca and Petrova (2008), Brown et al. (2010), Basso et al. (2010) and Brown and De Haas (2012).

The last category, “Financial integration”, accounts for international financial linkages across countries. In addition to *FX_Loans/Loans* used in the previous specification, we also include the ratio of BIS reporting banks’ consolidated foreign claims-to-GDP, *Foreign_Claims/GDP*, to approximate the international financial linkages. In line with the argument on the presence of foreign banks and the impact of more financial development, we expect that cross-broader claims have a positive influence on the amplitude of the financial cycle. In total, we are able to include 34 cycle phase observations for this category.

Descriptive Statistics

Table 2 reveals the descriptive statistics of the financial cycle phases for the 21 EU Member States included in the analysis. The grey shaded rows exhibit countries for which both the standard and the time-adjusted amplitude measures are higher than their respective medians. The standard amplitude measure (Amplitude A) seems to be more marked in up than in down phases, whereas with the alternative time-adjusted amplitude measure (Amplitude B) the distinction is less pronounced. For all countries, the duration of the financial cycle phase is similar with around 20 quarters per cycle phase. Nevertheless, on average the up phases tend to last longer than the down phases (25 and 14 quarters, respectively).

Table 2: Financial Cycle Phases across the Countries[7]

Phases / Country	*All Phases*				*Upswing Phases*				*Downswing Phases*			
	Amplitude A	Amplitude B	Duration (quarter)	# Obs.	Amplitude A	Amplitude B	Duration (quarter)	# Obs.	Amplitude A	Amplitude B	Duration (quarter)	# Obs.
Austria	0.043	0.0020	21.5	2	0.036	0.0020	18.0	1	0.050	0.0020	25.0	1
Belgium	0.032	0.0017	16.8	6	0.033	0.0019	15.8	4	0.029	0.0015	19.0	2
Denmark	0.095	0.0047	19.2	6	0.106	0.0047	21.7	3	0.084	0.0048	16.7	3
Finland	0.083	0.0037	18.3	6	0.100	0.0042	23.3	3	0.066	0.0033	13.3	3
France	0.076	0.0030	24.0	5	0.096	0.0033	31.0	2	0.062	0.0029	19.3	3
Germany	0.052	0.0014	29.7	3	0.048	0.0012	29.0	2	0.059	0.0019	31.0	1
Greece	0.056	0.0027	20.0	2	0.088	0.0028	31.0	1	0.023	0.0025	9.0	1
Hungary	0.133	0.0070	19.5	2	0.176	0.0065	27.0	1	0.091	0.0075	12.0	1
Ireland	0.085	0.0037	25.0	4	0.106	0.0030	34.5	2	0.065	0.0043	15.5	2
Italy	0.116	0.0051	23.2	5	0.150	0.0054	32.0	2	0.094	0.0049	17.3	3
Latvia	0.364	0.0199	19.0	2	0.412	0.0172	24.0	1	0.316	0.0226	14.0	1
Lithuania	0.393	0.0197	20.0	2	0.587	0.0196	30.0	1	0.199	0.0199	10.0	1
Luxembourg	0.107	0.0043	29.0	2	0.167	0.0034	49.0	1	0.046	0.0051	9.0	1
Malta	0.063	0.0036	17.0	2	0.085	0.0038	22.0	1	0.041	0.0034	12.0	1
Netherlands	0.052	0.0021	25.8	4	0.062	0.0025	24.0	2	0.042	0.0017	27.5	2
Poland	0.175	0.0099	14.5	2	0.322	0.0129	25.0	1	0.027	0.0068	4.0	1
Portugal	0.042	0.0022	16.5	4	0.055	0.0025	21.5	2	0.029	0.0019	11.5	2
Slovakia	0.072	0.0057	11.5	2	0.111	0.0074	15.0	1	0.033	0.0041	8.0	1
Spain	0.145	0.0059	25.8	4	0.163	0.0051	31.5	2	0.128	0.0067	20.0	2
Sweden	0.103	0.0052	17.5	6	0.125	0.0058	21.0	3	0.082	0.0046	14.0	3
United Kingdom	0.158	0.0059	28.3	3	0.191	0.0042	45.0	1	0.141	0.0067	20.0	2
Median/Sum	0.080	**0.0035**	**20.0**	**74**	**0.092**	**0.0057**	**25.0**	**37**	**0.048**	**0.0057**	**14.0**	**37**

[7] Amplitude A refers to the non-time-adjusted amplitude measure ($FinCyclPhaseAmp_A$) and Amplitude B refers to the time-adjusted amplitude measure ($FinCyclPhaseAmp_B$).

5 Estimation Results

The empirical model employs two independent variables ($FinCyclPhaseAmp_A$ and $FinCyclPhaseAmp_B$) and six groups of explanatory measures (Concentration, Foreign banks, Institution size and stability, Financial depth, Bank loans, Financial integration). Due to the low number of overlapping observations among the groups, we have to analyse the influence of each variable group separately.

To enhance the credibility and plausibility of our regressions, in Section 6 we supplement the analysis by other amplitude indicators and estimation techniques for robustness checks. We employ different estimations techniques: Ordinary Least Squares (OLS) with robust standards errors and General Linear Model (GLM) with either robust standards errors or clustered standard errors. We believe that different estimation techniques and varying standard errors are capable of accommodating the required demands of this setting. Overall, we obtain six regressions per estimation technique and per amplitude measure. Moreover, we re-estimate our model for all potential financial cycle measures defined by Stremmel (2015).

For the sake of convenience, we show results only for our preferred time-adjusted phase amplitude metric ($FinCyclPhaseAmp_B$) and the General Linear Model with robust standards errors. The results for other metrics and estimation techniques are very similar and will be considered in Section 6.

Table 3 shows the regression results for each indicator groups. The six columns (1) to (6) correspond to the six groups of structural banking characteristics defined in the previous section. Confirming the impressions from the correlation table (Table A2 in the Appendix), each variable features a significant influence on the amplitude measure. The obtained marginal values can be interpreted in semi-elastic terms. The results exhibit only the combined contribution of each variable group to the explanatory power of the regressions. The contribution of individual variables will be covered in detail in Section 6.

