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Financial Cycles in Europe:

Dynamics, Synchronicity and Implications for Business Cycles and Macroeconomic Imbalances

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Abstract

Using dynamic factor models and state-space techniques we quantify financial cycles for twenty European countries over the period 1960Q1–2015Q4 capturing imbalances across credit, housing, bond and equity markets. The paper documents the existence of slow-moving and persistent financial cycles for all countries in the sample, many of which also exhibit high cross-country synchronicity. Spillover analysis points at the significant role the global financial cycle and a common latent region-specific factor, the European financial cycle, play in shaping national financial market dynamics. Estimations using Bayesian panel VAR models to assess interactions between external and internal macroeconomic imbalances suggest that financial cycles are an important driver of business cycles and public debt dynamics, with much stronger shock transmission observed in the euro area and systemic European economies.

Keywords: financial cycles, macroeconomic imbalances, financial stability, business cycles, financial spillovers, panel VAR, Bayesian VAR

JEL classification: E44, F32, G15, F4

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1 Introduction

The global financial crisis of 2007–2008 has put financial stability considerations at the center of policy discussions focusing on macroeconomic resilience and sustainable economic growth. The debate revisiting economic implications and impacts of financial markets has revealed major weaknesses in existing macroeconomic policy frameworks largely focusing on price stability considerations and neglecting financial market sustainability and risks.

Financial markets appear to be prone to persistent long-run cyclical fluctuations—“financial cycles”—reflecting the build-up of imbalances as credit rapidly expands and asset prices rise to overinflated levels, followed by market corrections often taking the form of sharp adjustments (Adarov, 2018; Borio, 2013, 2014). Therefore, while deep financial markets are indeed important for economic development, as the “finance-growth nexus” literature reports (Goldsmith, 1969; McKinnon, 1973; Shaw, 1973, Beck and Levine, 2004; Beck et al., 2000; Demetriades and Hussein 1996; King and Levine, 1993; Levine, 1997; Levine and Zervos, 1998; Rousseau and Wachtel, 2011), fluctuations in financial market activity may, by contrast, lead to vastly destabilizing macroeconomic effects. In Europe these risks are aggravated by the so-called “bank bias” as its financial structure is strongly dominated by banks, whereas capital markets remain much less developed (for additional discussion see, for instance, Pagano et al., 2014). Overreliance on the banking system is believed to be among the important factors that contributed to the depth of the recent crisis in Europe, prompting a renewed debate on the necessity to foster deeper capital markets and thereby diversify funding sources and facilitate risk sharing.

In light of these challenges, in this paper we take a closer look at European financial markets from the perspective of their long-run cyclical dynamics: we quantify financial cycles at country and regional levels, analyze their properties, cross-country synchronicity and spillovers, association with the business cycles and implications for macroeconomic imbalances. Thematically thus the paper is most closely related to the growing empirical literature on financial cycles, including research on credit booms, financial stress and asset bubbles. While the idea of inherent instability and the cyclical nature of financial market dynamics conceptually is not new per se, going back to Minsky (1978, 1982), Kindleberger (1978) and related works, the global financial crisis has revived interest in the topic. A growing body of research focuses on the estimation and analysis of financial cycles (Adarov, 2018; Aikman et al., 2015; Borio, 2013, 2014; Borio et al., 2013, 2014; Claessens et al., 2011, 2012; Claessens and Kose 2017; Drehmann et al., 2012; Hatzius et al. 2010; Miranda-Agrippino and Rey, 2015; Nowotny et al., 2014; Schüler et al., 2015; Schularick and Taylor, 2012; Stremmel, 2015).

To date, only a few studies empirically document and analyze financial cycles focusing specifically on Europe, the EU or the euro area. Among the recent contributions, Schüler et al. (2016) estimate financial cycle indicators for euro area countries using credit, house, equity and bond prices. Rünstler et al. (2018) analyze cycles and study their properties for real GDP, house prices, credit, and nominal liquid financial assets in 17 EU countries. Similarly, in Stremmel (2015) financial cycles are extracted for 11 European countries using various credit aggregates and asset prices. All studies report the existence of slow-moving cycles in financial markets, which are closely associated with financial distress episodes. Examining the impact of financial cycles on current account balances and real effective exchange rates in EU countries, Comunale (2017) applies panel and Bayesian techniques and finds that financial gaps can have a greater influence on current account misalignments than output gaps. The literature however is still rather scarce, particularly, as regards the analysis of macroeconomic implications of financial cycles.

In this paper we contribute to the debate along several dimensions. First, we derive a novel financial cycle measure computed as a synthetic index based on aggregation of information from a large number of observable market characteristics conveying price, quantity and risk dynamics across four financial market segments—credit, housing, equity and bond markets. This allows for a more comprehensive approach to measuring financial cycles as opposed to proxy variables typically used in the literature, for instance, credit-to-GDP ratios[1], and capture the joint dynamics of the banking sector, capital markets and the housing sectors. The paper examines the properties of financial cycles, their association with the business cycles and cross-border spillovers, also identifying the common regional European financial cycle and assessing its role along with the impact of the global financial cycle in European financial markets. Second, the paper employs Bayesian panel vector autoregression (PVAR) approach to estimate the impact of financial cycles on macroeconomic imbalances. This framework allows to take take advantage of the richer information content contained in panel data as opposed to VAR models for individual countries, at the same time allowing for fully endogeneous covariates and dynamic interactions among them, in contrast to conventional panel data models, while the Bayesian shrinkage mitigates overparametrization issues. The latter is especially relevant in the context of short data span available for many European countries. Finally, and related to the above, we study financial cycles for a broader set of European countries, comprising advanced and developing economies, while the literature mostly focuses on selected EU or euro area countries. Inter alia, this permits us to explore heterogeneous effects within Europe by estimating the extent of macro-financial spillovers for the European core and periphery countries, as well as the euro area, in addition to the full European sample.

More specifically, in this paper we estimate segment-specific (credit, housing, bond and equity) and aggregate financial cycles for 20 European countries at a quarterly frequency over the period 1960Q1–2015Q4 using dynamic factor modeling and state-space techniques. We find that activity in financial markets is indeed characterized by highly persistent and recurring cyclical nature. These financial cycles fluctuate at generally lower frequencies than business cycles and have a strong association with major financial distress episodes. The average length of European financial cycles mostly falls into the range of 8–12 years, and for some countries is even longer reaching up to 20 years.

We find significant general co-movement among national financial cycles within Europe, and for many countries financial cycles are synchronized 70-80% of time, as measured by the phase concordance index. Much of this is attributed to the impact of the global financial cycle and the idiosyncratic European financial cycle. In this respect it is noteworthy that the financial cycles of the UK and Sweden virtually mimic the dynamics of the global financial cycle. Overall, cross-country spillover analysis using Bayesian VAR with Minnesota and Normal-Inverse-Wishart

[1] See, for instance, Aikman et al.(2015), Claessens et al.(2012), Dell'Arriccia et al. (2012), Schularick and Taylor (2012)

priors points at the significant role the global and European common financial cycles play in shaping the dynamics of European financial markets.

The analysis reveals rather mixed patterns of contemporaneous synchronization between financial and business cycles, although for some countries co-movement between real and financial cycles is rather high, particularly for Hungary, Italy, Germany (financial cycles and business cycles tend to move in sync 70% of time or more).

To further disentangle the macroeconomic impacts of financial cycles we use the Bayesian panel VAR framework, which allows to model fully endogenous covariates in a panel data setting and addresses the "curse of dimensionality" issue. Using a parsimonious four-variable model setup incorporating the derived financial cycle index, output gap as a percentage of potential GDP, current account balance as a percentage of GDP and general government debt as a percentage of GDP, we find that financial cycles do have non-trivial impacts on macroeconomic imbalances. In particular, the analysis strongly supports the conjecture that financial cycles constitute an important driver of business cycles, as well as influence debt-to-GDP dynamics (the impact on current account balances appears to be largely insignificant). The magnitude of the impact is also non-negligible: a one-standard deviation shock in the financial cycle variable induces macroeconomic overheating equivalent to 0.5 percent of potential GDP (positive output gap) and a decline by 0.7 pp in the ratio of public debt to GDP. Such strong impact on output gaps is attributed largely to the reaction in the "core" European economies—advanced and systemically important countries of Europe[2], while the response in the "periphery" group is less statistically and economically significant. Notably, for the European core economies financial cycles appear to have a greater impact on public debt-to-GDP ratios in comparison with the business cycles. Fifteen percent of forecast error variance in output gap is explained by financial cycles in the case of the European core countries, in contrast to only five percent for the full European sample.

In the euro area financial cycles invoke a particularly strong impact on public debt ratios and a much stronger in comparison to the rest of the sample, albeit still only marginally significant, reaction of the current account balance, which yields additional evidence on the implications of constraints imposed by the monetary union arrangements. The response is also highly persistent, especially in the case of the fiscal position variable: a one-standard-deviation positive shock in the financial cycle variable reduces the debt ratio by about one percent of GDP on impact (peak response) with the effect phasing out only at the horizon of ten years.

The results have important policy implications highlighting the significance of tackling the buildup of financial imbalances as one of the roots of macroeconomic overheating leading to economic crises. Inter alia, besides an important role of prudential regulations to tackle systemic risks, this implies that macroeconomic policy frameworks focusing exclusively or predominantly on targeting inflation as the principal nominal anchor may be suboptimal and need to be revised to allow for a more proactive monitoring and policy response to the buildup of financial misalignments. As a related matter, deepening of financial markets, and, particularly, the strive to facilitate capital markets in Europe, besides the known benefits, may carry additional macroeconomic stability risks associated with the interplay between the self-reinforcing build-

[2] See Section 2 for details about the country composition of the full sample and sub-groups.

up of financial market imbalances and related boom-bust cycles, deepening macro-financial linkages across countries and increasing complexity of financial innovation, which need to be taken into account when designing the future European financial market architecture. In this regard, notable revealed exposure of European economies to the global financial cycle and a strong common regional element in financial cycle dynamics, i.e. the European regional financial cycle, reiterate the importance of regulatory mechanisms to monitor and mitigate the risks stemming from intensifying cross-country macro-financial linkages, financial spillovers and common exposures.

The remainder of the paper is organized as follows. Section 2 describes the sample and the data. Section 3 provides an overview of the estimated financial cycles and their main properties. Section 4 reviews the association between financial and business cycles, as well as analyzes the interactions between financial and macroeconomic imbalances in Europe. Section 5 focuses on cross-country synchronicity and spillovers between financial cycles, also discussing the exposure to the global financial cycle and a common European cycle. Section 6 reviews policy implications and concludes.

2 Data and sample

Segment-specific and aggregate financial cycles are estimated at a quarterly frequency for 20 European countries over the period 1960Q1–2015Q4 based on a large number of financial market variables. For the purposes of the panel VAR analysis focusing on macro-financial spillovers we employ variables at an annual frequency and also use a smaller strongly balanced panel data, which reduces the effective sample by three countries. Table 1 summarizes the country composition of the full sample and subgroups used in additional case studies (the European "core" and "periphery" countries, the euro area). The country composition and the period considered in each empirical exercise are generally determined by data availability. In this regard, the available financial market data was particularly limiting for the transition economies of Europe, often available only for a small number of variables and a relatively short post-2000 period.

Table 1: Sample composition and characteristics

sample	countries included	period	N	T	Obs
A. Europe: quarterly full sample, unbalanced	Austria (AUT), Belgium (BEL), Switzerland (CHE), Czech Republic (CZE), Germany (DEU), Spain (ESP), Estonia (EST), Finland (FIN), France (FRA), United Kingdom (GBR), Hungary (HUN), Italy (ITA), Lithuania (LTU), latvia (LVA), Netherlands (NLD), Norway (NOR), Poland (POL), Russia (RUS), Slovakia (SVK), Sweden (SWE)	1960Q1–2015Q4	20	227	4540
B. Europe: annual full sample, strongly balanced	AUT, BEL, CHE, CZE, DEU, ESP, EST, FIN, FRA, GBR, HUN, ITA, NLD, NOR, POL, SVK, SWE	1998-2012	17	15	255
C. Europe: core	AUT, BEL, CHE, DEU, FRA, GBR, NLD	1998-2012	7	15	105
D. Europe: periphery	CZE, ESP, EST, FIN, HUN, ITA, NOR, POL, SVK, SWE	1998-2012	10	15	150
E. Euro area	AUT, BEL, DEU, ESP, EST, FIN, FRA, ITA, NLD, SVK	1998-2012	10	15	150

The data for financial markets, including interest rates, private credit volumes, asset prices, stock market index returns and other data which was used for the estimation of financial cycles (discussed in the next subsection), are obtained from multiples sources, including Bank for International Settlements databases, IMF International Financial Statistics, OECD Main Economic Indicators, OECD Housing Statistics, Federal Reserve Economic Data, World Bank Global Financial Development Database, Investing.com, Yahoo Finance, Haver Analytics and national monetary authorities.[3]

The variables used in the analysis of macroeconomic imbalances, along with their source and descriptive statistics, are listed in Table 2. Output gap estimates are obtained from the IMF World Economic Outlook and complemented by the OECD Economic Outlook for missing or shorter series. Public debt data are sourced from the IMF Historical Public Debt and the IMF Global Debt databases.

Table 2: Descriptive statistics and data sources, full sample

Variable name	Variable description	N	Mean	Std. dev.	Min	Max	Source
FC	Financial cycle index	255	0.07	0.83	-2.32	2.48	Own estimates
$YGAP$	Output gap, percent of potential GDP	255	0.13	2.63	-11.36	11.86	IMF World Economic Outlook, OECD Economic Outlook
CA	Current account balance, percent of GDP	255	0.68	6.15	-14.98	16.23	IMF World Economic Outlook
$DEBT$	General government debt, percent of GDP	255	54.75	25.52	3.66	123.34	IMF Historical Public Debt Database, IMF Global Debt Database

3 Segment-specific and aggregate financial cycles: estimation and properties

3.1 State-space model for the estimation of financial cycle indices

This section provides a brief recap of the estimation methodology, which is documented in more detail in Adarov (2018), discussing financial cycles in a global context. Financial cycles reflect the buildup and correction of imbalances in financial markets due to changing risk perceptions, liquidity conditions, and other demand and supply factors, and empirically manifest in the form of repeated boom-bust cycles. In order to construct a comprehensive financial cycle measure we strive to pick up market dynamics not only in the banking sector, but also in capital and housing markets and therefore estimate financial cycles in two steps.

First, segment-specific financial cycle indices are estimated for the four key financial market segments—the banking sector, housing, equity and debt security markets—as a latent dynamic common factor extracted from a range of observable variables conveying price, quantity and risk characteristics of activity in the respective market, data permitting. In the second step,

[3] As a large number of variables were used in the estimation of financial cycles, differing across countries and the four financial market segments analyzed, summary statistics and detailed sources per each variable are not reported in the paper, but are available on request from the author.

these segment-specific financial cycles are used to derive a national aggregate financial cycle, characterizing the state of financial markets in a given country in general. Figure 1 summarizes the estimation sequencing listing most commonly used variables (a detailed variable composition behind each financial cycle is reported in Appendix B with factor loadings and their statistical significance).

Figure 1: Estimation of aggregate financial cycles

$$
\left.\begin{array}{r}
\left.\begin{array}{r}\text{private credit by banks}\\ \text{lending, deposit and other interest rates}\\ \text{maturity and risk interest rate spreads}\end{array}\right\} FC_c^{CR} \text{ (credit cycle)}\\
\left.\begin{array}{r}\text{real housing price index}\\ \text{price to rent and price to income ratios}\end{array}\right\} FC_c^{H} \text{ (housing cycle)}\\
\left.\begin{array}{r}\text{maturity and risk bond yield spreads}\\ \text{government and corporate bond yields}\\ \text{bond market capitalization}\end{array}\right\} FC_c^{B} \text{ (bond cycle)}\\
\left.\begin{array}{r}\text{benchmark stock market index returns}\\ \text{volatility of returns}\\ \text{stock market capitalization}\end{array}\right\} FC_c^{EQ} \text{ (equity cycle)}
\end{array}\right\} FC_c^{AG} \text{ (aggregate cycle)}
$$

The dynamic factor models (Geweke, 1977; Sargent and Sims, 1977) are formulated in a state-space form, which allows their estimation via the Kalman filter and smoother. For country c's financial market segment S, the vector of observable financial market variables[4] $\mathbf{y}_{c,t}^S = [y_{c1t} \ldots y_{cNt}]'$ for $t = 1 \ldots T$ is modeled as the sum of the unobservable common factor $f_{c,t}^S$ and the vector of idiosyncratic shocks $\mathbf{v_{c,t}^S}$:

$$
\begin{cases}
f_{c,t}^S = \alpha_c^S \times f_{c,t-1}^S + u_{c,t}^S \\
\mathbf{y}_{c,t}^S = \mathbf{B_c^S} \times f_{c,t}^S + \mathbf{v_{c,t}^S}
\end{cases}
\tag{1}
$$

where the state equation specifies a first-order autoregressive process with the persistence parameter α_c^S for the latent factor $f_{c,t}^S$. The $N \times 1$ vector of factor loadings $\mathbf{B_c^S}$ links N observable input financial variables to the latent common factor; $u_{c,t}^S$ and $\mathbf{v_{c,t}^S}$ are the state and the measurement equation *i.i.d.* error terms. The estimated common factor $\hat{f}_{c,t}^S$ in a standardized form (scaled to have a zero mean and a standard deviation of unity) then constitutes a *segment-specific* financial cycle index for a given country and market segment.

[4] The variables are standardized (demeaned and divided by their sample standard deviation) to ensure their variances contribute to the variance of the estimated latent factor symmetrically, regardless of their measurement scale and historical volatility.

Estimation of aggregate financial cycles for each country c is based on a state-space system with a similar structure, but using the four previously estimated segment-specific financial cycles as observed variables[5] comprising the vector $\hat{\mathbf{f}}_{c,t}^{S}$ in the measurement equation:

$$\begin{cases} f_{c,t}^{AG} = \alpha_c^{AG} \times f_{c,t-1}^{AG} + u_{c,t}^{AG} \\ \hat{\mathbf{f}}_{c,t}^{S} = \mathbf{B_c^{AG}} \times f_{c,t}^{AG} + \mathbf{v_{c,t}^{AG}} \end{cases} \tag{2}$$

The *aggregate* financial cycle index is then the estimated factor $f_{c,t}^{AG}$, standardized to have a zero mean and a standard deviation of unity, which helps to interpret its magnitude in terms of standard deviations from the historical mean. An alternative model for estimating aggregate financial cycles uses observable financial market variables pooled across the four financial market segments instead of the estimated segment-specific financial cycles. Both estimation strategies however yield largely identical results.