Table 3: Regressions of Financial Cycle Measure

$FinCyclPhaseAmp_B$	(1)	(2)	(3)	(4)	(5)	(6)
Concentration	0.0074***					
Foreign_Banks		0.0093***				
Credit/Deposits			0.0046*			
Deposits/GDP			0.0067**			
Market_Cap/GDP				0.0021*		
Bank_Assets/GDP				0.0071***		
FX_Loans/Loans					0.0925***	
Credit/GDP					0.0098***	
FX_Loans/Loans						0.1229***
Foreign_Claims/GDP						0.0058***
No. of Observation	60	26	62	51	34	33
Constant	yes	yes	yes	yes	yes	yes
Adjusted R^2 (from OLS)	0.48	0.33	0.22	0.23	0.55	0.51
BIC	-464.00	-201.71	-480.98	-391.34	-271.45	-261.76

* p<.1, ** p<.05, *** p<.01

The variables *Concentration* and *foreign banks* (Model (1) and (2)) seem to have the highest positive impact on the amplitude of the financial cycle. Both models also offer considerable explanatory power in terms of a high adjusted R^2 measure. In addition, Model (5) suggests that *Foreign Currency Loans* also contribute significantly to the amplification of the financial cycle. Model (6) exhibits that *Financial Linkages* are also important drivers of the amplitude.

In contrast, the impacts of *Financial depth*, Model (4), and the explanatory power of this specification tend to be limited in terms of low adjusted R^2 measure. Nevertheless, the components of this measure need to be differentiated. In comparison to the depth of stock market, the relative size of the banking sector seems to be the main driver of the financial cycle. Finally, the *Institution size and stability* specification – Model (3) – is also able to explain a notable part of the variation of the amplitude measures, although its total explanatory power is lower in comparison to other groups.

Overall, our regression results suggest that structural features of national banking sectors have a significant impact on the amplitude of the financial cycle. Although all banking sector indicator groups have some explanatory power, the magnitude of the impact varies significantly across the indicator groups. In particular, banking concentration, the share of foreign banks, banks loans and financial linkages offer considerably high explanatory power.

6 Robustness Checks

To demonstrate the robustness of our findings, we perform three robustness checks. First, we successively add variables to the individual model specification to investigate model stability. Second, we explore whether the influence of banking sector characteristics on

financial cycles diverges in up- and downswing phases. Lastly, we estimate our model specification for other left-hand side variable measures.

In the first step, we explore the stability of the individual parameters of the banking sector characteristics and their contribution to the explanatory power of variable groups based on the results in Section 5. For each category, we gradually extend the specification by sequentially introducing the variables. The first two columns in Table 3 are identical with the first two columns in Table 4 due to the single banking sector variable in those specifications. For the remaining characteristic categories we employ three model specifications in each case. The first two specifications reflect the individual category components, whereas the third specification of each group represents the combined influence of both components.

All employed banking sector characteristics indicators in Table 4 are significant at least at the 10% confidence level. The marginal value of the individual indicators remains stable by adding additional components. Further, the sum of the individual explanatory powers in terms of the adjusted R^2 values add up quite closely to aggregate measures. This suggests that each of the used indicators offers additional and complementary explanatory power.[8] However, the added explanatory power is different among the indicators. Variables such as *Market_CAP/GDP or Deposits/GDP* only increase the explanatory power marginally. In comparison, other variables are better placed to explain large parts of the variation (e.g. *Concentration, Foreign currency loans*). All in all, the selected indicators seem to be well determined and remain robust individually and in combination, but their individual contribution to the explanatory power of each specification differs markedly.

In a second robustness check, we investigate whether the influence of the structural banking sector variables on the amplitude of the financial cycle varies across different phases of the cycle. We split the sample into up- and down-phases of the financial cycle. The regression results are presented in Table 5. Importantly, due to the low number of financial cycle phases included in the analysis, the results have to be interpreted with caution.

[8] The samples of the latter two banking sector characteristics groups - Model (10) to (14) - are not identical and therefore their comparability is limited. Although the number of the observations is similar, the coverage of the countries is different (Table T1 in the Appendix), hence the marginal values of the identical variables vary between the two groups.

Table 4: Robustness Check for Variables Groups

$FinCyclPhaseAmp_B$	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Concentration	0.0074***													
Foreign_Banks		0.0093***												
Credit/Deposits			0.0049*		0.0046*									
Deposits/GDP				0.0077***	0.0067**									
Market_Cap/GDP						0.0023**		0.0021*						
Bank_Assets/GDP							0.0071***	0.0071***						
FX_Loans/Loans									0.0955**		0.0925**			
Credit/GDP										0.0102***	0.0098***			
FX_Loans/Loans												0.1243***		0.1229***
Foreign_Claims/GDP													0.006***	0.0058***
No. of Observation	60	26	62	62	62	51	51	51	34	34	34	33	33	33
Constant	yes	yes	yes	Yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Adjusted R^2 (from OLS)	0.48	0.33	0.15	0.07	0.22	0.01	0.22	0.23	0.30	0.25	0.55	0.45	0.06	0.51
BIC	-464.00	-201.71	-479.11	-474.51	-480.98	-381.27	-393.58	-391.34	-259.22	-256.82	-271.45	-260.43	-242.28	-261.76

*p<.1,**p<.05,***p<.01

Table 5: Robustness Check for Financial Cycle Phase

	Upswing Financial Cycle Phase						*Downswing Financial Cycle Phase*					
$FinCyclPhaseAmp_B$	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Concentration	0.0074***						0.0074***					
Foreign_Banks		0.0119***						0.0062**				
Credit/Deposits			0.0118***						0.0004			
Deposits/GDP			0.0025						0.0038			
Market_Cap/GDP				0.0014*						-0.0003		
Bank_Assets/GDP				0.0096***						0.0036**		
FX_Loans/Loans					0.0362						0.1100**	
Credit/GDP					0.0074***						0.0087	
FX_Loans/Loans						-0.0043						0.1495***
Foreign_Claims/GDP						0.0066***						-0.0034
No. of Observation	28	19	33	24	12	11	32	7	29	27	22	22
Adjusted R^2 (from OLS)	0.49	0.50	0.61	0.36	0.80	0.61	0.46	0.35	-0.05	0.02	0.44	0.61
BIC	-218.58	-141.86	-269.15	-180.52	-118.27	-102.18	-246.87	-70.05	-229.90	-212.89	-162.57	-170.73