Complementing the original financial cycle measure, we also compute its "smoothed" version by applying the Hodrick-Prescott filter, which nets out short-run transitory shocks and allows to focus on the long-run dynamics.[6]

3.2 Overview of European financial cycles and their key properties

The resulting smoothed and detrended segment-specific and aggregate financial cycles for each country in the sample are shown in Figure 2 (sorted alphabetically by ISO3 code). In addition, Figure 3 reports smoothed and unsmoothed aggregate financial cycles. The estimated financial cycle indices pick up major systemic market events well, including major international crises, as, for instance, reflected in the synchronized downturn associated with the recent global financial crisis observed across many countries, as well as country-specific or segment-specific distress episodes. In general, segment-specific cycles tend to co-move during major boom-bust episodes, which also manifests in aggregate financial cycles. In many cases, however, stock market cycles exhibit leading properties relative to other segment-specific cycles as regards the timing of their turning points and phase sequencing.

Financial cycles appear to be slow-moving and highly persistent (Appendix B reports details about variable composition, factor loadings and estimated persistence parameters for each financial cycle and all countries in the sample). For aggregate and segment-specific cycles alike the fitted autoregressive parameter yields generally very high values, in many cases reaching 0.8–0.9, which implies that the accumulation of financial market imbalances followed by corrections constitutes a rather persistent self-reinforcing process.

In order to dissect financial cycles into alternating expansion and contraction phases and pinpoint peaks and troughs more precisely, we apply the BBQ turning point identification algorithm (Harding and Pagan, 2002). The BBQ algorithm is widely used in the literature on

[5] For some countries estimation of certain segment-specific cycles is not possible as a result of insufficient data (short series or completely missing data for certain variables). In such cases we include instead a proxy variable for which the longest time span is available, cross-checking its validity. In particular, in a few cases real housing price index is used as a proxy for the synthetic housing financial cycle.

[6] To this end, the signal-to-noise ratio λ in the Hodrick-Prescott filter is set to 1600, which is a typical choice for quarterly data. Alternative statistical filters, e.g. Christiano-Fitzerald, yield similar results.

business cycles and is the quarterly implementation of the Bry and Boschan (1971) procedure developed originally for monthly frequency data. The algorithm identifies local peaks and troughs subject to constraints on the search window and the minimum duration of cycles or phases. In our application, we set the moving search window $[\tilde{t} - k;\ \tilde{t} + k]$ to $k = 9$ quarters and the minimum phase duration to 3 quarters to avoid a possible bias towards long cycles. For the variable ψ (the financial cycle index; the same algorithm is also applied to business cycles in the next section) the turning points tp are then defined as follows:

$$tp = 1 \text{ (peak) at } t = \tilde{t} \text{ if: } \begin{cases} \psi_{\tilde{t}} > 0; \psi_{\tilde{t}-1} > 0; \psi_{\tilde{t}-2} > 0 \\ \psi_{\tilde{t}+1} < 0; \psi_{\tilde{t}+2} < 0; \psi_{\tilde{t}+3} < 0 \\ \min |\tilde{t}_{peak} - t_{trough}| \geqslant 3 \text{ quarters} \end{cases} \tag{3}$$

$$tp = \text{-1 (trough) at } t = \tilde{t} \text{ if: } \begin{cases} \psi_{\tilde{t}} < 0; \psi_{\tilde{t}-1} < 0; \psi_{\tilde{t}-2} < 0 \\ \psi_{\tilde{t}+1} > 0; \psi_{\tilde{t}+2} > 0; \psi_{\tilde{t}+3} > 0 \\ \min |\tilde{t}_{peak} - t_{trough}| \geqslant 3 \text{ quarters} \end{cases} \tag{4}$$

Table 3 shows the average phase and cycle duration for each country and a summary for the sample (for both smoothed and unsmoothed aggregate financial cycles), also indicating the number of turning points identified by the BBQ algorithm.[7] The duration of financial cycles across all segments and countries tends to fall into the range of 8–12 years, but for some countries reaches 20 years. In this respect financial cycles of European countries exhibit rather similar properties in comparison with the broader global sample. The average length of aggregate financial cycle for the European sample is 8 years for unsmoothed FC and 12 years after smoothing is applied.

Notably, the movements of financial cycles tend to exhibit asymmetry and a “sawtooth” pattern (as opposed to a symmetric “sinewave” shape) as the expansions are longer than contraction phases, thus signifying that the buildup of financial imbalances generally constitutes a relatively more protracted process in comparison with contractions, which often take the form of abrupt adjustments—financial crises. As can be seen in Table 3, on average, financial cycle expansions are about six quarters longer than contractions.

[7] For reference, summary statistics for the global sample are also provided using estimates reported in Adarov, 2018.

Table 3: Cyclical properties of financial cycles

Notes: The table shows the average duration in quarters of phases (**Avg. phase**) and cycles (**Avg. cycle**) for national aggregate financial cycles, smoothed and unsmoothed. The countries are listed by ISO3 code in alphabetic order. **N** indicates the number of observations; **Exp. phase** and **Cont. phase** denote expansion and contraction phases; **TP count** denotes the number of turning points identified. * – summary statistics for the global sample of 34 countries provided for reference from Adarov (2018). Blanks indicate cases when turning points could not be robustly identified and thus a concordance index could not be computed.

Country	**N**	**Smoothed *FC***					**Unsmoothed *FC***				
		Exp. phase	**Cont. phase**	**Avg phase**	**Avg cycle**	**TP count**	**Exp. phase**	**Cont. phase**	**Avg phase**	**Avg cycle**	**TP count**
AUT	180	21.0	17.7	19.3	38.6	7	24.5	12.7	19.4	38.0	8
BEL	115	17.0	17.7	17.4	33.3	6	12.7	11.3	11.9	24.5	8
CHE	133	51.0	28.0	39.5	79.0	3	12.0	25.5	18.8	34.7	5
CZE	84	32.0		32.0		2	14.0	9.0	11.5	21.0	5
DEU	166	17.8	16.3	17.0	35.4	9	18.5	14.2	16.1	34.5	10
ESP	116	42.0	28.0	35.0	70.0	3	46.0	27.0	36.5	73.0	3
EST	71	25.0	18.0	21.5	43.0	3	17.5	6.0	11.8	23.7	5
FIN	89	42.0		42.0		2	19.0	10.0	16.0	29.0	4
FRA	148	17.0	15.8	16.3	32.8	8	16.0	17.3	16.7	32.5	8
GBR	133	34.0	30.0	31.3	64.0	4	21.0	15.3	17.6	36.0	6
HUN	92		43.0	43.0		2	14.0	17.0	16.0	31.0	4
ITA	133	40.0	26.0	33.0	66.0	3	15.5	11.5	13.5	28.0	9
LTU	55		19.0	19.0		2		15.0	15.0		2
LVA	56						15.0		15.0		2
NLD	90	14.0	18.0	16.0	32.0	3	18.0	8.3	12.2	27.0	6
NOR	124	22.0	15.0	19.7	37.0	4	19.0	11.5	14.7	30.2	8
POL	72						11.0	10.5	10.7	21.5	4
RUS	72		20.0	20.0		2	25.0	15.0	20.0	40.0	3
SVK	69	25.0		25.0		2	33.0	10.0	21.5	43.0	3
SWE	135	19.0	20.0	19.6	37.3	6	24.0	14.7	18.4	37.8	6
European sample											
avg	*106.7*	*27.9*	*22.2*	*25.9*	*47.4*	*3.9*	*19.8*	*13.8*	*16.7*	*33.6*	*5.5*
min	*55.0*	*14.0*	*15.0*	*16.0*	*32.0*	*2.0*	*11.0*	*6.0*	*10.7*	*21.0*	*2.0*
max	*180.0*	*51.0*	*43.0*	*43.0*	*79.0*	*9.0*	*46.0*	*27.0*	*36.5*	*73.0*	*10.0*
*Global sample**											
avg	*110.5*	*27.1*	*22.5*	*25.3*	*47.8*	*3.9*	*18.2*	*13.3*	*15.8*	*31.3*	*5.9*
min	*55.0*	*13.0*	*13.0*	*13.8*	*26.7*	*2.0*	*9.0*	*6.0*	*8.3*	*15.4*	*2.0*
max	*180.0*	*51.0*	*43.0*	*43.0*	*79.0*	*9.0*	*46.0*	*27.0*	*36.5*	*73.0*	*10.0*

Figure 2: Aggregate and segment-specific financial cycles in Europe

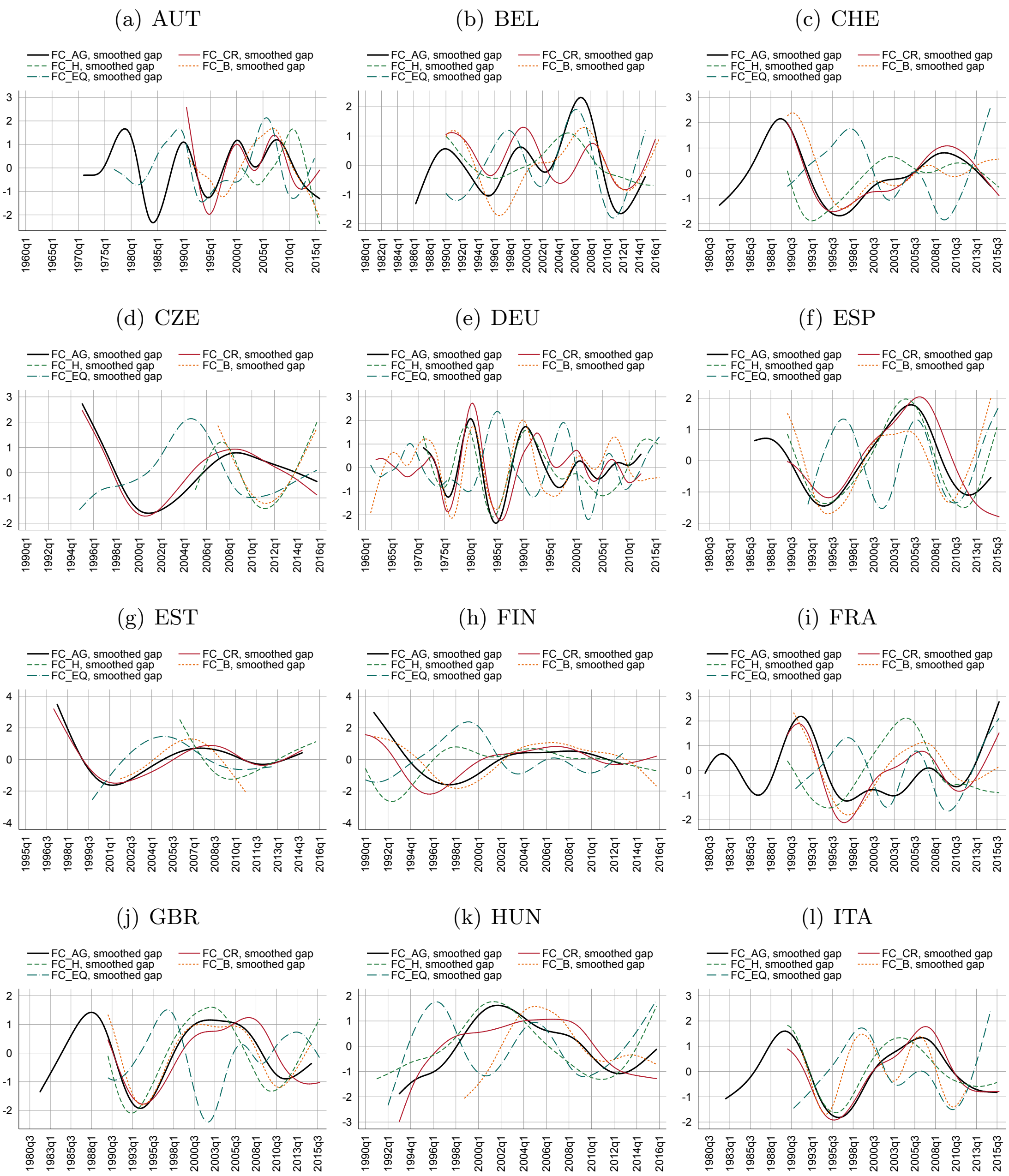


Figure 2 (cont.): Aggregate and segment-specific financial cycles in Europe

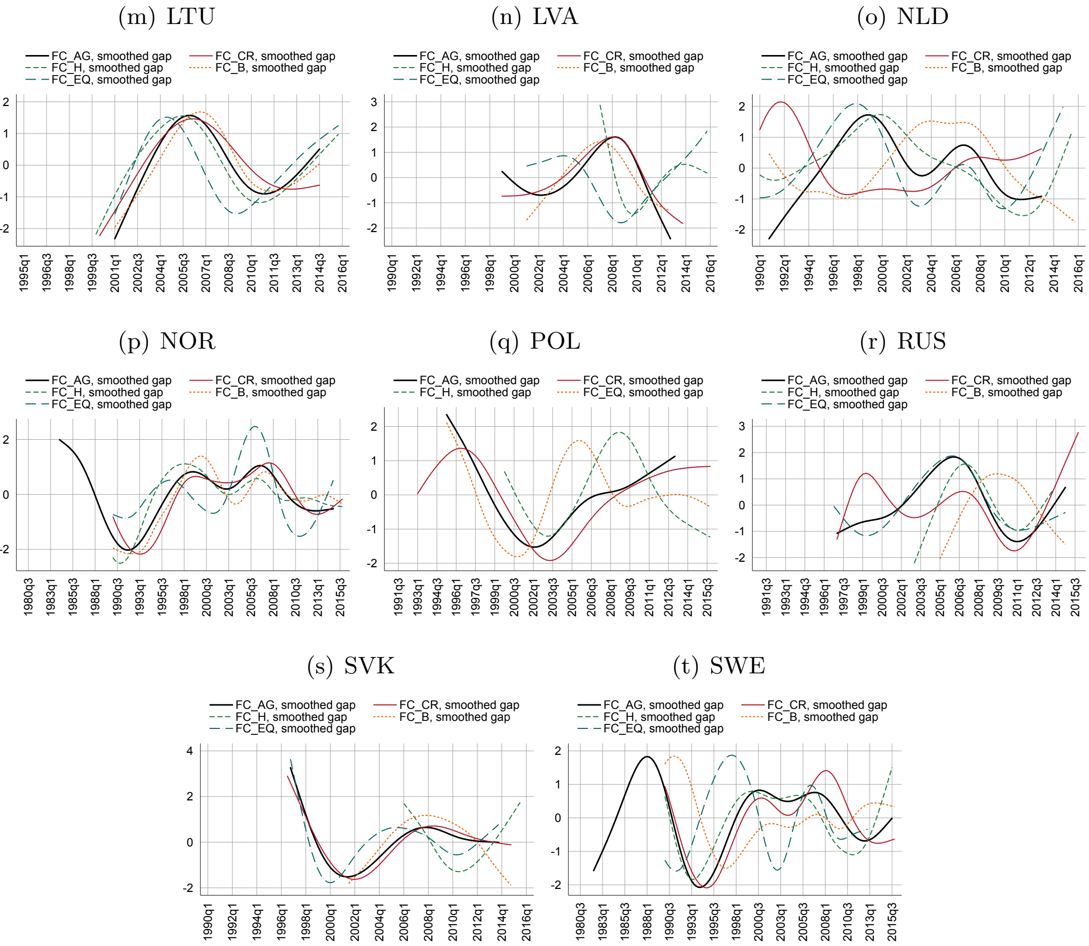
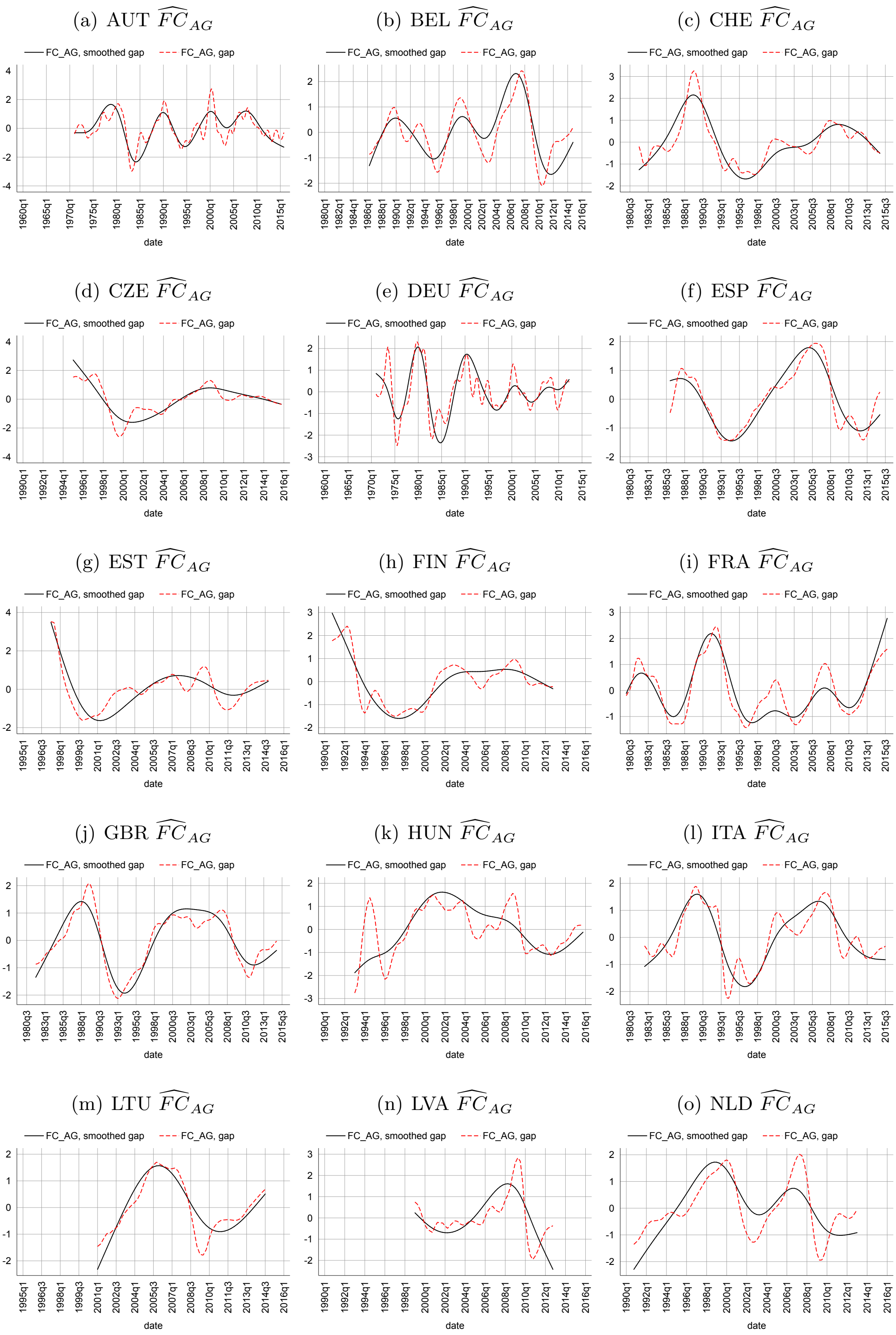
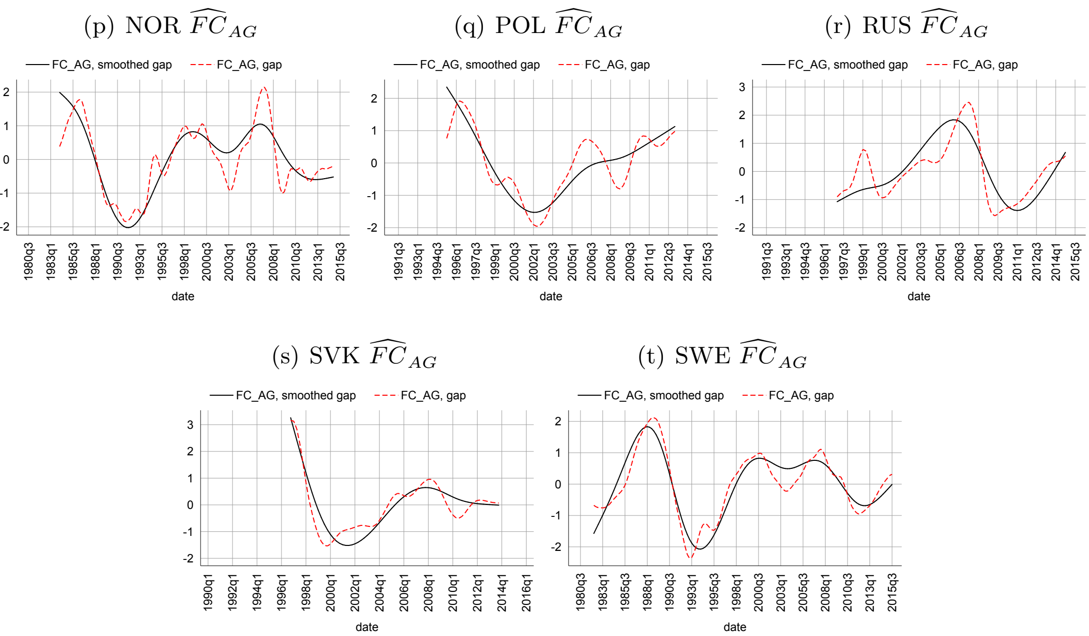