*p<.1,**p<.05,***p<.01

In Table 5, the first six columns (Model 1-6) reflect the regression results for the upswing financial cycle phases, whereas the latter six columns (Model 7-12) reflect the regressions for the downswing financial cycle phases. The regression results suggest that the influence of the structural banking features varies across the financial cycle phases. The *Concentration* of the banking sector seems to be an important driver in both types of financial cycle phase. Although the market share of *Foreign banks* has an influence in both phases, its influence tends to be bigger in upswings phases. The *Institution size and stability* group tends to have an influence on the cycle phases in the upswing. The *Financial depth* group occurs to be important in both phases, albeit its impact is higher in the upswing phase. The *Share of FX Loans* seems to be a major driver in the financial cycle amplitude during downswing phases, indicating that countries with high levels of foreign currency loans are exposed to more severe contractions in these periods. In addition, *Financial integration* (*Foreign_Claims/GDP)* seems to be important for the amplitude in upswing phases of the financial cycle. However, due to the limited number of financial cycle phases, we restrain from drawing far-reaching conclusions from these results. Obviously, this robustness check leaves room for improvement by adding further phases and investigating the impact of structural features in more detail.

As a third step we investigate the robustness of the banking sector characteristics by enlarging the econometric analysis to other financial cycle measures. Stremmel (2015) investigated a number of potential indicators to obtain the best performing measure to portray the financial cycle. In this round we employ all potential synthetic cycle measures to explore the robustness of our findings. Table A1 in the Appendix provides an overview of the different financial cycle measures.

We re-estimate the regressions for all financial cycle measures. As in the baseline model, we have to determine the financial cycle phases and calculate their amplitude as well as the corresponding banking sector characteristics for each financial cycle indicator. In addition, we also run the regression just for the eleven countries used in Stremmel (2015) to control whether the influence of variables has changed. We employ three estimation techniques for the seven financial cycle measures with a potential maximum of 42 specifications per banking sector characteristics category.[9] To manage the number of regressions, we opt to visualize the condensed overview of results in Table 6. We only exhibit the proportion of well-determined RHS variables that are significant at 10% level across the models.

[9] The number of 42 regressions is based on the following procedure. We estimate seven regressions per financial cycle amplitude – for each category one regression. We use two different amplitude phase measures – $FinCyclPhaseAmp_A$ and $FinCyclPhaseAmp_B$ – and we employ three different estimation techniques – Ordinary Least Squares (OLS) with robust standards errors and General Linear Model (GLM) with either robust standards errors or clustered standard errors. The theoretical maximum would be 252 regressions (42 multiplied by 6 indicators groups). Due to the requirements of having an appropriate number of 20 observations per estimation, we only include 198 specifications in the robustness checks.

Table 6: Proportion of Significant and Well-Determined RHS Variables

LHS Measure	# Regression	$FinCyclPhaseAmp_A^*$	$FinCyclPhaseAmp_B^*$	Total
Concentration	42	100.0%	100.0%	100.0%
Foreign_Banks	24	100.0%	100.0%	100.0%
Credit/Deposits	42	100.0%	100.0%	100.0%
Deposits/GDP		42.9%	42.9%	42.9%
Market_Cap/GDP	42	100.0%	100.0%	100.0%
Bank_Assets/GDP		100.0%	100.0%	100.0%
FX_Loans/Loans	24	75.0%	91.7%	83.3%
Credit/GDP		100.0%	100.0%	100.0%
FX_Loans/Loans	24	83.3%	91.7%	87.5%
Foreign_Claims/GDP		91.7%	83.3%	87.5%
Overall**	198	87.8%	88.8%	88.3%

* As a critical significant threshold we choose the 10% confidence level for each variable.
**The overall average is calculated as the accuracy of the underlying model weighted by the number of observation.

Table 6 demonstrates that the overall accuracy of different financial cycle measures is remarkably high. In 88% of all regressions the coefficients of the banking sector characteristics are correctly specified and significant. This confirms that our findings are not specific to the chosen financial cycle measure but generally applicable to all financial cycle measures. Nonetheless, there are differences across banking sector characteristics. While, the large majority of the indicators have the expected sign and are significant in every single specification, there are some exceptions. Regarding *Foreign_Claims/GDP and FX_Loans/Loans* in two different specifications, the share of correctly specified indicators is high. In contrast, *Deposits/GDP* is only significant in 4 out of 10 cases. This finding is in line with the previous robustness check that revealed that the explanatory power of this component is rather limited. Somewhat surprisingly, both measures of *Financial depth* are significant throughout all models, although their explanatory power tends to be rather low. Based on all robustness checks, we are confident that our findings from Section 5 are not conditional on the choice of a specific financial cycle measure but have validity in more general terms.

As a general caveat it has to be pointed out that our study is only able to include a small number of observations reflecting the availability of the underlying data. The restricted data availability for the LHS variable encouraged us to use financial cycle phases instead of full financial cycles. The constraints of the RHS variables led us to employ the banking characteristic indicators individually or pairwise. In our view, these are sensible ways to deal with data constraints. Another caveat is that the specifications diverge in both the number of observations and country coverage. An obvious solution would be to find a common denominator of phase coverage through all models but this would reduce the number of observations dramatically. Nonetheless, we are convinced that our approach appropriately accounts for the data limitations and provide consistent, robust and insightful regression results.

7 Impacts from Monetary Policy

Related to the question of whether structural banking features influence the financial cycle is the question whether monetary policy also contributes to the development of the financial cycle. We explore this relationship by extending our structural banking sector specifications by incorporating a measure of the monetary policy stance.

Recent literature argues that monetary policy contributes to the build-up of financial cycles by extending banks' balance sheets, triggering additional bank risk-taking and boosting credit supply (e.g. Adrian and Shin (2008), Altunbas et al. (2010), Maddaloni and Peydró (2011), Houben and Kakes (2013), Dell'Ariccia et al. (2013), and Borio (2014)).[10]

To measure the impacts of monetary policy on the financial cycle, we calculate the difference between the actual policy rate and the implied policy rate using the Taylor rule. The literature generally considers the Taylor rule as an accurate approximation of the monetary policy rate decisions in modern times (Hofmann and Bogdanova, 2012). It mechanically links policy rates to the deviations in the inflation rate and the output gap. Therefore, the implied Taylor rate is often used as a yardstick to gauge the stance of the monetary policy. We follow the classical simple formulation of the Taylor (1993) rule (e.g. Orphanides (2007)):

$$r_{i,t} = 2 + \pi_{i,t} + 0.5(\pi_{i,t} - 2) + 0.5y_{i,t} \ ,$$

where $r_{i,t}$ is the implied key policy rate by the Taylor rule for country *i* in year *t*, $\pi_{i,t}$ is the inflation rate and the current output gap is represented by $y_{i,t}$.

$$\varepsilon_{i,t} = i_{i,t} - r_{i,t}$$

The difference between the actual policy rate $i_{i,t}$ and the implied policy rate by the Taylor rule $t_{i,t}$ are the Taylor rule residuals $\varepsilon_{i,t}$. In general, negative (positive) deviations are associated with looser (tighter) monetary policy in a given jurisdiction (Hofmann and Bogdanova, 2012).[11]

[10] Smets (2014) provides a detailed overview of the literature on this topic.

[11] We construct country-specific shadow policy rates implied by the Taylor rule for each quarter. Therefore, we calculate also country-specific Taylor rates for the countries that have adopted the euro.

Table 7: Impact of Monetary Policy on the Financial Cycle

NON-TIME-ADJUSTED AMPLITUDE MEASURE	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Concentration	0.1071***							0.1071***					
Foreign_Banks		0.1592**							0.1656*				
Credit/Deposits			0.0267**							0.0307***			
Deposits/GDP			0.2962***							0.2482***			
Market_Cap/GDP				0.0561**							0.0541**		
Bank_Assets/GDP				0.1381***							0.1309***		
FX_Loans/Loans					0.3247*							0.4418*	
Credit/GDP					0.2188***							0.2151***	
FX_Loans/Loans						1.2246**							1.4420***
Foreign_Claims/GDP						0.1843***							0.1843***
Taylor Rule Residuals							-0.0188*	-0.0113	-0.0144	-0.0154	-0.0107	-0.0041	-0.0089
No. of Observation	34	16	29	30	21	20	34	34	16	29	30	21	20
Constant	yes	Yes	yes	yes	yes	yes	Yes	yes	yes	yes	yes	yes	yes
Adjusted R^2 (from OLS)	0.50	0.12	0.45	0.41	0.75	0.49	0.07	0.51	0.11	0.5	0.43	0.74	0.49
BIC	-81.64	-32.37	-66.26	-65.53	-65.94	-54.08	-60.69	-79.63	-30.67	-66.68	-63.99	-63.27	-52.25

*p<.1,**p<.05,***p<.01

TIME-ADJUSTED AMPLITUDE MEASURE	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Concentration	0.0048***							0.0048***					
Foreign_Banks		0.0057***							0.0057***				
Credit/Deposits			0.0008*							0.0009*			
Deposits/GDP			0.0100***							0.0090***			
Market_Cap/GDP				0.0023**							0.0023**		
Bank_Assets/GDP				0.0052***							0.0050***		
FX_Loans/Loans					0.0604*							0.0695*	
Credit/GDP					0.0085***							0.0082***	
FX_Loans/Loans						0.0904***							0.1042***
Foreign_Claims/GDP						0.0068***							0.0068***
Taylor Rule Residuals							-0.0005	-0.0002	-0.0003	-0.0002	-0.0003	-0.0006	-0.0001
No. of Observation	34	16	29	30	21	20	34	34	16	29	30	21	20
Constant	yes	Yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Adjusted R^2 (from OLS)	0.65	0.14	0.31	0.37	0.57	0.30	0.01	0.64	0.08	0.31	0.36	0.56	0.3
BIC	-308.80	-141.36	-247.65	-257.42	-184.61	-167.2	-276.31	-305.27	-138.76	-245.18	-254.35	-182.22	-165.55

*p<.1,**p<.05,***p<.01

We obtain the Taylor rule residuals $\varepsilon_{i,t}$ for 11 European countries, starting from 1990.[12] The inflation rate and the output gap data are sourced through IMF WEO database and actual key policy rates are obtained via Haver Analytics. After calculating the Taylor rule residuals, we incorporate them into the model. We calculate the median value of the Taylor rule residuals in the corresponding financial cycle phase.[13] We employ the General Linear Model with robust standards errors with both the non-adjusted ($\mathrm{FinCyclPhaseAmp_A}$) and the time-adjusted phase amplitude metric ($\mathrm{FinCyclPhaseAmp_B}$) for the financial cycle measure.

The upper panel of Table 7 shows the results for the non-time adjusted amplitude metric of the financial cycle phases ($\mathrm{FinCyclPhaseAmp_A}$), while the lower panel includes the results for the time-adjusted amplitude metric ($\mathrm{FinCyclPhaseAmp_B}$). The regressions of both panels provide similar conclusions. In each panel, the first six columns represent the baseline results for the structural banking features. These specifications remain robust for the selected sub-period (Columns 1-6). Model 7 represents the influence of the Taylor rule residuals without accounting for structural banking sector characteristics. The monetary policy indicator turns out to be significant for the non-time adjusted measures (upper panel of Table 7). As suggested by the literature, the Taylor rule residuals have a negative sign, implying that looser monetary policy inflates the amplitude of the financial cycle. However, by taking into account the speed of the adjustment of the financial cycle amplitude (lower panel), the impact of monetary policy becomes insignificant.

The latter six columns of each panel (Columns 8-13) contain models covering the influence of both the banking characteristic group specifications and the Taylor rule residuals. By combining both impacts, only the banking sector characteristics are robust across the specifications. Although the marginal values of the Taylor rule residuals also remain at comparable levels, none of these indicators turn out to be significant. These results suggest that banking sector characteristics tend to override the explanatory power of Taylor rule residuals in explaining the financial cycle amplitude. This finding also indicates that structural banking features matter more than the monetary policy stance for building up of the financial cycle phase amplitude over the medium term.