Figure 3: Aggregate financial cycles in Europe



(a) AUT $\widehat{FC}_{AG}$ (b) BEL $\widehat{FC}_{AG}$ (c) CHE $\widehat{FC}_{AG}$
(d) CZE $\widehat{FC}_{AG}$ (e) DEU $\widehat{FC}_{AG}$ (f) ESP $\widehat{FC}_{AG}$
(g) EST $\widehat{FC}_{AG}$ (h) FIN $\widehat{FC}_{AG}$ (i) FRA $\widehat{FC}_{AG}$
(j) GBR $\widehat{FC}_{AG}$ (k) HUN $\widehat{FC}_{AG}$ (l) ITA $\widehat{FC}_{AG}$
(m) LTU $\widehat{FC}_{AG}$ (n) LVA $\widehat{FC}_{AG}$ (o) NLD $\widehat{FC}_{AG}$

Figure 3 (cont.): Aggregate financial cycles in Europe



4 Macroeconomic implications of financial cycles

The section focuses on the impact of financial cycles on the national economies reviewing their association with business cycles and analyzing dynamic spillovers on the key variables measuring external and internal macroeconomic imbalances, i.e. output gap, current account balance and public debt burden, also allowing for heterogeneous effects across the European sample with two additional case studies: identifying the effects for the euro area and splitting the sample into the European "core" and "periphery" groups.

4.1 Synchronicity between financial cycles and business cycles

In order to gauge the extent to which financial cycles co-move with business cycles we compute concordance indices measuring the share of time over which two given cyclical series are in the same phase (expansion or contraction) over the observed period of time. The measure of business cycles BC is obtained by applying the Christiano-Fitzgerald band-pass filter to quarterly seasonally adjusted real GDP series for each of the twenty countries in the sample. We filter out stochastic cycles at frequencies smaller than 6 and greater than 32 quarters.[8] The turning points for BC are determined using the BBQ algorithm described in the previous section. Using the identified turning points we compute $\Omega_c^{FC,BC}$ measuring phase concordance between business cycles (BC_c) and financial cycles (FC_c) for each country c as follows:

$$\Omega_c^{FC,BC} = \frac{1}{T}\sum_{t=1}^{T}\left[\phi_{c,t}^{FC}\phi_{c,t}^{BC} + (1-\phi_{c,t}^{FC})(1-\phi_{c,t}^{BC})\right] \tag{5}$$

[8] Alternative statistical filters (Baxter-King and the Hodrock-Prescott filters) produce very similar results.

where $\phi^{FC}_{c,t}$ and $\phi^{BC}_{c,t}$ are the phase indicators for financial cycles and business cycles defined as:

$$\phi^{FC}_{c,t} \text{ (or } \phi^{BC}_{c,t}) = \begin{cases} 1 \text{ if } FC_c \text{ (or } BC_c) \text{ is in the expansion phase in } t \\ 0 \text{ if } FC_c \text{ (or } BC_c) \text{ is in the contraction phase in } t \end{cases} \quad (6)$$

By construction, $\Omega^{FC,BC}_c$ is 1 if both cycles are perfectly synchronized over the entire period T, and takes the value of 0 if the two series always move in opposite directions.

Table 4 reports the computed concordance index based on quarterly FC and BC series. also reporting the length of the time (quarters) over which both variables are available for a given country (T). Obviously, $\Omega^{FC,BC}_c$ associated with higher T implies a more robust relationship. In particular, for European transition economies the data is particularly scarce and the observed co-movement is largely attributed to the effect of the Great Recession. At the same time, some countries with long time spans also exhibit very high contemporaneous association between financial and business cycles. Particularly, in Italy or Germany FC and BC move in-synch about 70% of time—a rather strong degree of co-movement based on 30 and 39 years of data, respectively. On average, considering the entire sample, however, co-movement is not significant at 55%, which does not allow to conclude that the relationship holds robustly in general. This is also expected as business cycles are not associated exclusively with financial market crises and also tend to fluctuate at a higher frequency in comparison with financial cycles.

Table 4: Co-movement between financial and business cycles

Note: $\Omega^{FC,BC}_c$ indicates the value of the concordance index between financial cycles and business cycles; T denotes the number of observations available for FC and BC ($T_{FC} \cap T_{BC}$)

Rank	ISO3	$\Omega^{FC,BC}_c$	T	Rank	ISO3	$\Omega^{FC,BC}_c$	T
1	HUN	0.77	61	11	RUS	0.55	58
2	ITA	0.73	118	12	SVK	0.54	57
3	DEU	0.69	156	13	AUT	0.53	66
4	BEL	0.64	72	14	NLD	0.53	53
5	CHE	0.59	103	15	POL	0.52	44
6	CZE	0.59	71	16	FIN	0.48	64
7	LTU	0.58	36	17	LVA	0.47	49
8	SWE	0.58	108	18	ESP	0.41	71
9	FRA	0.56	137	19	NOR	0.37	115
10	GBR	0.56	104	20	EST	0.31	61

4.2 Implications for macroeconomic imbalances: panel VAR model setup

The analysis of contemporaneous synchronization does not reveal possible spillovers from financial cycles to the real economy. Therefore, we use the Bayesian panel VAR (BPVAR) model to gain deeper insights into possibly causal mutual interactions between financial cycles, business cycles and macroeconomic imbalances. A panel VAR framework allows to control for individual country heterogeneity and model dynamic mutual impacts among multiple endogenous covariates, while Bayesian shrinkage allows to address the "the curse of dimensionality" given the relatively small sample available both in terms of time and country dimensions. Formalizing, given N countries indexed $i = 1, ..., N$ and time $t = 1, ..., T$, the model is set up as follows:

$$\mathbf{X}_{it} = \mu_i + \mathbf{\Theta}(\mathbf{L})\mathbf{X}_{it} + \epsilon_{it} \tag{7}$$

where the vector $\mathbf{X}_{it} = \begin{bmatrix} FC_{it} & YGAP_{it} & CA_{it} & DEBT_{it} \end{bmatrix}'$ consists of the financial cycle index (FC), output gap as a percent of potential GDP ($YGAP$), current account as a percent of GDP (CA) and public debt as a percent of GDP ($DEBT$). $\mathbf{\Theta}(\mathbf{L})$ is a matrix polynomial in the lag operator L, μ_i is the vector of time-invariant country effects, ϵ_{it} is the error term. Alternative specifications estimated for robustness are also augmented by exogenous variables, including VIX index, US financial cycle and US output gap.

The variables enter the model in first-differences, which ensures their stationarity.[9] The annualized financial cycles expressed in year-on-year changes as used in the BPVAR analysis along with other variables are reported in Appendix A. Conventional lag order selection criteria (Schwarz Bayesian (SBIC), Akaike (AIC) and Hannan–Quinn (HQ) information criteria) suggest a specification with one lag for the variables, which is also helpful for arriving at a most parsimonious model.

Nevertheless, as the number of observations is still rather small even for the full European sample, to mitigate overparametrization issues we estimate the model via Bayesian panel VAR estimation techniques.[10] Under this approach (see Litterman, 1979 and Doan et al., 1984), model parameters are treated as random variables, characterized by an underlying probability distribution defined by hyperparameters. The prior information about the model parameters can then be used to update these probability distributions conditional on actually observed data. We use the standard Normal-Inverse-Wishart prior with hyperparameter values optimized via a grid-search procedure. The Normal-Inverse-Wishart prior has the benefit over another popular choice for similar applications, the Minnesota (Litterman) prior, as it assumes that the panel VAR coefficients and the residual covariance matrix are both unknown.[11]

The model is estimated first for the full European sample to gain a general inference on macro-financial spillovers in Europe. Then, to explore the heterogeneous effects within Europe, we estimate the model by splitting the European sample into the core and the periphery subgroups, and, in the second case study, focusing only on the euro area countries.

4.3 Implications for macroeconomic imbalances: evidence from the full European sample

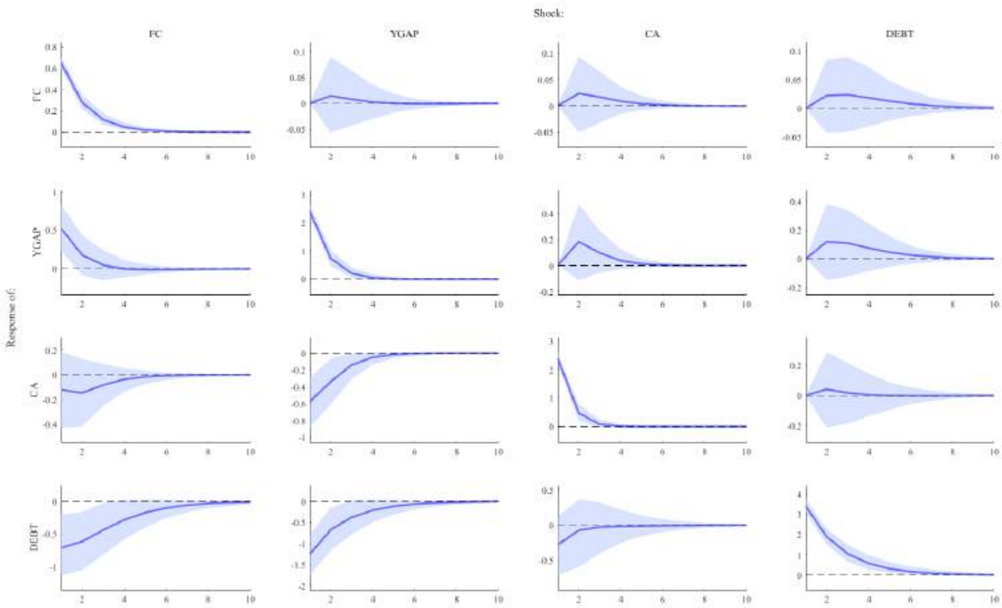
Estimations using the pooled Bayesian PVAR estimator with the full European sample comprising 17 countries confirm the conjecture of the significant role played by financial cycles in shaping macroeconomic imbalances. Most importantly, the results strongly suggest that financial cycles constitute an important driver of business cycles. Figure 4 shows the orthogonalized impulse response functions (IRFs) associated with the estimated model. The IRFs are obtained via Cholesky factorization scheme with the variables ordered as in the PVAR speci-

[9] This is confirmed by Im-Pesaran-Shin (2003) and Fisher-type panel unit root tests.
[10] The MATLAB version of the Bayesian Estimation, Analysis and Regression (BEAR) toolbox introduced in Dieppe et al. (2016) is used for estimations.
[11] Estimations with the Minnesota prior produced similar results.

fication: $\mathbf{X}_{it} = \begin{bmatrix} FC_{it} & YGAP_{it} & CA_{it} & DEBT_{it} \end{bmatrix}'$. This scheme implies that variables lower in the ordering may affect the variables of higher order only with a lag, while being affected by innovations in the variables higher in the ordering contemporaneously (i.e. $DEBT$ in this setup is the "most endogenous", while FC is the "most exogenous" variable in $\mathbf{X}_{it}$). The results however remain robust to alternative ordering schemes.

Figure 4: Impulse response functions, Europe–full sample

Note: The figure shows orthogonalized impulse response functions with the 95% confidence intervals. The impulse variables are listed in the first row, the response variables are listed in the first column.



A positive shock in the financial cycle measure FC invokes a statistically significant positive response of the output gap $YGAP$, as well as a negative response of the fiscal stance variable $DEBT$ (vice versa for negative shocks). The magnitudes of the marginal effect are also notable: a one-standard-deviation innovation in FC[12] induces a widening of the output gap by about 0.5 percent of GDP (macroeconomic "overheating") and a decline in the public debt-to-GDP ratio by 0.7 percentage points. The response of both variables to financial shocks is also fast and persistent: peaking in the first year, it phases out only four years after the initial shock in the case of the output gap and over the course of eight years for the fiscal stance variable. By contrast, the effect on the current account balance is not significant. The model results suggest that it is largely influenced by output gap innovations, consistent with expectations as positive demand shocks indeed are associated with growing imports, which translates to a worsening current account position.

[12] This corresponds to a magnitude of 0.7. As noted above, financial cycle indices are difficult to interpret in terms of magnitudes. However, standardization allows to interpret FC changes in terms of the number of standard deviations from the (country-specific) historical mean. These can then be related to the past financial distress episodes as a benchmark—see Figure 7. Generally, systemic financial market events are typically reflected in financial cycle fluctuations of at least one standard deviation in magnitude.

Complementing the empirical evidence from the IRFs, Table 5 reports forecast error variance decomposition (FEVD) showing the proportion of forecast error variance explained by innovations in model variables at selected time horizons—1, 5 and 10 years, following the initial shock—sorted first by the impulse variable and then by the response variable. The table reports the results jointly for the full sample of European countries, as well as for additional case studies discussed in the next section. Most of the forecast error variance is attributed to variables' own innovations, as expected. Nevertheless, fluctuations in both financial cycles and business cycles do have notable explanatory power, consistent with the evidence from the IRF analysis and the Granger causality tests. In particular, financial shocks contribute notably to the variance of $YGAP$ and $DEBT$, but not CA. The impact of FC on $YGAP$ already in the first year after the initial shock reaches 4.5% of its total forecast error variance, and increases only marginally over the next years reaching 4.8%. The effect of FC on $DEBT$ is also significant: financial cycle shocks explain 3.7% of its total forecast error variance in the first year, gradually increasing afterwards and reaching 6% ten years after the shock. As a related matter, changes in the business cycle yet appear to be relatively more important in comparison to FC for both the public debt-to GDP ratio and the current account balance. Output gap shocks explain 7.8% of forecast error variance in the current account and 11.1% in the public debt variable over a ten-year horizon. The feedback from $YGAP$, CA, $DEBT$ on FC is not significant, supporting evidence from the IRF analysis.

For additional insights on possibly causal impacts of financial cycles we also perform a sequence of Granger causality tests for all model variables following the Dumistrescu and Hurlin (2012) methodology. The test is based on the average of individual Wald statistics for Granger non-causality tests computed for each cross-section unit (country). It is simple to implement and does not require panel estimations for each model, retains its power for small N and T and is particularly well-suited for heterogeneous panels.

The results of the test, reported in Table 6 (Panel I), also indicate a potentially causal link from FC to $YGAP$ as evidenced by the statistically significant test statistic, thereby confirming the results from other empirical exercises discussed above. The test also points at Granger causality from FC to CA (at the 5% statistical significance level); however, neither the IRF nor the FEVD analysis support this result, as well as the positive feedback from business cycles to financial cycles indicated by the test.

4.4 Implications for macroeconomic imbalances: European core-periphery and the euro area

Further analysis examines whether the interactions among macro-financial imbalances exhibit different patterns within Europe by splitting the sample into the *"core"* and the *"periphery"* groups, where the "core" comprises relatively more advanced and systemically important in the European context economies with deeper financial markets and thus likely stronger interlinkages between the financial sector and the real economy (the sample composition is reported in Section 2). Separate Bayesian PVAR models are estimated for each sample retaining the same period of time (1998–2012) to facilitate comparability. The orthogonal IRF plots are reported in Figures 5 and 6 for the European core and the periphery groups, respectively. FEVD and

Table 5: Forecast error variance decomposition

Note: The table reports forecast error variance decomposition for panel VAR variables at the horizons of 1, 5 and 10 years. The results are listed for the four PVAR models associated with the full sample, European core and periphery samples, as well as the euro area.

Horizon	Impulse variable	Response variable	Share of variance explained, percent			
			I. Europe: full sample	II. Europe: core	III. Europe: periphery	IV. Euro area
1	FC	FC	100.0%	100.0%	100.0%	100.0%
5	FC	FC	98.4%	94.7%	97.0%	96.5%
10	FC	FC	98.3%	94.2%	96.8%	96.2%
1	FC	YGAP	4.5%	14.6%	1.3%	3.2%
5	FC	YGAP	4.8%	15.0%	2.0%	3.8%
10	FC	YGAP	4.8%	15.1%	2.0%	3.9%
1	FC	CA	0.3%	0.5%	0.8%	0.3%
5	FC	CA	1.1%	2.5%	1.4%	2.9%
10	FC	CA	1.1%	2.6%	1.4%	3.0%
1	FC	DEBT	3.7%	11.9%	0.5%	9.1%
5	FC	DEBT	5.9%	11.6%	2.6%	9.8%
10	FC	DEBT	6.0%	11.6%	2.7%	9.8%
1	YGAP	FC	0.0%	0.0%	0.0%	0.0%
5	YGAP	FC	0.3%	2.3%	0.8%	0.5%
10	YGAP	FC	0.3%	2.6%	0.8%	0.5%
1	YGAP	YGAP	95.5%	85.4%	98.7%	96.8%
5	YGAP	YGAP	93.1%	80.5%	94.9%	91.9%
10	YGAP	YGAP	93.0%	80.3%	94.7%	91.4%
1	YGAP	CA	5.6%	0.5%	9.3%	11.6%
5	YGAP	CA	7.8%	4.4%	9.7%	12.9%
10	YGAP	CA	7.8%	4.5%	9.7%	12.9%
1	YGAP	DEBT	11.1%	8.4%	11.7%	15.1%
5	YGAP	DEBT	11.1%	8.2%	11.6%	13.3%
10	YGAP	DEBT	11.1%	8.2%	11.7%	13.1%
1	CA	FC	0.0%	0.0%	0.0%	0.0%
5	CA	FC	0.3%	0.8%	0.4%	0.9%
10	CA	FC	0.3%	0.8%	0.4%	1.0%
1	CA	YGAP	0.0%	0.0%	0.0%	0.0%
5	CA	YGAP	0.7%	2.5%	0.5%	1.3%
10	CA	YGAP	0.7%	2.6%	0.5%	1.3%
1	CA	CA	93.7%	98.5%	89.0%	87.7%
5	CA	CA	90.2%	90.6%	87.1%	82.3%
10	CA	CA	90.1%	90.3%	87.0%	82.1%
1	CA	DEBT	0.6%	3.2%	0.3%	1.0%
5	CA	DEBT	0.8%	3.6%	0.9%	1.5%
10	CA	DEBT	0.8%	3.6%	0.9%	1.6%
1	DEBT	FC	0.0%	0.0%	0.0%	0.0%
5	DEBT	FC	0.4%	0.8%	0.7%	0.9%
10	DEBT	FC	0.5%	1.0%	0.8%	1.0%
1	DEBT	YGAP	0.0%	0.0%	0.0%	0.0%
5	DEBT	YGAP	0.6%	0.6%	1.3%	1.6%
10	DEBT	YGAP	0.6%	0.7%	1.5%	1.9%
1	DEBT	CA	0.0%	0.0%	0.0%	0.0%
5	DEBT	CA	0.3%	0.8%	0.5%	0.5%
10	DEBT	CA	0.3%	0.8%	0.5%	0.5%
1	DEBT	DEBT	84.1%	74.9%	86.7%	73.9%
5	DEBT	DEBT	81.4%	73.9%	83.6%	74.0%
10	DEBT	DEBT	81.3%	73.7%	83.3%	74.0%

Granger causality test results are listed in Tables 5 and 6, along with the baseline full-sample results.

Table 6: Granger causality test results

Note: The table shows the results of the Dumistrescu and Hurlin (2012) Granger causality test for heterogeneous panel data models. Null-hypothesis: variable X (first row) does not Granger-cause variable Y (first column). ***, **, * indicate statistical significance at the 1%, 5% and 10% levels.

I. Europe: full sample

Y ↓	X →	*FC*	*YGAP*	*CA*	*DEBT*
FC	$\tilde{Z}$		4.59***	1.60	0.39
	p-value		0.00	0.11	0.69
YGAP	$\tilde{Z}$	5.92***		-0.32	0.30
	p-value	0.00		0.75	0.77
CA	$\tilde{Z}$	2.37**	3.88***		-0.29
	p-value	0.02	0.00		0.77
DEBT	$\tilde{Z}$	0.95	1.30	-1.39	
	p-value	0.34	0.19	0.16	

II. Europe: periphery

Y ↓	X →	*FC*	*YGAP*	*CA*	*DEBT*
FC	$\tilde{Z}$		3.44***	1.73*	0.90
	p-value		0.00	0.08	0.37
YGAP	$\tilde{Z}$	5.40***		-1.41	0.02
	p-value	0.00		0.16	0.98
CA	$\tilde{Z}$	1.81*	-1.22		-1.14
	p-value	0.07	0.22		0.25
DEBT	$\tilde{Z}$	0.73	-0.69	-0.82	
	p-value	0.47	0.49	0.41	

III. Europe: core

Y ↓	X →	*FC*	*YGAP*	*CA*	*DEBT*
FC	$\tilde{Z}$		3.04***	0.43	-0.46
	p-value		0.00	0.67	0.64
YGAP	$\tilde{Z}$	2.78***		1.18	0.44
	p-value	0.00		0.24	0.66
CA	$\tilde{Z}$	1.53	7.51***		0.91
	p-value	0.13	0.00		0.36
DEBT	$\tilde{Z}$	0.60	2.85***	-1.19	
	p-value	0.55	0.00	0.23	

IV. Euro area

Y ↓	X →	*FC*	*YGAP*	*CA*	*DEBT*
FC	$\tilde{Z}$		3.82***	1.06	0.13
	p-value		0.00	0.31	0.89
YGAP	$\tilde{Z}$	4.81***		-0.30	0.03
	p-value	0.00		0.76	0.98
CA	$\tilde{Z}$	1.55	2.03**		-0.10
	p-value	0.12	0.04		0.92
DEBT	$\tilde{Z}$	0.71	2.11**	-1.11	
	p-value	0.48	0.04	0.27	

The analysis reveals a number of critical differences between the core and the periphery groups. In particular, the European core group exhibits a much stronger impact of financial cycles on other variables in comparison with the periphery group. In fact, for the European periphery sample the impact of FC is not significant for CA and $DEBT$, and is only marginally significant for $YGAP$, as indicated by the corresponding IRF profiles and a low proportion of forecast error variance explained (only 2% at the horizon of 10 years). By contrast, in the case of the European core the impact of FC on $YGAP$ and $DEBT$ is very strong: a one-standard-deviation positive shock in FC invokes macroeconomic overheating equivalent to 0.7% of potential GDP on impact and a reduction in public debt-to-GDP ratio by 1.1 percentage points. The response to financial shocks is also long-lasting: the impact on $YGAP$ dissipates over the course of about 5 years (longer than for other cases examined—full sample, periphery and euro area groups) and the impact on $DEBT$ takes as long as 8-9 years to fade away. Notably, consistent with the evidence from the IRFs, for the European core the share of variance explained by FC is very high for both $YGAP$ (15%) and $DEBT$ (11.6%)—again, the highest across all other samples, including the full European sample.

Figure 5: Impulse response functions, European core

Note: The figure shows orthogonalized impulse response functions along with the 95% confidence intervals. The impulse variables are listed in the first row, the response variables are listed in the first column.

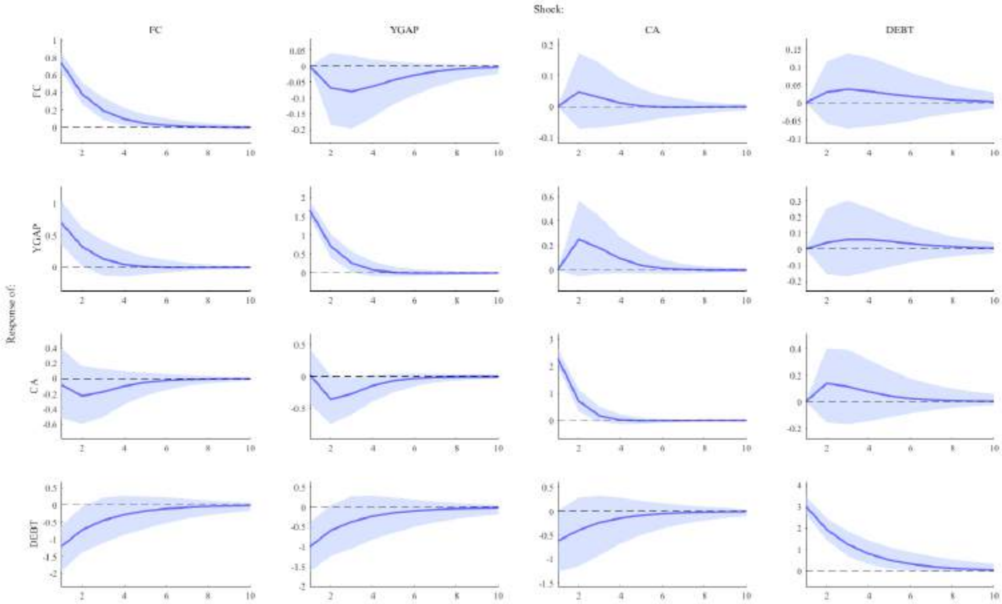
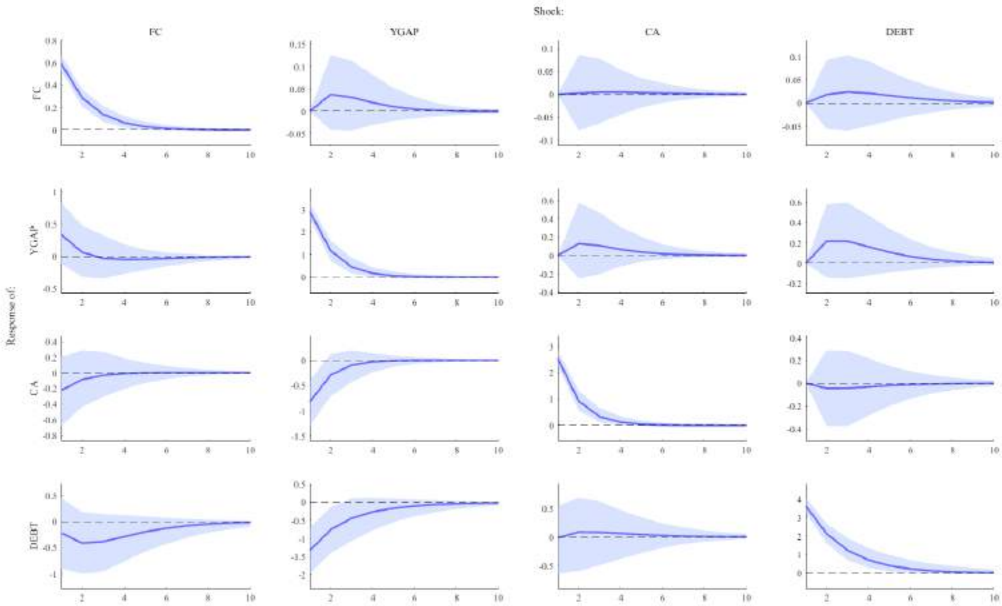


Figure 6: Impulse response functions, European periphery

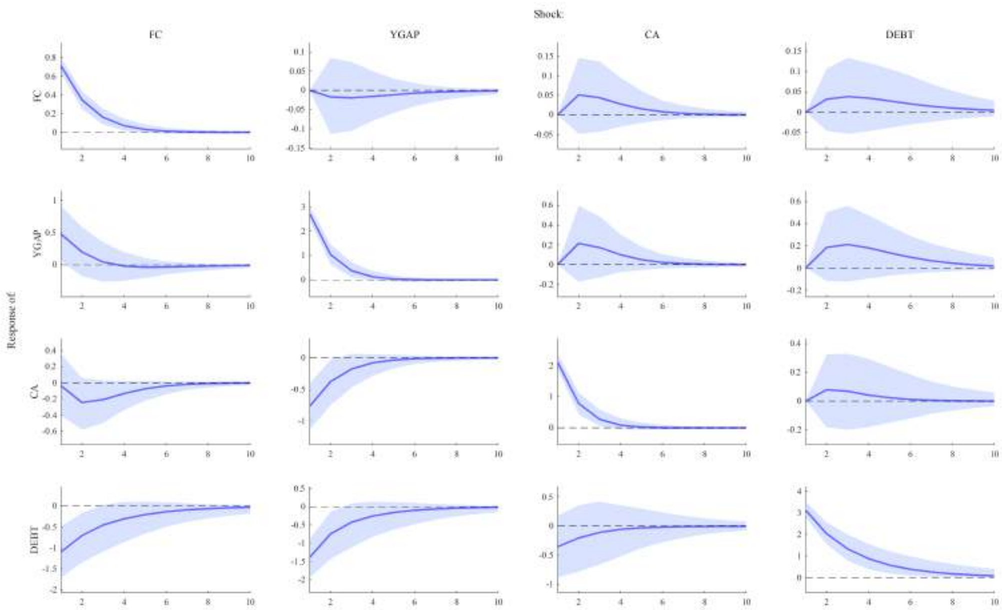
Note: The figure shows orthogonalized impulse response functions along with the 95% confidence intervals. The impulse variables are listed in the first row, the response variables are listed in the first column.



Finally, another set of empirical exercises based on Bayesian PVAR modeling is carried out for the *euro area* sample, comprising ten countries over the period 1998–2012 (see Table 1 for details). Most of the countries in the sample are the founding members of the bloc, except for Estonia (joined in 2011) and Slovakia (joined in 2009). The latter countries participated in the European Exchange Rate Mechanism II before the accession, and therefore are included in the sample for the entire period. The constraints imposed by the euro area arrangements on macroeconomic policy and the dynamics of imbalances, along with a lack of optimal currency area characteristics (see Mundell, 1961 and McKinnon, 1963) may have important implications for the transmission of shocks in comparison with the broader European sample, which we try to test in this exercise.

Figure 7: Impulse response functions, euro area

Note: The figure shows orthogonalized impulse response functions along with the 95% confidence intervals. The impulse variables are listed in the first row, the response variables are listed in the first column.



The orthogonal IRF plots for the euro area analysis are reported in Figure 7, FEVD and Granger causality test results are listed in Tables 5 and 6 (along with the baseline results). Estimates using the euro area sample, as far as the implications of financial cycles are concerned, are largely consistent with the evidence from other samples discussed above. In particular, financial cycles exhibit a robust impact on business cycles with a one-standard-deviation shock in FC leading to a positive change in $YGAP$ of about 0.5 pp in the first period with the impact phasing out at the horizon of 3 years.

At the same time, the influence of financial cycles on current account and public debt dynamics is much stronger in the euro area in terms of both economic and statistical significance in comparison with the full European sample. The share of forecast error variance explained by FC reaches 3% for CA and 10% for $DEBT$ over the horizon of ten years. In this regard, the impact of FC on other model variables in the case of the euro area looks similar to spillover patterns observed for the European core group. The main difference is in the more significant (economically and statistically) effect of $YGAP$ shocks on other model variables in the case of the euro area sample. The impact of FC is also rather persistent, especially for the public debt ratio: the peak response (a reduction of the debt-to-GDP ratio by about one percentage point) is reached in the first period and dissipates fully only after 10 years. The effect of FC on CA is also more significant in the case of the euro area in comparison with all other cases examined. Similarly to the European core sample, the peak response to a shock in FC of CA (-0.2 percent of GDP) manifests not on impact, but rather in the second year after the shock, gradually phasing out over six years. In terms of economic significance and the proportion of variance explained this effect however is not sizable, similarly to other cases examined.

5 Cross-country synchronicity, spillovers and a common European cycle

The section examines the relationship between national aggregate financial cycles within Europe, including co-movement patterns, spillovers and association with the global and European common financial cycles.

5.1 Cross-country synchronicity of financial cycles in Europe

Following the approach employed earlier to assess the degree of co-movement between financial and business cycles, we compute phase concordance indices to gauge cross-country co-movement between financial cycles. The concordance index $\Omega^{FC}_{c1,c2}$ measuring synchronization between national aggregate financial cycles of countries $c1$ and $c2$ is defined as follows ($\phi^{FC}_{c1,t}$ and $\phi^{FC}_{c1,t}$ are the binary phase indicator variables):

$$\Omega^{FC}_{c1,c2} = \frac{1}{T} \sum_{t=1}^{T} \left[\phi^{FC}_{c1,t} \phi^{FC}_{c2,t} + (1 - \phi^{FC}_{c1,t})(1 - \phi^{FC}_{c2,t}) \right] \tag{8}$$

Figure 8 reports $\Omega^{FC}_{c1,c2}$ and simple correlations (based on first-differenced FC) for each country dyad in the sample. The values are color-coded to aid inference and the number of observations per each country is reported to convey the robustness of $\Omega^{FC}_{c1,c2}$ for the given pair of countries (as discussed earlier, concordance index values based on short series may be biased upwards, particularly in light of the recent global financial crisis during which multiple countries experienced a synchronized downturn).