8 Conclusion

In this paper we explore the relationship and potential interactions between certain structural features of the banking sectors in the EU Member States and the performance of the banking sectors over the financial cycle. Overall, our analytical findings provide evidence

[12] We need to restrict the investigation to this sub-period due to data constraints. In detail, we include the following countries: Belgium, Denmark, Finland, France, Germany, Ireland, Italy, the Netherlands, Spain, Sweden and the United Kingdom. These countries are also used in Stremmel (2015) to determine the financial cycle.

[13] We also tried to shift the calculation window of the median value of the Taylor residual to account for potential time lags of monetary policy (6 to 8 quarters). The results remain similar to those provided in this section.

that structural banking sector characteristics do influence the amplitude of the financial cycle. We find robust results across the variable groups using both different estimation techniques and different financial cycle measures. The robustness checks as well as the specification tests confirm the choice of our variables. The structural characteristics of the banking sector, such as the concentration of the banking sector and the share of foreign banks as well as the amount and composition of banks loans and financial integration seem to be important drivers of the financial cycle amplitude.

Besides these influencing factors, the depth of financial intermediation and the size and stability of financial institutions show weaker impacts on the amplitude. We also find that monetary policy contributes to the financial cycle amplitude, but the banking sector characteristics tend to override the explanatory power of monetary policy stance.

We believe that our findings also contribute to the on-going discussion on the implementation of macro-prudential policy measures, in particular as regards certain structural and cyclical policy instruments. Based on the identified differences in financial cycles across EU countries as well as the impact of certain structural banking characteristics on the amplitude of the financial cycle, we can conclude that the implementation of macro-prudential measures should be differentiated across EU Member States. The timing of activation and the relative calibration of the policy measures should take into consideration the differences both in financial cycles and banking structures.

In particular, our results suggest that the activation and calibration of structural policy measures, such as the systemic risk buffer (SRB), should be mindful of the cyclical position of the banking system. On the one hand, if a structural measure is activated and phased-in in a boom period to address structural risks, it may, at the same time, also mitigate the upward swings in the financial cycle, in particular if it coincides with the implementation of counter-cyclical measures, such as the counter-cyclical buffer (CCB). On the other hand, if a structural measure is activated in a recessionary phase, it may counteract other cyclical policy measures, such as the release of the CCB.

The regression results also confirm the intuition that the activation and calibration of counter-cyclical policy measures (e.g. CCB) should not only depend on the cyclical situation of the banking sector, but it should also take into consideration the structural characteristics of the banking systems in individual Member States. Concretely, in the absence of structural measures in place, in countries where the banking sector is more concentrated, more integrated and/or dominated by foreign banks and foreign currency lending, the calibration of the CCB may need to be more stringent, given that those banking systems are found to be more exposed to cyclical swings. However, if systemic risk buffers or other structural measures are in place, these measures may also contribute to reducing the amplitude of the cycle, provided that the underlying structural risks are addressed effectively.

Nonetheless, further analyses are needed to achieve a better understanding of the combined impact of cyclical and structural policy measures that may ultimately have an impact on their relative calibration and the proper timing of their activation.

References

ADRIAN, T. and H.S. SHIN (2008): “Financial Intermediaries, Financial Stability, and Monetary Policy”, in Maintaining Stability in a Changing Financial System, Proceedings of the Federal Reserve Bank of Kansas City Economic Symposium, Jackson Hole, Wyoming, August 21–23.

AIKMAN, D., A.G. HALDANE and B. NELSON (2010): “Curbing the Credit Cycle”, Speech given at the Columbia University Center on Capitalism and Society Annual Conference, New York, November.

AIKMAN, D., A.G. HALDANE and B. NELSON (2014): “Curbing the Credit Cycle”, The Economic Journal, forthcoming.

AIYAR, S. (2012): “From Financial Crisis to Great Recession: The Role of Globalized Banks”, American Economic Review, 102, 225–30.

AIZENMAN, J., B. PINTO and S. VLADYSLAV (2013): "Financial Sector Ups and Downs and the Real Sector in the Open Economy: Up by the Stairs, Down by the Parachute", Emerging Markets Review, 16(C), 1–30.

ALTUNBAS, Y., L. GAMBACORTA and D. MARQUÉZ-IBAÑEZ (2010): “Does Monetary Policy Affect Bank Risk-Taking? ”, ECB Working Paper, No 1166.

ARCAND, J.–L., E. BERKES and U. PANIZZA (2012): “Too Much Finance?”, IMF Working Paper, No WP/12/161.

BASSO, H., O. CALVO–GONZALEZ and M. JURGILAS (2010): “Financial Dollarization: The Role of Foreign–Owned Banks and Interest Rates“, Journal of Banking and Finance, 35, 794–806.

BECK, T. (2008): “Bank Competition and Financial Stability: Friends or Foes?”, World Policy Research Working Paper, No 4656.

BERGER, A. N., A. DEMIRGÜC–KUNT, R. LEVINE and J. G. HAUBRICH (2004): “Bank Concentration and Competition: An Evolution in the Making”, Journal of Money, Credit and Banking, 36, 434–50.

BERGER, A. N., L. F. KLAPPER and R. TURK–ARISS (2009): “Bank Competition and Financial Stability”, Journal of Financial Services Research, 35, 99–118.

BOLTON, P., X. FREIXAS, L. GAMBACORTA and P. MISTRULLI (2013): "Relationship and Transaction Lending Over the Business Cycle ", BIS Working Paper, No 417.

BORIO, C. (2013): “Macroprudential Policy and the Financial Cycle: Some Stylized Facts and Policy Suggestions”, Speech given at the “Rethinking Macro Policy II: First Steps and Early Lessons” hosted by the IMF in Washington, DC.

BORIO, C. (2014): "Monetary Policy and Financial Stability: What Role in Prevention and Recovery?", BIS Working Paper, No 440.

BOYD, J. and G. DE NICOLO (2005): "The Theory of Bank Risk Taking Revisited", Journal of Finance, 60(3), 1329–43.

BOYD, J., G. DE NICOLO and A.M. JALAL (2006): "Bank Risk Taking and Competition Revisited: New Theory and Evidence", IMF Working Paper, No WP/06/297.

BRACKE, P. (2013): "How Long Do Housing Cycles Last? A Duration Analysis for 19 OECD Countries", Journal of Housing Economics, 22, 213–30.

BROWN, M. and R. DE HAAS (2012): “Foreign Banks and Foreign Currency Lending in Emerging Europe”, Economic Policy, 27(69), 57–98.

BROWN, M., K. KIRSCHENMANN and S. ONGENA (2010): “Foreign Currency Loans: Demand or Supply Driven?“, CEPR Discussion Paper, No 7952.

BUSH, O., R. GUIMARAES and H. STREMMEL (2014): “Beyond the Credit Gap: Quantity and Price of Risk Indicators for Macro–Prudential Policy”, Bank of England, Manuscript.

CECCHETTI, S. G. and E. KHARROUBI (2012): “Reassessing the Impact of Finance on Growth“, BIS Working Paper, No 381.

CHRISTIANO, L. and T. FITZERALD (2003): “The Band–Pass Filter”, International Economic Review, 44(2), 435–65.

CIHAK, M., A. DEMIRGÜÇ–KUNT, E. FEYEN, and R. LEVINE (2013): “Benchmarking Financial Systems around the World”, NBER Working Paper, No 18946.

CLAESSENS, S., M. KOSE and M. TERRONES (2011a): “Financial Cycles: What? How? When?”, IMF Working Paper, No WP/11/76.

CLAESSENS, S., M. KOSE and M. TERRONES (2011b): “How Do Business and Financial Cycles Interact?”, IMF Working Paper, No WP/11/88.

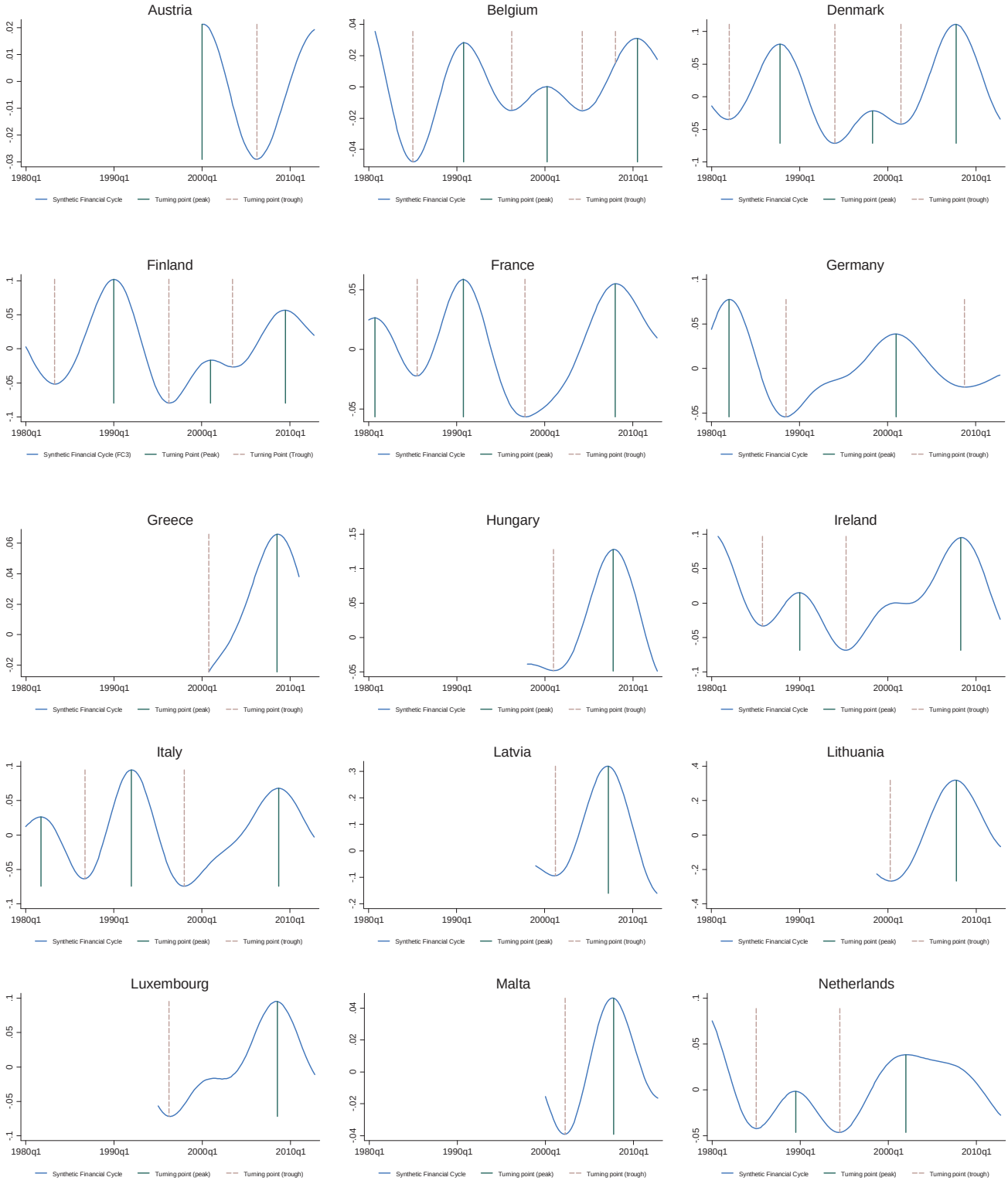
CLAESSENS, S., and N. VAN HOREN (2014): “Foreign Banks: Trends and Impact”, Journal of Money, Credit and Banking, 46(s1), 295–326.