While there is significant heterogeneity across countries, the results point at a rather high degree of cross-country synchronicity of financial cycles for many European countries. In many cases the concordance index reaches especially high levels above 0.8–0.9 even for the country dyads that have at least 100 quarterly observations, implying a rather robust effect. Among these are SWE–BEL, ITA–CHE, ESP–GBR, FRA–DEU and GBR–SWE, for which financial cycles move in-synch 80-90% of time over the span of several decades.

Figure 8: Synchronicity of aggregate financial cycles

Note: The figure shows concordance and correlation coefficient between national aggregate financial cycle indices. The colorscale reflects the degree of co-movement from red (highly positive) to green (highly negative). In the correlation tables, the bold font indicates the level of statistical significance of at least 10%. N denotes the number of observations for the country. For POL turning points could not be robustly identified and therefore $\Omega^{FC}_{c1,c2}$ is not reported.

(a) Concordance index: smoothed FC

N		AUT	BEL	CHE	CZE	DEU	ESP	EST	FIN	FRA	GBR	HUN	ITA	LTU	LVA	NLD	NOR	RUS	SVK	SWE
180	**AUT**																			
115	**BEL**	0.66																		
133	**CHE**	0.75	0.58																	
84	**CZE**	0.77	0.47	0.98																
166	**DEU**	0.66	0.67	0.52	0.30															
116	**ESP**	0.52	0.74	0.53	0.47	0.51														
71	**EST**	0.53	0.87	0.60	0.61	0.63	0.84													
89	**FIN**	0.82	0.52	0.95	0.95	0.45	0.60	0.66												
148	**FRA**	0.59	0.72	0.49	0.38	0.81	0.60	0.77	0.51											
133	**GBR**	0.50	0.67	0.49	0.28	0.57	0.87	0.65	0.44	0.50										
92	**HUN**	0.43	0.65	0.23	0.25	0.57	0.75	0.58	0.30	0.58	0.88									
133	**ITA**	0.75	0.64	0.90	0.84	0.50	0.65	0.61	0.91	0.53	0.58	0.42								
55	**LTU**	0.28	0.84	0.16	0.19	0.72	0.88	0.74	0.26	0.86	0.93	0.84	0.42							
56	**LVA**	0.88	0.55	0.95	0.97	0.36	0.45	0.62	0.98	0.45	0.24	0.29	0.86	0.23						
90	**NLD**	0.85	0.64	0.63	0.72	0.38	0.39	0.52	0.68	0.51	0.31	0.48	0.72	0.37	0.83					
124	**NOR**	0.76	0.62	0.57	0.73	0.33	0.55	0.53	0.73	0.43	0.41	0.47	0.66	0.40	0.84	0.94				
72	**RUS**	0.30	0.86	0.19	0.21	0.70	0.91	0.77	0.28	0.84	0.95	0.86	0.44	0.98	0.26	0.40	0.42			
69	**SVK**	0.87	0.56	0.92	0.93	0.34	0.51	0.67	0.98	0.46	0.31	0.32	0.90	0.28	0.97	0.82	0.84	0.30		
135	**SWE**	0.71	0.82	0.56	0.42	0.65	0.75	0.76	0.55	0.64	0.79	0.80	0.62	0.77	0.50	0.64	0.63	0.79	0.51	
N		*180*	*115*	*133*	*84*	*166*	*116*	*71*	*89*	*148*	*133*	*92*	*133*	*55*	*56*	*90*	*124*	*72*	*69*	*135*

(b) Pearson's correlation index: unsmoothed FC in first-differences

N		AUT	BEL	CHE	CZE	DEU	ESP	EST	FIN	FRA	GBR	HUN	ITA	LTU	LVA	NLD	NOR	POL	RUS	SVK	SWE
180	**AUT**																				
115	**BEL**	**0.20**																			
133	**CHE**	**0.33**	**0.30**																		
84	**CZE**	-0.14	0.02	-0.16																	
166	**DEU**	**0.44**	**0.28**	**0.45**	0.06																
116	**ESP**	**0.18**	**0.25**	0.13	**-0.27**	0.11															
71	**EST**	-0.10	**-0.32**	**-0.22**	**0.47**	**-0.41**	-0.11														
89	**FIN**	-0.09	-0.10	**0.38**	**0.36**	**0.27**	-0.17	0.11													
148	**FRA**	**0.21**	**0.49**	**0.26**	0.00	**0.31**	0.14	-0.11	**0.39**												
133	**GBR**	**0.18**	**0.51**	**0.56**	0.00	**0.18**	**0.49**	-0.18	-0.05	0.06											
92	**HUN**	0.06	0.23	**0.35**	0.04	**0.33**	-0.12	**-0.32**	-0.06	**-0.18**	**0.18**										
133	**ITA**	**0.39**	**0.26**	**0.45**	-0.05	**0.53**	**0.38**	**-0.47**	**0.62**	**0.52**	**0.30**	-0.16									
55	**LTU**	0.07	**0.46**	**-0.28**	-0.04	0.22	**0.80**	**-0.23**	**-0.48**	**0.43**	**0.47**	**-0.24**	**0.66**								
56	**LVA**	-0.16	0.14	**0.28**	**0.26**	-0.19	**-0.52**	**0.48**	**0.50**	-0.10	0.07	**0.31**	**-0.37**	**-0.61**							
90	**NLD**	**0.33**	**0.57**	0.06	**-0.23**	**0.27**	**0.55**	**-0.35**	**-0.27**	**0.50**	**0.28**	0.02	**0.36**	**0.69**	**-0.50**						
124	**NOR**	**0.24**	**0.20**	-0.09	-0.15	**0.17**	**0.37**	-0.04	-0.15	0.03	**0.22**	0.07	0.09	**0.54**	**-0.33**	**0.71**					
72	**POL**	**0.32**	**-0.21**	**-0.32**	0.03	-0.14	**0.27**	**0.41**	**-0.69**	0.10	**-0.26**	**-0.63**	-0.09	**0.41**	**-0.40**	**0.34**	**0.39**				
72	**RUS**	-0.15	**0.51**	0.06	**-0.29**	-0.12	**0.56**	-0.05	-0.12	**0.43**	**0.47**	-0.09	0.29	**0.70**	-0.15	**0.59**	**0.53**	0.06			
69	**SVK**	0.06	0.03	-0.07	**0.83**	0.07	**-0.21**	**0.60**	0.09	0.00	-0.14	-0.17	-0.02	**0.30**	**0.24**	-0.12	-0.11	**0.35**	-0.14		
135	**SWE**	**0.28**	**0.36**	**0.52**	-0.11	**0.16**	**0.55**	-0.06	**-0.26**	-0.05	**0.80**	**0.38**	0.11	0.23	0.10	**0.26**	**0.31**	-0.01	**0.39**	**-0.24**	
N		*180*	*115*	*133*	*84*	*166*	*116*	*71*	*89*	*148*	*133*	*92*	*133*	*55*	*56*	*90*	*124*	*72*	*72*	*69*	*135*

5.2 Common European financial cycle

The observed co-movement patterns between financial cycles may result from exposure to common global or regional (European) factors and financial spillovers between countries. The rest of the section examines both hypotheses.

First, we assess the existence and significance of a common factor behind financial cycle dynamics in Europe. To this end, we extract the common European latent factor f_t^{EUR} from the estimated national aggregate financial cycles comprising the vector $\hat{\mathbf{f}}_{c,t}^{AG}$ via the following dynamic factor model in a state-space formulation:

$$\begin{cases} f_t^{EUR} = \alpha^{EUR} \times f_{t-1}^{EUR} + u_t^{EUR} \\ \hat{\mathbf{f}}_{c,t}^{AG} = \mathbf{B_c^{EUR}} \times f_t^{EUR} + \mathbf{v_{c,t}^{EUR}} \end{cases} \tag{9}$$

The estimated common supra-national factor after standardization is referred to as the European "gross" financial cycle index as it captures common variation in the financial European markets the region, which is partly attributed to the global financial cycle. Two versions are estimated for robustness: version 1 based on 7 countries for which the longest time span of financial cycle data is available (1983–2013) and version 2 based on 12 countries with a shorter time span available (1993–2013).[13] Both approaches yield very similar estimates (Figure 9, panel a) and thus it is safe to focus on version 1 as the baseline proxy for the European "gross" financial cycle.

In Figure 9 panel b, the index is plotted along with the global financial cycle and the European "net" financial cycle estimated in Adarov (2018). The latter index, in contrast to the "gross" European financial cycle, is purged of the variation attributed to the global financial cycle and thus captures only the idiosyncratic Europe-specific common latent factor.[14] As can be seen, the European gross financial cycle closely mimics the dynamics of the global financial cycle, which, in turn, is heavily influenced by the US financial market developments. Besides that, the European net (region-specific) financial cycle also tends to follow the global cycle with a lag, except for the mid-1990s period, which also underscores the significant exposure of European financial markets to global factors.

The exposure to the supra-national financial cycles however differs across countries, as can be seen in Table 7,showing the share of variance explained, as well as correlations between national and supra-national cycles. Notably, financial cycles of the UK and Sweden very closely mimic the dynamics of the global financial cycle over the entire period observed—30 years. For both countries this also manifests in especially high levels of FC variance explained by the global cycle and correlation levels. In contrast, French and Italian financial markets are largely influenced by Europe-specific regional factors captured by the European net financial cycle. Switzerland is the only country in the sample that is significantly exposed to both the global

[13] The country composition is as follows: AUT, SWE, DEU, FRA, CHE, GBR, ITA for version 1; AUT, SWE, DEU, FRA, CHE, GBR, ITA, BEL, ESP, NOR, HUN, NLD for version 2.

[14] The European net financial cycle and the global financial cycle are obtained in Adarov (2018) by estimating simultaneously the global common factor and three region-specific factors for Asia, Europe and North/South America in a single state-space system based on the global sample. The regional cycles thus pick up only idiosyncratic region-specific common shocks.

and European financial cycles, each explaining about 40% of the variation in the Swiss financial cycle.

Figure 9: European common financial cycle

Note: Panel (a) shows the European gross financial cycle estimated with the European sample of 12 countries (version 2) and 7 countries (version 1), the latter comprising countries with a much longer data span. Panel (b) shows the European net and gross financial cycles along with the global financial cycle.

(a) European gross financial cycle (b) European vs global financial cycle

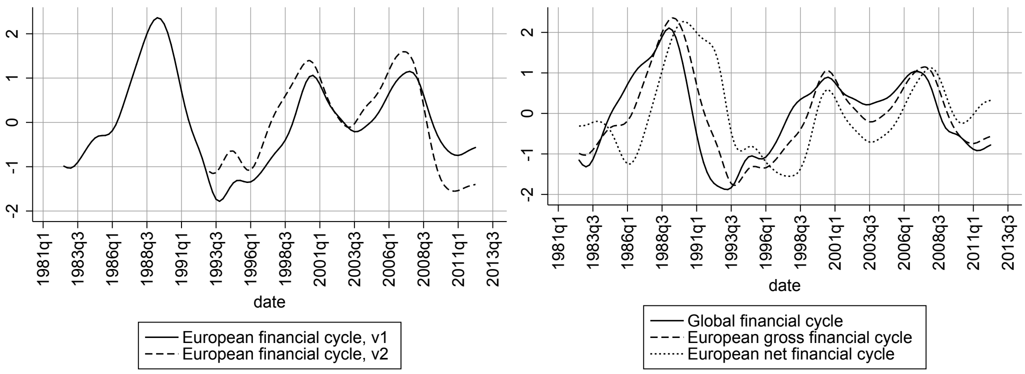


Table 7: Exposure to the global and the European financial cycles

Note: N indicates the number of observations (quarters) available for the given aggregate country financial cycle FC_I. FC^{GL} denotes the global financial cycle; FC^{EUR} denotes the European net financial cycle. The highest values are indicated in bold font.

		Share of variance explained by:		Correlation (first-differences) with:		Correlation (levels) with:	
FC_I	N	FC^{GL}	FC^{EUR}	FC^{GL}	FC^{EUR}	FC^{GL}	FC^{EUR}
FC_{AUT}	119	0.16	0.24	0.40	0.48	0.53	0.52
FC_{BEL}	104	0.21	0.13	0.45	0.36	0.44	0.34
FC_{CHE}	119	0.40	0.43	0.63	0.65	0.60	**0.78**
FC_{CZE}	69	0.04	0.00	-0.20	-0.05	-0.53	-0.14
FC_{DEU}	119	0.11	0.35	0.32	0.59	0.33	0.68
FC_{ESP}	105	0.33	0.03	0.57	0.18	**0.79**	0.15
FC_{EST}	60	0.08	0.11	-0.28	-0.34	-0.13	-0.37
FC_{FIN}	86	0.01	0.27	-0.11	0.52	-0.14	**0.79**
FC_{FRA}	119	0.00	0.54	0.02	**0.74**	-0.18	**0.76**
FC_{GBR}	119	**0.78**	0.08	**0.88**	0.28	**0.97**	0.18
FC_{HUN}	77	0.06	0.00	0.25	-0.03	0.59	0.30
FC_{ITA}	119	0.11	0.66	0.33	**0.81**	0.56	**0.82**
FC_{LTU}	45	0.35	0.06	0.59	0.24	0.63	0.23
FC_{LVA}	53	0.03	0.01	-0.18	-0.08	0.15	0.28
FC_{NLD}	86	0.20	0.10	0.45	0.31	0.54	-0.10
FC_{NOR}	113	0.17	0.02	0.41	-0.13	0.46	-0.46
FC_{POL}	68	0.00	0.01	0.02	-0.10	-0.52	-0.28
FC_{RUS}	61	0.31	0.01	0.56	0.10	**0.72**	0.24
FC_{SVK}	62	0.09	0.01	-0.30	0.07	-0.27	-0.20
FC_{SWE}	119	**0.72**	0.02	**0.85**	0.15	**0.96**	0.23

5.3 Cross-border financial spillovers: Bayesian VAR analysis

As a final empirical exercise the paper examines the extent of cross-country spillovers between the estimated European financial cycles. To this end the following Bayesian VAR model is estimated:

$$\mathbf{F}_{it} = \nu + \mathbf{\Psi}(\mathbf{L})\mathbf{F}_{it} + \mathbf{\Psi}^{\mathbf{x}}(\mathbf{L})\mathbf{X}_t + \epsilon_{it} \tag{10}$$

where the vector $\mathbf{F}_{it} = \begin{bmatrix}\Delta FC_{1it} & ... & \Delta FC_{mit}\end{bmatrix}'$ includes the estimated aggregate financial cycle indices (quarterly series, in first-differences) of countries 1...m. In the baseline analysis m=7 countries with the longest length of available data are included (1982Q4–2012Q2), namely, CHE, GBR, DEU, FRA, ITA, SWE, AUT.[15] The basis for this ordering of the countries in the BVAR setup, also used in the Cholesky decomposition, is the countries' relative financial development level (average over the sample period) as measured in Sahay et al. (2015) using various depth, access and efficiency characteristics of countries' financial institutions and markets. $\mathbf{\Psi}(\mathbf{L})$ is a matrix polynomial in the lag operator L for endogenous variables (national financial cycles). $\mathbf{\Psi}^{\mathbf{x}}(\mathbf{L})$ is a matrix polynomial in the lag operator L for exogenous variables. The vector of exogenous variables $\mathbf{X}_t$ includes the global financial cycle and the European net financial cycle. ν is the constant and ϵ_{it} is the error term.

The model is estimated with the lag order of 2, as suggested by the Schwarz Bayesian information criterion (SBIC) and Hannan–Quinn information criterion (HQ), and using the Normal-Inverse-Wishart prior with hyperparameter values optimized via a grid-search procedure (estimations using the Minnesota prior yield very similar results—reported in Appendix C, Table 15).

Controlling for the common global and European net financial cycles allows to identify the effects attributed to spillovers from country-specific shocks, in addition to the impact of shared exposures to global or regional factors. Figure 10 reports the IRFs associated with the shocks in each endogenous and exogenous variable and Figure 11 outlines the forecast error variance decomposition at the 10-quarter horizon. In line with the expectations and the evidence from other empirical exercises, the results confirm the significance (both statistical and economic) of the global and European financial cycles in driving country-specific aggregate financial cycles. The impact of the global financial cycle on the UK and Sweden is much stronger—in terms of statistical significance, magnitude and persistence—in comparison with the rest of the sample, which is consistent with the very high degree of comovement of FC_{GBR} and FC_{SWE} with the global cycle reported in the previous subsection. The response from the global financial shock phases out only after 6 quarters in the case of the UK and after 8 quarters for Sweden, while for other countries the impact dissipates within 3 quarters after the initial shock.

[15] Additional estimations are carried out with the broader sample of 12 countries, including CHE, GBR, DEU, NLD, ESP, FRA, ITA, SWE, AUT, NOR, BEL and HUN (the ordering reflects the order in the BVAR model). However, in this case the available time span is rather short: 1993Q2–2012Q2, especially is one takes into account the slow-moving nature of financial cycles. The preference thus is given to the estimates based on the longer period available, albeit in both cases the results are mutually consistent. The FEVD results associated with the broader sample are reported in Appendix C for reference and additional results are available on request.

Figure 10: Spillovers between financial cycles: BVAR with Normal-Inverse-Wishart prior, controlling for the global and the European financial cycles

Note: The figure shows orthogonalized impulse response functions with the 95% confidence intervals. The impulse variables are listed in the first row, the response variables are listed in the first column. The IRFs associated with the shocks in the exogenous variables—global (GL) and European net financial cycle (EURnet)—are separated by a vertical line.