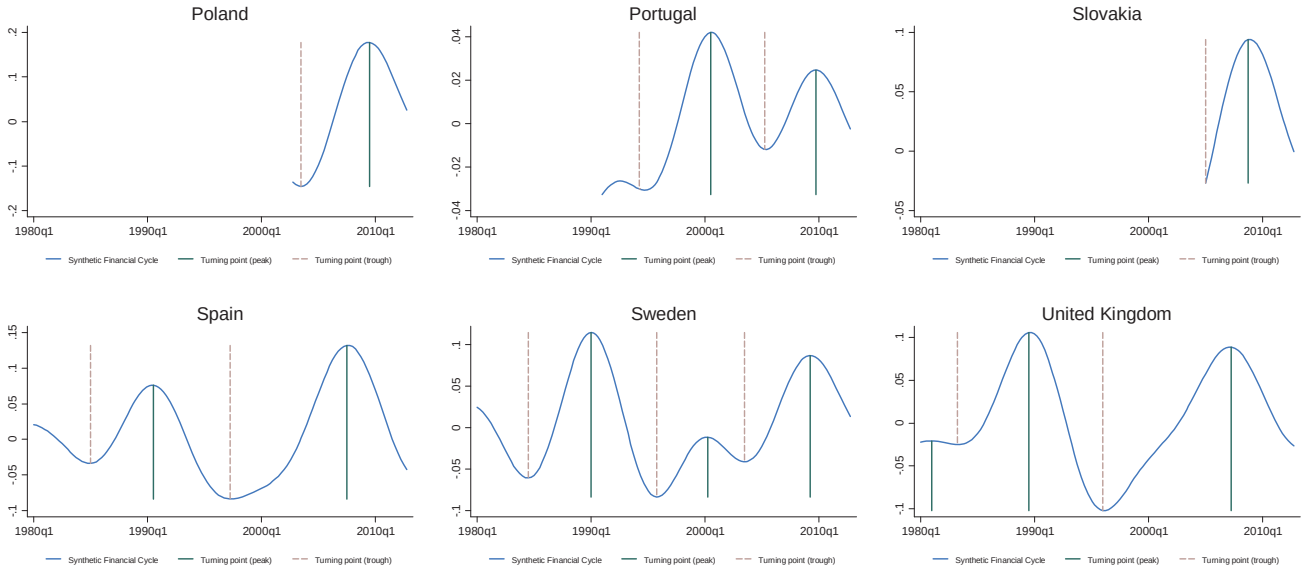
DE HAAS, R. and N. VAN HOREN (2013): “Running for the Exit? International Bank Lending during a Financial Crisis”, Review of Financial Studies, 26, 244–85.

DE HAAS, R. and N. VAN LELYVELD (2014): “Multinational Banks and the Global Financial Crisis: Weathering the Perfect Storm?”, Journal of Money, Credit and Banking, 46(2), 333–64.
DE NICOLO, G. and E. LOUKOIANOVA (2007): “Bank Ownership, Market Structure and Risk”, IMF Working Paper, No WP/07/215.
DEGRYSE, H., M. A. ELAHI, and M. F. PENAS (2013): “Determinants of Banking System Fragility: A Regional Perspective”, ECB Working Paper, No 1567.
DELL’ARICCIA, G., L. LAEVEN, and G. SUAREZ (2013): “Bank Leverage and Monetary Policy’s Risk-Taking Channel: Evidence from the United States”, IMF Working Paper, No Wp/13/143.
DETKEN, C., O. WEEKEN, L. ALESSI, D. BONFIM, M. M. BOUCINHA, C. CASTRO, S. FRONTCZAK, G. GIORDANA, J. GIESE, N. JAHN, J. KAKES, B. KLAUS, J. H. LANG, N. PUZANOVA and P. WELZ (2014): “Operationalizing the Countercyclical Capital Buffer: Indicator Selection, Threshold Identification and Calibration Options”, ESRB Occasional Paper, 5.
DREHMANN, M., C. BORIO and K. TSATSARONIS (2012): “Characterising the Financial Cycle: Don't Lose Sight of The Medium Term!”, BIS Working Paper, No 380.
DREHMANN, M. and K. TSATSARONIS (2014): “The Credit–to–GDP Gap and Countercyclical Capital Buffers: Questions and Answers”, BIS Quarterly Review, March 2014.
EUROPEAN SYSTEMIC RISK BOARD Advisory Scientific Committee (ESRB ASC) (2014), “Is Europe Overbanked?”, ASC Report, No 4, June 2014.
FUNGÁCOVÁ, Z., R. HERRALA, and L. WEILL (2013): “The Influence of Bank Ownership on Credit Supply: Evidence from the Recent Financial Crisis”, Emerging Markets Review, 15, 136–47.
GAMBACORTA L., J. YANG and K. TSATSARONIS (2014): “Financial Structure and Growth”, BIS Quarterly Review, March 2014.
GERDESMEIER, D., H.–E. REIMERS and B. ROFFIA (2010): "Asset Price Misalignments and the Role of Money and Credit", International Finance, 13, 377–407.
HOFMANN, B. and B. BOGDANOVA (2012): “Taylor rules and monetary policy: a global great deviation? ”,BIS Quarterly Review, September (2012), pp. 37–49
HOUBEN, A. and J. KAKES (2013): “Financial Imbalances and Macroprudential Policy in a Currency Union”, DNB Occasional Studies, 11, 5.
LUCA, A. and I. PETROVA (2008): “What Drives Credit Dollarization in Transition Economies?“, Journal of Banking & Finance, 32, 858–69.
MADDALONI, A. and J.-L. PEYDRÓ (2011): “Bank Risk-taking, Securitization, Supervision, and Low Interest Rates: Evidence from Euro-area and U.S. Lending Standards”, Review of Financial Studies, 24 (6), 2121–65.
ORPHANIDES, A (2007): “Taylor Rules”, Finance and Economics Discussion Series 2007-18, Board of Governors of the Federal Reserve System (U.S.).
POPOV, A. and G. F. UDELL: (2012): “Cross–Border Banking, Credit Access, and the Financial Crisis”, Journal of International Economics, 87, 147–61.
SCHAECK, K., M. CIHAK, and S. WOLFE (2009): “Are Competitive Banking Systems More Stable?”, Journal of Money, Credit, and Banking, 41(4), 711–34.
SMETS, F. (2014): “Financial Stability and Monetary Policy: How Closely Interlinked?”, International Journal of Central Banking, 10(2), 263-300.
STREMMEL, H. (2015): “Capturing the Financial Cycle in Europe”, ECB Working Paper Series, No 1811.
TAYLOR, J.B. (1993): “Discretion versus Policy Rules in Practice”, Carnegie-Rochester Conference Series on Public Policy 39, December, 195-214.
UHDE, A. and U. HEIMESHOFF (2009): "Consolidation in Banking and Financial Stability in Europe: Empirical Evidence", Journal of Banking & Finance, 33(7), 1299–1311.