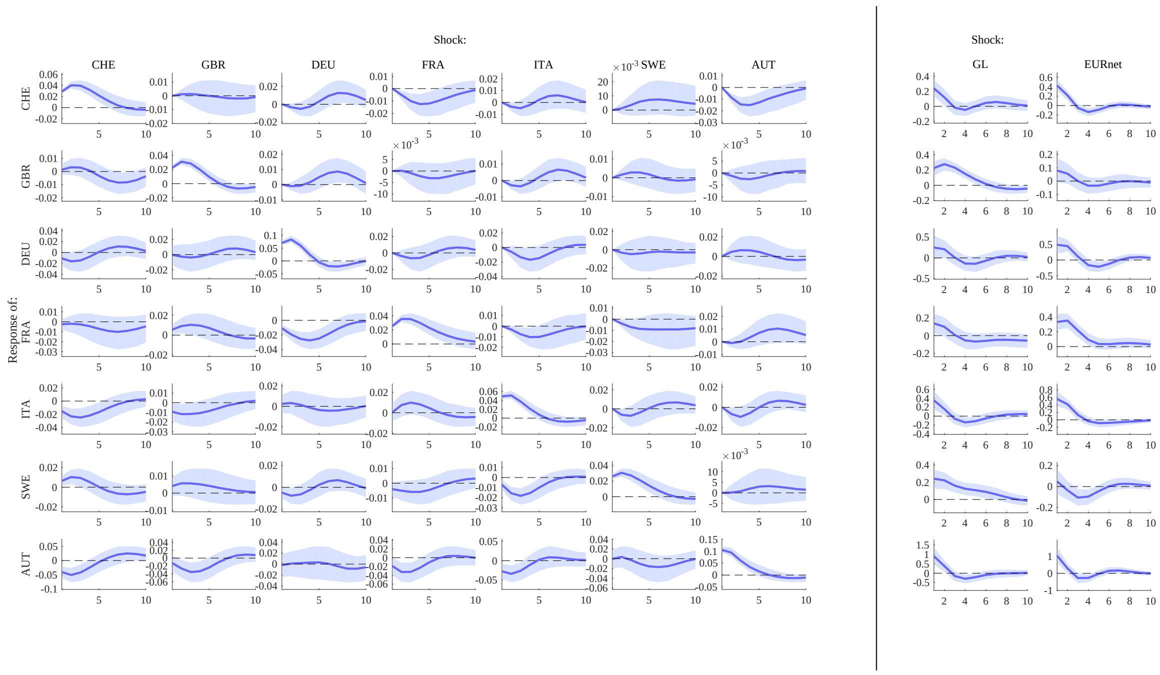
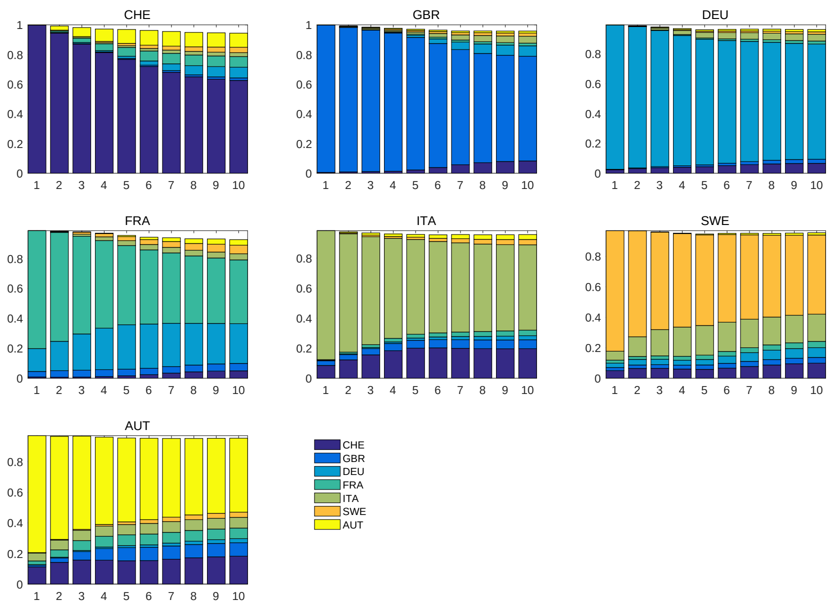


Figure 11: Spillovers between financial cycles: forecast error variance decomposition

Note: The figure shows FEVD for BVAR model with the Normal-Inverse-Wishart prior incorporating the baseline sample of 7 countries (global and European net financial cycles are included as exogenous variables).



More generally, in terms of the magnitudes, the impact of supranational financial cycles—innovations in the global and European financial cycles—is far more important from the spillover perspective across the examined European sample in comparison with the impact of orthogonal financial shocks in individual countries, also facilitating the observed cross-country synchronicity in national financial cycles.

Among the significant residual country-specific financial cycle shocks, the most notable spillovers stem from Switzerland, which appears to exert relatively more influence on the financial cycles of Austria and Italy, as evidenced by the IRFs and FEVD results (a positive shock in FC_{CHE} leads to a negative response in FC_{ITA} and FC_{AUT}). In the case of Austria a reverse feedback is also detected: a positive shock in FC_{AUT} brings about a negative response in FC_{CHE}. One can also observe a notable impact of shocks in FC_{DEU} on FC_{FRA} and shocks in FC_{ITA} on FC_{SWE}. In both cases the IRFs point at a negative statistically significant, as well as persistent effects, phasing out after 7 or more quarters. As can be seen from the IRF profiles across the sample, innovations in idiosyncratic national financial cycle shocks generally induce negative spillover effects, in contrast to the positive effects associated with the spillovers from the supranational financial cycles facilitating greater synchronization.

Besides the baseline analysis and robustness checks, we estimate a BVAR model with the vector of exogenous variables $\mathbf{X}_t$ that includes only the global financial cycle. This allows to gauge the extent to which individual countries may be contributing to the formation of common regional financial dynamics, i.e. the European financial cycle, via cross-country spillovers. The IRF profiles associated with this BVAR model (Figure 13 in Appendix C) suggest that responses to financial cycle shocks in Switzerland and Sweden are particularly profound and thus could constitute an important factor contributing to the formation of a common European cycle.

6 Conclusion

The recent global economic crisis has revealed major gaps in our understanding of the macroeconomic impacts of financial markets. The paper provides additional empirical evidence showing important implications of the inherent cyclicality exhibited by financial markets in the context of European economies. Our findings supports the conjecture that financial markets are prone to persistent cyclical dynamics associated with the accumulation of imbalances and followed by contractions often leading to macroeconomic downturns. The analysis is based on a synthetic measure of financial cycles estimated using information on relevant price, quantity and risk characteristics across key financial market segments. Using this comprehensive measure of financial cycles in Europe we demonstrate empirically their significance as a driver of business cycles and an important factor shaping public debt dynamics, as well as show the extent of financial cross-country synchronization, spillovers and the notable role of the common Europe-specific cycle and the global financial cycle play in shaping the dynamics of national financial markets.

The results thus have important policy implications. Financial markets in Europe are currently undergoing a transition towards a presumably more resilient structure. Overreliance on the banking sector, while capital markets remain relatively less developed, has been recognized as one of the vulnerabilities of the European economies, which contributed to the depth of the (double-dip) recession in Europe. The importance of fostering deeper capital markets and thereby diversify funding sources and facilitate risk sharing has therefore received much emphasis giving rise to the Capital Markets Union initiative to facilitate development of deep and mutually integrated capital markets in the EU.

At the same time, it is important to recognize that capital markets are also prone to inherent instability risks perhaps even to a greater extent than the credit markets, and may contribute to systemic risks associated with the procyclicality and formation of asset bubbles, especially if one takes into account the rapid development of innovative structured financial instruments for which risks are more difficult to understand. Therefore, the envisioned deepening of capital markets should be accompanied by a carefully designed regulatory framework to deal with the buildup of financial imbalances as one of the roots of macroeconomic overheating, as well as limiting the risks of spillovers to other financial market segments and countries.

While much progress has been made in regulating the banking sector in Europe, particularly along the lines of the Basel III reforms focusing on macroprudential measures to strengthen its resilience to shocks and improve its risk management capacity, vulnerabilities still stem from the unregulated shadow banking sector, which is growing in importance and is interconnected with the banking sector. This again highlights the critical relevance of further work along the lines of strengthening the Banking Union and the Capital Markets Union initiatives launched by European Commission and complementary regulatory reforms. In this regard, the revealed exposure of European economies to the global financial cycle and a strong common regional element in financial cycle dynamics, as picked up by the European regional financial cycle, reiterate the importance of regulatory mechanisms to monitor and mitigate the risks associated with the intensifying cross-country macro-financial linkages, financial spillovers and common exposures. This however brings up yet more challenges, as, for instance, the ongoing debates on the needed single European safe financial asset and the importance of fiscal union elements for a truly effective Capital Markets Union demonstrate.

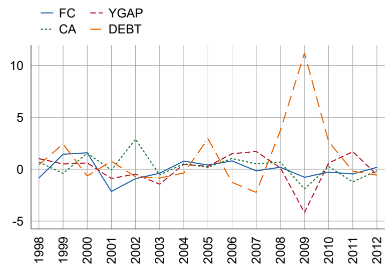
At a more general level, aside from prudential regulations, the existing macroeconomic policy paradigms may need to be enhanced in light of the risks stemming from financial markets. Inter alia, monetary policy frameworks focusing predominantly or exclusively on inflation targeting as the principal nominal anchor need to be reassessed given financial instability risks and strong interactions between financial and macroeconomic imbalances as shown in the paper. In this regard, a more proactive monitoring and policy response mechanisms to mitigate and respond to the buildup of financial imbalances needs to be implemented in macroeconomic policy frameworks in general, as the guidance provided by conventional inflation and output gap measures alone proved to be insufficient as the recent global crisis has clearly demonstrated.

Appendix A

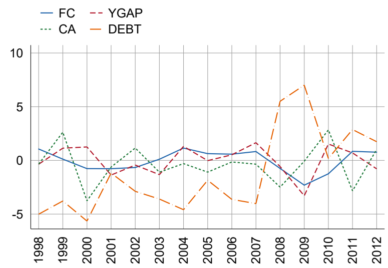
Figure 12: Dynamics of macro-financial imbalances

Note: The figure shows the dynamics of the variables used in the empirical analysis, including the financial cycle index (FC), the output gap as a percentage of potential GDP ($YGAP$), the current account as a percentage of GDP (CA), the general government debt as a percentage of GDP ($DEBT$), all expressed in first-differences. The countries are arranged alphabetically by their ISO3 codes.

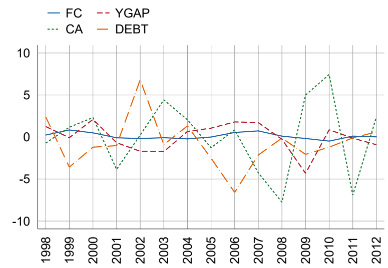
(a) AUT



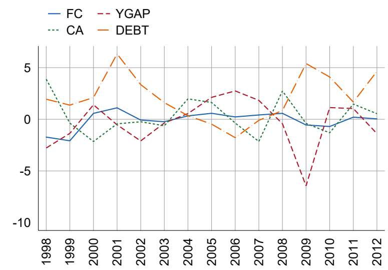
(b) BEL



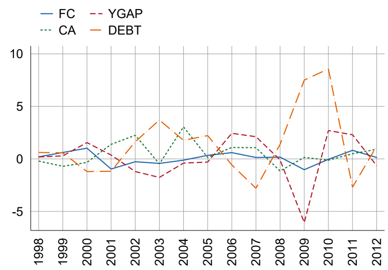
(c) CHE



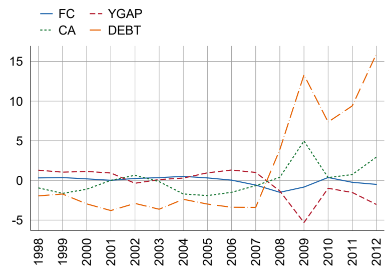
(d) CZE



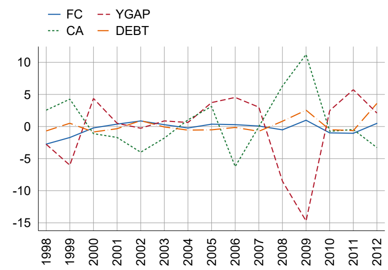
(e) DEU



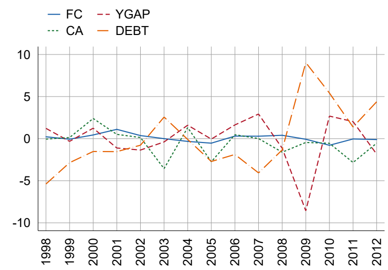
(f) ESP



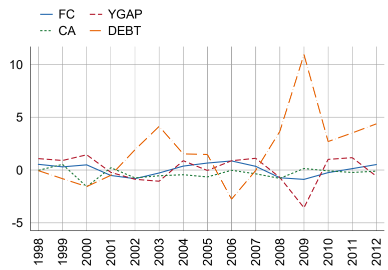
(g) EST



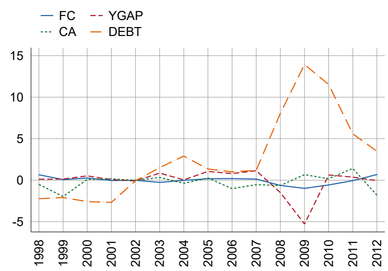
(h) FIN



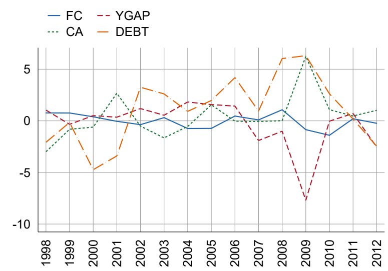
(i) FRA



(j) GBR



(k) HUN



(l) ITA

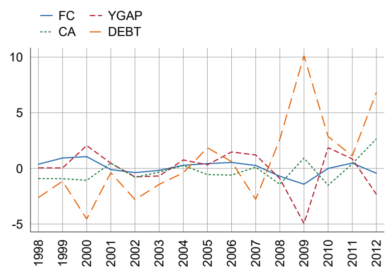
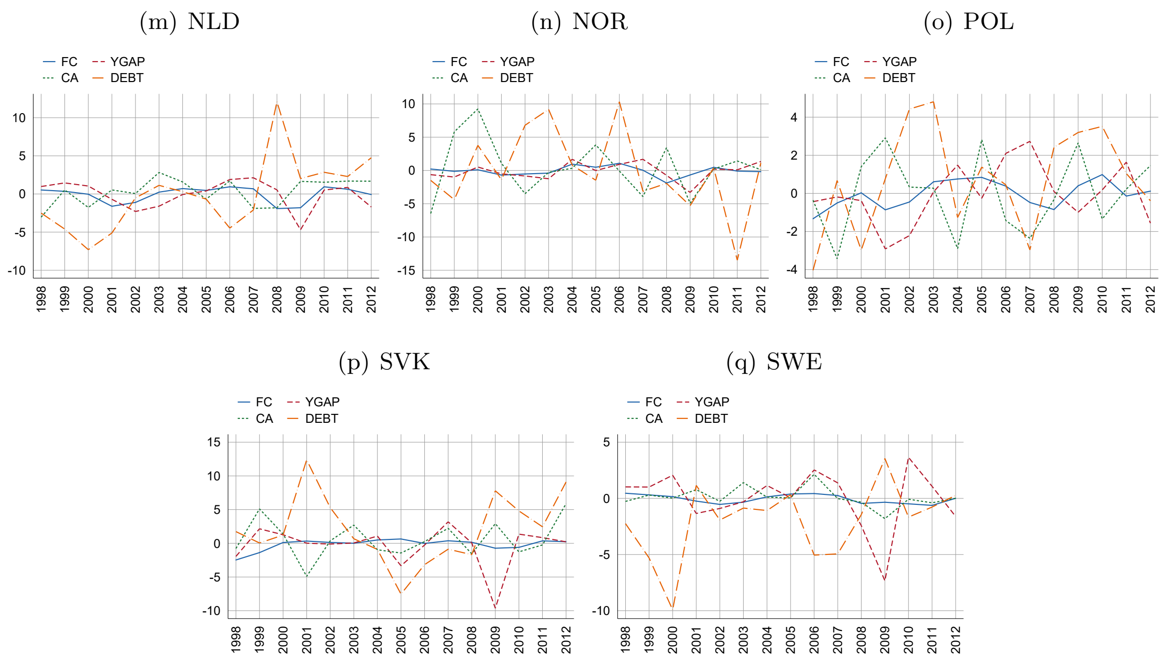


Figure 12 (cont.): Dynamics of macro-financial imbalances



Appendix B

The appendix includes tables reporting autoregressive coefficient estimates (denoted by f_{t-1}) and factor loadings on the latent common factor of input signal variables from the dynamic factor models associated with segment-specific and aggregate financial cycles, indicated by FC^{CR} (credit market cycle), FC^{H} (housing market cycle), FC^{B} (bond market cycle), FC^{EQ} (equity market cycle), FC^{AG} (aggregate financial cycle).

Column **Coef** reports parameter estimates; *, **, *** denote statistical significance at the 10, 5 and 1% levels, respectively; *n/a* indicates the listed variable was used as a proxy for the respective financial cycle (instead of a dynamic factor model, owing to data availability issues); Column **SE** reports standard errors. Column **Attr** indicates the market attribute the variable captures: Price (P), Quantity (Q), Risk (R), or (C) in the cases when estimated segment-specific cycles are used as input variables in the estimation of aggregate financial cycles. Column **Trans** reports transformations applied to input signal variables prior to their inclusion in the respective dynamic factor model: *std*—standardization (the variable is demeaned and divided by its standard deviation); Δyoy—year-on-year difference; $std\%\Delta yoy$—year-on-year percent change. The tables are organized by country ISO3 code in alphabetic order.

Table 1: AUT

AUT FC^{CR}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.92***	(0.03)		
Total credit to private non-financial sector, % of GDP	0.27***	(0.10)	$std\Delta yoy$	Q
Total credit to private non-financial sector, LCU	0.29***	(0.04)	$std\%\Delta yoy$	Q
3-Month or 90-day Rates and Yields: Interbank Rates	0.11	(0.10)	$std\Delta yoy$	P
Money market interest rate, % pa	0.10	(0.06)	$std\Delta yoy$	P
Spread between 3-month interbank interest rate and government bond rate	0.18***	(0.05)	std	R
Spread between money market and 3-month interbank interest rate	-0.03	(0.07)	std	R
AUT FC^{H}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.63***	(0.11)		
Price to rent ratio	0.71***	(0.09)	$std\Delta yoy$	P
Price to income ratio	0.72***	(0.09)	$std\Delta yoy$	P
Real house price index, sa	0.74***	(0.10)	$std\%\Delta yoy$	P
AUT FC^{B}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.83***	(0.05)		
International debt securities by all issuers, amt outstanding, mln USD	0.12***	(0.02)	$std\%\Delta yoy$	Q
Debt securities by all issuers, amt outstanding, mln USD	0.48***	(0.05)	$std\%\Delta yoy$	Q
Government Bonds Interest Rate, % pa	0.35***	(0.06)	$std\Delta yoy$	P
AUT FC^{EQ}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.89***	(0.04)		
Stock market capitalization to GDP (%)	0.28***	(0.06)	$std\Delta yoy$	Q
Stock market total value traded to GDP (%)	0.35***	(0.04)	$std\Delta yoy$	Q
Stock market turnover ratio (%)	0.31***	(0.08)	$std\Delta yoy$	Q
AUT Share prices: VSE WBI index	0.38***	(0.07)	$std\%\Delta yoy$	P
AUT FC^{AG}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.93***	(0.02)		
Total credit to private non-financial sector, % of GDP	0.29***	(0.05)	$std\Delta yoy$	Q
Total credit to private non-financial sector, LCU	0.31***	(0.02)	$std\%\Delta yoy$	Q
Government Bonds Interest Rate, % pa	0.19***	(0.05)	$std\Delta yoy$	P
AUT Share prices: VSE WBI index	0.02	(0.06)	$std\%\Delta yoy$	P

Table 2: BEL

BEL FC^{CR}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.87***	(0.03)		
Total credit to private non-financial sector, % of GDP	0.35***	(0.06)	$std\Delta yoy$	Q
Total credit to private non-financial sector, LCU	0.40***	(0.03)	$std\%\Delta yoy$	Q
3-Month or 90-day Rates and Yields: Interbank Rates	0.09	(0.11)	$std\Delta yoy$	P
Spread between 3-month interbank rates and treasury bill rate	-0.10	(0.10)	std	R
BEL FC^{H}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.95***	(0.02)		
Price to rent ratio	0.28***	(0.02)	$std\Delta yoy$	P
Price to income ratio	0.27***	(0.02)	$std\Delta yoy$	P
Real house price index, sa	0.27***	(0.02)	$std\%\Delta yoy$	P
BEL FC^{B}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.88***	(0.03)		
10Y-3M government bond spread	-0.36***	(0.04)	std	R
Long-Term Government Bond Yields: 10-year	0.33***	(0.04)	$std\Delta yoy$	P
BEL FC^{EQ}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.92***	(0.02)		
Stock market capitalization to GDP (%)	0.27*	(0.14)	$std\Delta yoy$	Q
Stock market total value traded to GDP (%)	0.38***	(0.05)	$std\Delta yoy$	Q
Stock market turnover ratio (%)	0.27***	(0.10)	$std\Delta yoy$	Q
BEL Share prices: All Shares index	0.20*	(0.12)	$std\%\Delta yoy$	P
BEL FC^{AG}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.92***	(0.02)		
FC^{CR}	0.22***	(0.08)	std	C
FC^{B}	0.19***	(0.06)	std	C
FC^{EQ}	0.26***	(0.09)	std	C
FC^{H}	0.09**	(0.05)	std	C

Table 3: CHE

CHE FC^{CR}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.91***	(0.05)		
Total credit to private non-financial sector, % of GDP	0.25**	(0.11)	$std\Delta yoy$	Q
Total credit to private non-financial sector, LCU	0.36***	(0.07)	$std\%\Delta yoy$	Q
Call Money/Interbank Rate	0.15*	(0.09)	$std\Delta yoy$	P
Money market interest rate, % pa	0.14	(0.12)	$std\Delta yoy$	P
Spread between lending and deposit interest rate	-0.26***	(0.05)	std	R
Spread between 3-month and overnight interbank rates	0.08**	(0.03)	std	R
CHE FC^{H}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.92***	(0.03)		
Price to rent ratio	0.38***	(0.02)	$std\Delta yoy$	P
Price to income ratio	0.37***	(0.02)	$std\Delta yoy$	P
Real house price index, sa	0.38***	(0.02)	$std\%\Delta yoy$	P
CHE FC^{B}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.92***	(0.04)		
10Y-3M government bond spread	-0.35***	(0.03)	std	R
Long-Term Government Bond Yields: 10-year	0.28***	(0.07)	$std\Delta yoy$	P
CHE FC^{EQ}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.86***	(0.04)		
Stock market capitalization to GDP (%)	0.39***	(0.12)	$std\Delta yoy$	Q
Stock market total value traded to GDP (%)	-0.14	(0.38)	$std\Delta yoy$	Q
Stock market turnover ratio (%)	-0.16	(0.32)	$std\Delta yoy$	Q
CHE Share prices: UBS 100 index	0.38***	(0.07)	$std\%\Delta yoy$	P
CHE FC^{EQ}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.95***	(0.02)		
FC^{CR}	0.26***	(0.03)	std	C
FC^{B}	0.18***	(0.06)	std	C
FC^{EQ}	-0.10	(0.08)	std	C
FC^{H}	0.11	(0.09)	std	C

Table 4: CZE

CZE FC^{CR}	Coef	SE	Trans	Attr
f_{t-1}	0.77***	(0.11)		
Total credit to private non-financial sector, % of GDP	0.44***	(0.07)	$std\Delta yoy$	Q
Total credit to private non-financial sector, LCU	0.45***	(0.07)	$std\%\Delta yoy$	Q
Immediate Rates: Less than 24 Hours: Call Money/Interbank Rate	0.35	(0.39)	$std\Delta yoy$	P
Money market interest rate, % pa	0.40	(0.33)	$std\Delta yoy$	P
Spread between lending interest rate and deposit interest rate	0.19***	(0.06)	std	R
Spread between lending interest rate and treasury bill rate	0.26	(0.20)	std	R
CZE FC^{H}	**Coef**	**SE**	**Trans**	**Attr**
Real housing price	n/a		$std\%\Delta yoy$	P
CZE FC^{B}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.89***	(0.05)		
10Y-3M government bond spread	-0.44***	(0.11)	std	R
International debt securities by all issuers, amt outstanding, mln USD	-0.12	(0.07)	$std\%\Delta yoy$	Q
Debt securities by all issuers, amt outstanding, mln USD	-0.13	(0.16)	$std\%\Delta yoy$	Q
Treasury Bill Rate, % pa	0.09	(0.06)	$std\Delta yoy$	P
CZE FC^{EQ}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.82***	(0.07)		
Average daily stock market index value	0.49***	(0.07)	$std\%\Delta yoy$	P
Average daily stock market return	0.21***	(0.05)	std	P
Standard deviation of daily stock market returns	-0.17***	(0.05)	std	R
CZE FC^{AG}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.91***	(0.03)		
Treasury Bill Rate, % pa	0.26***	(0.10)	$std\Delta yoy$	P
FC^{CR}	0.26***	(0.07)	std	C
FC^{EQ}	-0.13	(0.20)	std	C

Table 5: DEU

DEU FC^{CR}	Coef	SE	Trans	Attr
f_{t-1}	0.76***	(0.05)		
Spread between money market rate and treasury bond rate	0.24**	(0.12)	std	R
Spread between 3-month and overnight interbank rates	0.09	(0.13)	std	R
Total credit to private non-financial sector, % of GDP	0.16	(0.14)	$std\Delta yoy$	Q
3-month interbank interest rate	0.53***	(0.09)	$std\Delta yoy$	P
Money market interest rate, pp	0.52***	(0.09)	$std\Delta yoy$	P
Private credit by banks, LCU	0.19	(0.14)	$std\%\Delta yoy$	Q
DEU FC^{H}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.95***	(0.02)		
Price to rent ratio	0.30***	(0.02)	$std\Delta yoy$	P
Real house price index, sa	0.31***	(0.02)	$std\%\Delta yoy$	P
DEU FC^{B}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.84***	(0.03)		
Yields on debt securities outstanding issued by residents / Corporate bonds	0.47***	(0.04)	$std\Delta yoy$	P
Government Bonds Interest Rate, % pa	0.48***	(0.03)	$std\Delta yoy$	P
Spread between corporate bond rate and government bond rate	-0.04	(0.07)	std	R
DEU FC^{EQ}	**Coef**	**SE**	**Trans**	**Attr**
DEU Share prices: CDAX index / Growth rate same period previous year	n/a		std	P
DEU FC^{AG}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.88***	(0.03)		
FC^{CR}	0.32***	(0.07)	std	C
FC^{B}	0.39***	(0.04)	std	C
FC^{EQ}	-0.14**	(0.06)	std	C
FC^{H}	0.28***	(0.04)	std	C

Table 6: ESP

ESP FC^{CR}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.98***	(0.01)		
Total credit to private non-financial sector, % of GDP	0.23***	(0.02)	$std\Delta yoy$	Q
Total credit to private non-financial sector, LCU	0.20***	(0.02)	$std\%\Delta yoy$	Q
Immediate Rates: Less than 24 Hours: Call Money/Interbank Rate	0.02**	(0.01)	$std\Delta yoy$	P
Money market interest rate, % pa	0.02*	(0.01)	$std\Delta yoy$	P
Spread between money market rate and overnight rate	-0.01	(0.01)	std	R
Spread between money market interest rate and treasury bill rate	0.03	(0.02)	std	R
ESP FC^{H}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.95***	(0.02)		
Price to rent ratio	0.30***	(0.02)	$std\Delta yoy$	P
Price to income ratio	0.30***	(0.02)	$std\Delta yoy$	P
Real house price index, sa	0.30***	(0.02)	$std\%\Delta yoy$	P
ESP FC^{B}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.82***	(0.05)		
Outstanding international private debt securities to GDP (%)	-0.18	(0.15)	$std\Delta yoy$	Q
Outstanding international public debt securities to GDP (%)	-0.38***	(0.12)	$std\Delta yoy$	Q
10Y-3M government bond spread	-0.21	(0.21)	std	R
Treasury Bill Rate, % pa	0.38**	(0.16)	$std\Delta yoy$	P
ESP FC^{EQ}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.82***	(0.07)		
Average daily stock market index value	0.44***	(0.07)	$std\%\Delta yoy$	P
Average daily stock market return	0.27***	(0.07)	std	P
Standard deviation of daily stock market returns	-0.37***	(0.08)	std	R
ESP FC^{AG}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.96***	(0.01)		
Total Share Prices for All Shares	0.07*	(0.04)	$std\%\Delta yoy$	P
FC^{CR}	0.21***	(0.02)	std	C
FC^{B}	0.11***	(0.04)	std	C
FC^{H}	0.26***	(0.04)	std	C

Table 7: EST

EST FC^{CR}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.91***	(0.08)		
Private credit by deposit money banks to GDP (%)	0.30***	(0.09)	$std\Delta yoy$	Q
3-Month or 90-day Rates and Yields: Interbank Rates	0.40***	(0.10)	$std\Delta yoy$	P
Lending interest rate, % pa	0.39***	(0.09)	$std\Delta yoy$	P
Private credit by banks, LCU	0.24***	(0.09)	$std\%\Delta yoy$	Q
Spread between lending and deposit interest rate	0.03	(0.07)	std	R
EST FC^{H}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.92***	(0.07)		
Price to rent ratio	0.32***	(0.06)	$std\Delta yoy$	P
Price to income ratio	0.42***	(0.07)	$std\Delta yoy$	P
Real house price index, sa	0.41***	(0.07)	$std\%\Delta yoy$	P
EST FC^{B}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.90***	(0.03)		
Outstanding international private debt securities to GDP (%)	-0.17*	(0.10)	$std\Delta yoy$	Q
Outstanding international public debt securities to GDP (%)	-0.42**	(0.19)	$std\Delta yoy$	Q
International debt securities by all issuers, amt outstanding, mln USD	-0.16***	(0.05)	$std\%\Delta yoy$	Q
Debt securities by all issuers, amt outstanding, mln USD	-0.24***	(0.09)	$std\%\Delta yoy$	Q
Government Bonds Interest Rate, % pa	0.29***	(0.06)	$std\Delta yoy$	P
EST FC^{EQ}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.93***	(0.11)		
Stock market capitalization to GDP (%)	-0.10	(0.19)	$std\Delta yoy$	Q
Stock market total value traded to GDP (%)	0.37***	(0.06)	$std\Delta yoy$	Q
Stock market turnover ratio (%)	0.34***	(0.12)	$std\Delta yoy$	Q
Average daily stock market index value	0.08	(0.08)	$std\%\Delta yoy$	P
Average daily stock market return	-0.00	(0.10)	std	P
Standard deviation of daily stock market returns	-0.14***	(0.04)	std	R
EST FC^{AG}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.94***	(0.18)		
Average daily stock market index value	0.24	(0.40)	$std\%\Delta yoy$	P
FC^{CR}	0.34**	(0.15)	std	C

Table 8: FIN

FIN FC^{CR}	Coef	SE	Trans	Attr
f_{t-1}	0.92***	(0.03)		
Total credit to private non-financial sector, % of GDP	0.38***	(0.07)	$std\Delta yoy$	Q
Total credit to private non-financial sector, LCU	0.28***	(0.07)	$std\%\Delta yoy$	Q
3-Month or 90-day Rates and Yields: Interbank Rates	0.21**	(0.11)	$std\Delta yoy$	P
Money market interest rate, % pa	0.17**	(0.08)	$std\Delta yoy$	P
Spread between money market interest rate and treasury bond rate	0.29***	(0.05)	std	R
Spread between money market and 3-month interbank rate	0.08*	(0.04)	std	R
FIN FC^{H}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.92***	(0.04)		
Price to rent ratio	0.38***	(0.04)	$std\Delta yoy$	P
Price to income ratio	0.37***	(0.04)	$std\Delta yoy$	P
Real house price index, sa	0.38***	(0.04)	$std\%\Delta yoy$	P
FIN FC^{B}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.76***	(0.09)		
International debt securities by all issuers, amt outstanding, mln USD	0.04***	(0.01)	$std\%\Delta yoy$	Q
Debt securities by all issuers, amt outstanding, mln USD	0.51***	(0.08)	$std\%\Delta yoy$	Q
Government Bonds Interest Rate, % pa	0.34	(0.25)	$std\Delta yoy$	P
FIN FC^{EQ}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.91***	(0.04)		
Stock market capitalization to GDP (%)	0.34***	(0.04)	$std\Delta yoy$	Q
Stock market total value traded to GDP (%)	0.26***	(0.05)	$std\Delta yoy$	Q
FIN Share prices: OMXH All Share index	0.37***	(0.07)	$std\%\Delta yoy$	P
FIN FC^{AG}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.93***	(0.04)		
FC^{CR}	0.27***	(0.07)	std	C
FC^{B}	0.20***	(0.06)	std	C
FC^{EQ}	-0.25***	(0.09)	std	C
FC^{H}	-0.22***	(0.06)	std	C

Table 9: FRA

FRA FC^{CR}	Coef	SE	Trans	Attr
f_{t-1}	0.91***	(0.04)		
Total credit to private non-financial sector, % of GDP	-0.07	(0.06)	$std\Delta yoy$	Q
Total credit to private non-financial sector, LCU	0.26***	(0.05)	$std\%\Delta yoy$	Q
Immediate Rates: Less than 24 Hours: Call Money/Interbank Rate	0.15	(0.11)	$std\Delta yoy$	P
Deposit interest rate, %	0.01	(0.04)	$std\Delta yoy$	P
Spread between deposit interest rate and overnight interbank interest rate	-0.36***	(0.13)	std	R
Spread between 3-month interbank and overnight interbank interest rate	-0.15	(0.13)	std	R
Spread between overnight interbank interest rate and treasury bond rate	0.28**	(0.13)	std	R
FRA FC^{H}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.96***	(0.02)		
Price to rent ratio	0.29***	(0.02)	$std\Delta yoy$	P
Price to income ratio	0.27***	(0.02)	$std\Delta yoy$	P
Real house price index, sa	0.28***	(0.02)	$std\%\Delta yoy$	P
FRA FC^{B}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.93***	(0.03)		
10Y-3M government bond spread	-0.32***	(0.05)	std	R
International debt securities by all issuers, amt outstanding, mln USD	0.09***	(0.03)	$std\%\Delta yoy$	Q
Debt securities by all issuers, amt outstanding, mln USD	0.21***	(0.08)	$std\%\Delta yoy$	Q
Treasury Bill Rate, % pa	0.06*	(0.03)	$std\Delta yoy$	P
FRA FC^{EQ}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.82***	(0.05)		
Average daily stock market index value	0.43***	(0.04)	$std\%\Delta yoy$	P
Average daily stock market return	0.18*	(0.10)	std	P
Standard deviation of daily stock market returns	-0.37***	(0.11)	std	R
FRA FC^{AG}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.98***	(0.01)		
Total Share Prices Index	0.04	(0.03)	$std\%\Delta yoy$	P
Treasury Bill Rate, % pa	0.04	(0.05)	$std\Delta yoy$	P
FC^{CR}	0.19***	(0.05)	std	C
FC^{H}	-0.05	(0.07)	std	C

Table 10: GBR

GBR FC^{CR}	Coef	SE	Trans	Attr
f_{t-1}	0.95***	(0.02)		
Total credit to private non-financial sector, % of GDP	0.28***	(0.03)	$std\Delta yoy$	Q
Lending interest rate, % pa	-0.00	(0.02)	$std\Delta yoy$	P
Money market interest rate, % pa	-0.01	(0.03)	$std\Delta yoy$	P
Private credit by banks, LCU	0.23***	(0.08)	$std\%\Delta yoy$	Q
Spread between lending interest rate and treasury bill rate	0.03***	(0.01)	std	R
Spread between 3-month and overnight interbank rates	0.03	(0.03)	std	R
GBR FC^{H}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.90***	(0.03)		
Household Variable Mortgage Rate in the United Kingdom	0.19***	(0.06)	$std\Delta yoy$	P
Price to rent ratio	0.38***	(0.03)	$std\Delta yoy$	P
Real house price index, sa	0.39***	(0.03)	$std\%\Delta yoy$	P
GBR FC^{B}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.92***	(0.02)		
Outstanding international private debt securities to GDP (%)	0.02	(0.15)	$std\Delta yoy$	Q
Outstanding international public debt securities to GDP (%)	-0.20**	(0.08)	$std\Delta yoy$	Q
10Y-3M government bond spread	-0.32***	(0.05)	std	R
Treasury Bill Rate, % pa	0.14*	(0.08)	$std\Delta yoy$	P
GBR FC^{EQ}	**Coef**	**SE**	**Trans**	**Attr**
GBR FTSE 100 share price index	n/a		$std\%\Delta yoy$	P
GBR FC^{AG}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.96***	(0.01)		
FC^{CR}	0.22***	(0.02)	std	C
FC^{B}	0.22***	(0.02)	std	C
FC^{EQ}	0.00	(0.02)	std	C
FC^{H}	0.16***	(0.03)	std	C