Appendix

Figure A1: Financial Cycle Phases





Source: Stremmel (2015)

Each of the 21 country panels reflects the financial cycle with the identified turning points over time. The financial cycle measure is borrowed from Stremmel (2015)). Turning points are the result of a visual inspection of the financial cycle time series for each country. The determination of the local minima and maxima of each cycle allows us to define the peaks and troughs of the financial cycle and to calculate the amplitude. The financial cycle phase lasts from the last from turning point to the next one and corresponds to an expansion or contraction phase of the financial cycle. Therefore, an upswing period (expansion phase) of the financial cycle measure will endure from a trough to peak point and, vice versa, a downswing period (contraction phase) lasts from a peak to a trough point of the financial cycle measure. Unfortunately, for some countries (e.g. Greece, Latvia or Slovakia) we face data constraints and therefore we may not be able to capture a full financial cycle. This fact also provides arguments for using financial cycle phases instead of full financial cycles. For a detailed interpretation of these country panels please see Section 4 in the paper.

Table A1: Financial Cycle Measures

Financial Cycle	Ingredients
FC1	Credit-to-GDP ratio
FC2	Credit-to-GDP ratio, House prices to income ratio
FC3	Credit-to-GDP ratio, House prices to income ratio, Credit growth
FC4	Credit-to-GDP ratio, House prices to income ratio, Credit growth, House price growth
FC5	Credit-to-GDP ratio, House prices to income ratio, Credit growth, Bank funding ratio
FC6	Credit-to-GDP ratio, House prices to income ratio, Credit growth, Bank net income to total assets
FC7	Credit-to-GDP ratio, House prices to income ratio, Credit growth, Loans to total assets

Source: Stremmel (2015)

This table exhibits various synthetic financial cycle measure considered in Stremmel (2015) to determine the financial cycle measure. For a detailed description and review of the underlying components in the financial cycle see Stremmel (2015). The ingredients are obtained using frequency-based filter techniques to isolate cyclical movements from the trend in each of the underlying time series. The financial measures represent the combination of individual cyclical ingredients.

Table A2: Country-level Data Availability for Each Phase and Indicator Group

Country	**Concentration of the banking sestor** (Start: 1988Q4)	**Market share of foreign banks** (Start: 1996Q1)	**Institution size and stability** (Start: 1981Q1)	**Financial depth** (Start: 1989Q4)	**Bank loans** (Start: 1997Q3)	**Financial integration** (Start: 1998Q3)	**Sum of Observations**
Austria	2	1	2	2	2	2	11
Belgium	5	3	6	5	3	3	25
Denmark	4	2	5	3	2	2	18
Finland	5	3	6	5	3	3	25
France	3	1	5	3	2	2	16
Germany	3	1	2	2	2	2	12
Greece	2	1	2	2	2	2	11
Hungary	2	1	1	1	1	1	7
Ireland	2		4	1	1	1	9
Italy	3	1	5	3	2	2	16
Latvia	2	1	1	1	1	1	7
Lithuania	2	1	1	1	1	1	7
Luxembourg	2	1	2	2	1		8
Malta	2		2	2	1	1	8
Netherlands	3		4	3	1	1	12
Poland	2	1			1	1	5
Portugal	4	2	4	4	3	3	20
Slovakia	2	1	2	2		1	8
Spain	3	1	4	3	2	1	14
Sweden	4	3	4	3	2	2	18
United Kingdom	3	1		3	1	1	9
∑ Sample	60	26	62	51	34	33	266

This table provides an overview of the availability of the indicators in terms of financial cycle phases for each variable group at the country level. For Sample 2, we are able to include 266 phase-observations. It is obvious that for new EU member states such as Hungary, Latvia or Lithuania the data history is rather limited. The categories that provide the best coverage with the longest time horizons are *Institution size and stability* and *Concentration*. In addition, it is also insightful to note that for some countries such as Ireland, Luxembourg, Malta, the Netherlands, Poland, and the United Kingdom certain explanatory variables are not available. This is mainly due to the lack of data on the *Share of foreign banks.* A further remark concerns the categories of *Bank loans* and *Financial integration*. Both data series start only at the end of the 1990s and therefore the overall number of observations is rather small.

Table A3: Correlation Matrix of Variables to Financial Cycle Phases

Correlation	$FinCyclPhaseAmp_A$	$FinCyclPhaseAmp_B$
Concentration	0.69	0.70
Foreign_Banks	0.58	0.60
Credit/Deposits	0.41	0.40
Deposits/GDP	0.41	0.31
Market_Cap/GDP	0.20	0.17
Bank_Assets/GDP	0.41	0.46
FX_Loans/Loans	0.44	0.57
Credit/GDP	0.50	0.45
Foreign_Claims/GDP	0.52	0.43

This table exhibits the Pearson correlations of banking sector characteristics and both financial cycle phase amplitude measures. The table shows that *Concentration* and the *Share of foreign currency loans* have high correlations. Other indicators, such as the variables of *Financial depth* are associated with a lower correlation to the financial cycles. All measures, except the *Market_Cap/GDP ratio*, are statistically significantly correlated at the 5% confidence level.

Acknowledgements
The authors are very grateful to Sophia Chen, Luis Gutierrez de Rozas, Benjamin Klaus, Tuomas Peltonen, Willem Schudel, Peter Welz, Bent Vale as well as Benjamin Nelson and Jonathan Frost for their useful comments on an earlier version of this paper. We also thank seminar participants at the European Central Bank (2014), 6th IFABS conference (2014), 46th MMF conference (2014), 11th International Conference Western Economic Association International (2015) as well as an anonymous referee for valuable comments and suggestions. The views expressed in this paper are those of the authors and do not necessarily reflect the views of the ECB or the Eurosystem.

Hanno Stremmel
WHU – Otto Beisheim School of Management;
e-mail: hanno.stremmel@whu.edu

Balázs Zsámboki
European Central Bank;
e-mail: balazs.zsamboki@ecb.int

Postal address	60640 Frankfurt am Main, Germany
Telephone	+49 69 1344 0
Internet	www.ecb.europa.eu

ISSN	1725-2806 (online)
ISBN	978-92-899-1625-7
DOI	10.2866/176942
EU catalogue number	QB-AR-15-052-EN-N