Table 11: HUN

HUN FC^{CR}	Coef	SE	Trans	Attr
f_{t-1}	0.85***	(0.13)		
Total credit to private non-financial sector, % of GDP	0.38***	(0.10)	$std\Delta yoy$	Q
Total credit to private non-financial sector, LCU	0.40***	(0.12)	$std\%\Delta yoy$	Q
Immediate Rates: Less than 24 Hours: Call Money/Interbank Rate	0.33	(0.24)	$std\Delta yoy$	P
Deposit interest rate	0.36*	(0.21)	$std\Delta yoy$	P
Spread between lending interest rate and deposit interest rate	-0.15	(0.15)	std	R
Spread between lending interest rate and treasury bill rate	-0.26	(0.16)	std	R
HUN FC^{H}	**Coef**	**SE**	**Trans**	**Attr**
Real housing price	n/a		$std\%\Delta yoy$	P
HUN FC^{B}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.90***	(0.05)		
5Y-3M government bond spread	-0.29***	(0.05)	std	R
International debt securities by all issuers, amt outstanding, mln USD	0.15***	(0.05)	$std\%\Delta yoy$	Q
Debt securities by all issuers, amt outstanding, mln USD	0.34***	(0.10)	$std\%\Delta yoy$	Q
Treasury Bill Rate, % pa	0.02	(0.03)	$std\Delta yoy$	P
HUN FC^{EQ}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.78***	(0.08)		
Average daily stock market return	0.28***	(0.08)	std	P
Standard deviation of daily stock market returns	-0.18*	(0.09)	std	R
Average daily stock market index value	0.46***	(0.08)	$std\%\Delta yoy$	P
HUN FC^{AG}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.88***	(0.07)		
Treasury Bill Rate, % pa	0.15	(0.17)	$std\Delta yoy$	P
FC^{CR}	0.35	(0.22)	std	C
FC^{EQ}	-0.18	(0.23)	std	C
FC^{H}	0.30***	(0.09)	std	C

Table 12: ITA

ITA FC^{CR}	Coef	SE	Trans	Attr
f_{t-1}	0.94***	(0.03)		
Total credit to private non-financial sector, % of GDP	0.11*	(0.06)	$std\Delta yoy$	Q
Total credit to private non-financial sector, LCU	0.32***	(0.05)	$std\%\Delta yoy$	Q
Money market interest rate, % pa	0.09	(0.06)	$std\Delta yoy$	P
ITA 3-month interbank rate on deposits	0.12*	(0.07)	$std\Delta yoy$	P
Spread between lending interest rate and money market interest rate	-0.12	(0.08)	std	R
Spread between money market interest rate and treasury bond rate	0.19***	(0.04)	std	R
ITA FC^{H}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.84***	(0.07)		
Price to rent ratio	0.51***	(0.05)	$std\Delta yoy$	P
Price to income ratio	0.51***	(0.06)	$std\Delta yoy$	P
Real house price index, sa	0.52***	(0.06)	$std\%\Delta yoy$	P
ITA FC^{B}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.87***	(0.03)		
Outstanding domestic private debt securities to GDP (%)	-0.39***	(0.06)	$std\Delta yoy$	Q
Outstanding domestic public debt securities to GDP (%)	-0.38***	(0.05)	$std\Delta yoy$	Q
Outstanding international private debt securities to GDP (%)	-0.19	(0.16)	$std\Delta yoy$	Q
Outstanding international public debt securities to GDP (%)	-0.28***	(0.09)	$std\Delta yoy$	Q
10Y-3M government bond spread	-0.20***	(0.06)	std	R
International debt securities by all issuers, amt outstanding, mln USD	-0.03	(0.04)	$std\%\Delta yoy$	Q
Debt securities by all issuers, amt outstanding, mln USD	-0.18**	(0.08)	$std\%\Delta yoy$	Q
Treasury Bill Rate, % pa	0.08	(0.08)	$std\Delta yoy$	P
ITA FC^{EQ}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.93***	(0.02)		
Stock market capitalization to GDP (%)	0.30***	(0.04)	$std\Delta yoy$	Q
Stock market total value traded to GDP (%)	0.39***	(0.04)	$std\Delta yoy$	Q
Equities, Index	0.15***	(0.04)	$std\%\Delta yoy$	P
ITA FC^{AG}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.93***	(0.03)		
Treasury Bill Rate, % pa	0.15	(0.11)	$std\Delta yoy$	P
Equities, Index	-0.07	(0.11)	$std\%\Delta yoy$	P
FC^{CR}	0.29***	(0.04)	std	C
FC^{H}	0.17***	(0.06)	std	C

Table 13: NLD

NLD FC^{CR}	Coef	SE	Trans	Attr
f_{t-1}	0.98***	(0.01)		
Total credit to private non-financial sector, % of GDP	0.02	(0.03)	$std\Delta yoy$	Q
Total credit to private non-financial sector, LCU	0.08***	(0.03)	$std\%\Delta yoy$	Q
3-Month or 90-day Rates and Yields: Interbank Rates	0.03	(0.04)	$std\Delta yoy$	P
Lending interest rate, % pa	0.03	(0.03)	$std\Delta yoy$	P
Spread between lending and deposit interest rate	0.21***	(0.03)	std	R
Spread between lending and treasury bond rate	0.19***	(0.04)	std	R
NLD FC^{H}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.97***	(0.02)		
Price to rent ratio	0.21***	(0.02)	$std\Delta yoy$	P
Price to income ratio	0.27***	(0.02)	$std\Delta yoy$	P
Real house price index, sa	0.22***	(0.02)	$std\%\Delta yoy$	P
NLD FC^{B}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.85***	(0.05)		
International debt securities by all issuers, amt outstanding, mln USD	0.14***	(0.02)	$std\%\Delta yoy$	Q
Debt securities by all issuers, amt outstanding, mln USD	0.45***	(0.04)	$std\%\Delta yoy$	Q
Government Bonds Interest Rate, % pa	0.28***	(0.07)	$std\Delta yoy$	P
NLD FC^{EQ}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.90***	(0.03)		
Stock market capitalization to GDP (%)	0.40***	(0.07)	$std\Delta yoy$	Q
Stock market total value traded to GDP (%)	0.34***	(0.06)	$std\Delta yoy$	Q
Stock market turnover ratio (%)	0.25***	(0.08)	$std\Delta yoy$	Q
Average daily stock market index value	0.29***	(0.09)	$std\%\Delta yoy$	P
Average daily stock market return	0.09	(0.08)	std	P
Standard deviation of daily stock market returns	-0.18*	(0.10)	std	R
NLD FC^{AG}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.96***	(0.02)		
FC^{CR}	0.16***	(0.04)	std	C
FC^{B}	0.07*	(0.04)	std	C
FC^{EQ}	0.27***	(0.07)	std	C
FC^{H}	0.22***	(0.03)	std	C

Table 14: NOR

NOR FC^{CR}	Coef	SE	Trans	Attr
f_{t-1}	0.94***	(0.02)		
Total credit to private non-financial sector, % of GDP	0.31***	(0.04)	$std\Delta yoy$	Q
Total credit to private non-financial sector, LCU	0.30***	(0.03)	$std\%\Delta yoy$	Q
Immediate Rates: Less than 24 Hours: Call Money/Interbank Rate	0.04	(0.06)	$std\Delta yoy$	P
Spread between 3-month and overnight interbank rates	0.06	(0.06)	std	R
NOR FC^{H}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.91***	(0.03)		
Price to rent ratio	0.39***	(0.03)	$std\Delta yoy$	P
Price to income ratio	0.39***	(0.03)	$std\Delta yoy$	P
Real house price index, sa	0.42***	(0.03)	$std\%\Delta yoy$	P
NOR FC^{B}	**Coef**	**SE**	**Trans**	**Attr**
Government Bonds Interest Rate, %pa	n/a		$std\Delta yoy$	P
NOR FC^{EQ}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.87***	(0.04)		
Stock market capitalization to GDP (%)	0.31***	(0.08)	$std\Delta yoy$	Q
Stock market total value traded to GDP (%)	0.37***	(0.05)	$std\Delta yoy$	Q
Stock market turnover ratio (%)	0.23***	(0.07)	$std\Delta yoy$	Q
Average daily stock market index value	0.33***	(0.10)	$std\%\Delta yoy$	P
Average daily stock market return	0.12	(0.08)	std	P
Standard deviation of daily stock market returns	-0.19	(0.15)	std	R
NOR FC^{AG}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.93***	(0.02)		
FC^{CR}	0.24***	(0.03)	std	C
FC^{B}	0.22***	(0.07)	std	C
FC^{EQ}	0.16**	(0.08)	std	C
FC^{H}	0.29***	(0.06)	std	C

Table 15: POL

POL FC^{CR}	Coef	SE	Trans	Attr
f_{t-1}	0.91***	(0.05)		
Total credit to private non-financial sector, % of GDP	-0.09	(0.14)	$std\Delta yoy$	Q
Total credit to private non-financial sector, LCU	0.26***	(0.06)	$std\%\Delta yoy$	Q
Immediate Rates: Less than 24 Hours: Call Money/Interbank Rate	0.33*	(0.20)	$std\Delta yoy$	P
Money market interest rate, % pa	0.29	(0.21)	$std\Delta yoy$	P
Spread between money market interest rate and overnight interbank rate	-0.12**	(0.05)	std	R
POL FC^{H}	**Coef**	**SE**	**Trans**	**Attr**
Average House Price: Residential Bldgs	n/a		$std\%\Delta yoy$	P
POL FC^{B}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.72***	(0.13)		
10Y-3M government bond spread	0.05	(0.13)	std	R
International debt securities by all issuers, amt outstanding, mln USD	-0.05*	(0.03)	$std\%\Delta yoy$	Q
Debt securities by all issuers, amt outstanding, mln USD	0.62***	(0.14)	$std\%\Delta yoy$	Q
Treasury Bill Rate, % pa	0.18**	(0.08)	$std\Delta yoy$	P
POL FC^{EQ}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.78***	(0.05)		
Average daily stock market index value	0.49***	(0.05)	$std\%\Delta yoy$	P
Average daily stock market return	0.23**	(0.10)	std	P
Standard deviation of daily stock market returns	-0.07	(0.11)	std	R
POL FC^{AG}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.96***	(0.04)		
Treasury Bill Rate, % pa	-0.03	(0.05)	$std\Delta yoy$	P
FC^{CR}	0.26***	(0.05)	std	C
FC^{EQ}	0.16	(0.15)	std	C

Table 16: SVK

SVK FC^{CR}	Coef	SE	Trans	Attr
f_{t-1}	0.93***	(0.07)		
Private credit by deposit money banks to GDP (%)	0.24***	(0.05)	$std\Delta yoy$	Q
Immediate Rates: Less than 24 Hours: Call Money	0.11	(0.24)	$std\Delta yoy$	P
Private credit by banks, LCU	0.31	(0.20)	$std\%\Delta yoy$	Q
Spread between 3-month and overnight interbank rates	-0.08	(0.20)	std	R
SVK FC^{H}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.89***	(0.06)		
Residential property prices total	0.32***	(0.04)	$std\%\Delta yoy$	P
Price to rent ratio	0.41***	(0.05)	$std\Delta yoy$	P
Price to income ratio	0.41***	(0.05)	$std\Delta yoy$	P
SVK FC^{B}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.89***	(0.05)		
Outstanding international private debt securities to GDP (%)	-0.42***	(0.07)	$std\Delta yoy$	Q
Outstanding international public debt securities to GDP (%)	-0.19	(0.18)	$std\Delta yoy$	Q
Debt securities by all issuers, amt outstanding, mln USD	-0.01	(0.03)	$std\%\Delta yoy$	Q
Government Bonds Interest Rate, % pa	0.19	(0.15)	$std\Delta yoy$	P
SVK FC^{EQ}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.90***	(0.11)		
Stock market capitalization to GDP (%)	-0.14	(0.14)	$std\Delta yoy$	Q
Stock market total value traded to GDP (%)	0.36***	(0.07)	$std\Delta yoy$	Q
Stock price volatility	-0.40***	(0.07)	$std\Delta yoy$	R
SVK Share prices: SAX index	0.20	(0.15)	$std\%\Delta yoy$	P
SVK FC^{AG}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.96***	(0.07)		
FC^{CR}	0.32***	(0.04)	std	C
FC^{EQ}	0.26***	(0.09)	std	C

Table 17: SWE

SWE FC^{CR}	Coef	SE	Trans	Attr
f_{t-1}	0.92***	(0.03)		
Total credit to private non-financial sector, % of GDP	0.34***	(0.04)	$std\Delta yoy$	Q
Total credit to private non-financial sector, LCU	0.39***	(0.06)	$std\%\Delta yoy$	Q
Immediate Rates: Less than 24 Hours: Call Money/Interbank Rate	-0.08	(0.10)	$std\Delta yoy$	P
Money market interest rate, % pa	-0.06	(0.14)	$std\Delta yoy$	P
Spread between money market and 3-month interbank rate	-0.07	(0.14)	std	R
Spread between money market interest rate and treasury bill rate	-0.08	(0.16)	std	R
SWE FC^{H}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.96***	(0.02)		
Price to rent ratio	0.30***	(0.02)	$std\Delta yoy$	P
Price to income ratio	0.30***	(0.02)	$std\Delta yoy$	P
Real house price index, sa	0.33***	(0.02)	$std\%\Delta yoy$	P
SWE FC^{B}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.76***	(0.05)		
5Y-3M government bond spread	-0.50***	(0.05)	std	R
Treasury Bill Rate, % pa	0.46***	(0.07)	$std\Delta yoy$	P
SWE FC^{EQ}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.88***	(0.03)		
Stock market capitalization to GDP (%)	0.40***	(0.04)	$std\Delta yoy$	Q
Stock market total value traded to GDP (%)	0.25***	(0.06)	$std\Delta yoy$	Q
SWE Share prices: OMXS30 index	0.40***	(0.08)	$std\%\Delta yoy$	P
SWE FC^{AG}	**Coef**	**SE**	**Trans**	**Attr**
f_{t-1}	0.95***	(0.01)		
Total Share Prices for All Shares	-0.00	(0.09)	$std\%\Delta yoy$	P
Real house price index, sa	0.27***	(0.05)	$std\%\Delta yoy$	P
FC^{CR}	0.23***	(0.04)	std	C
FC^{B}	-0.03	(0.05)	std	C

Appendix C

Figure 13: Spillovers between financial cycles: BVAR with Normal-Inverse-Wishart prior, controlling for the global financial cycle

Note: The figure shows orthogonalized impulse response functions with the 95% confidence intervals. The impulse variables are listed in the first row, the response variables are listed in the first column.

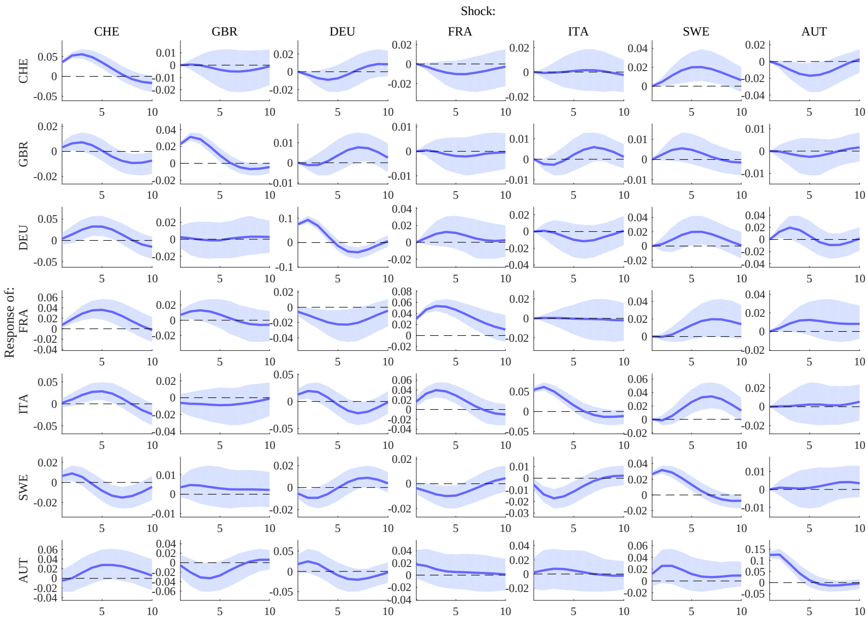


Figure 14: Spillovers between financial cycles: forecast error variance decomposition (expanded sample)

Note: The figure shows FEVD for BVAR model with the Normal-Inverse-Wishart prior incorporating a sample of 12 countries (global and European net financial cycles are included as exogenous variables).

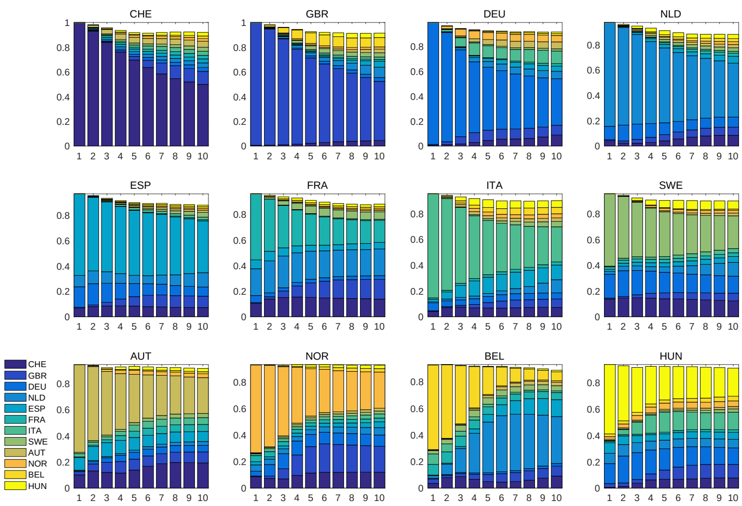
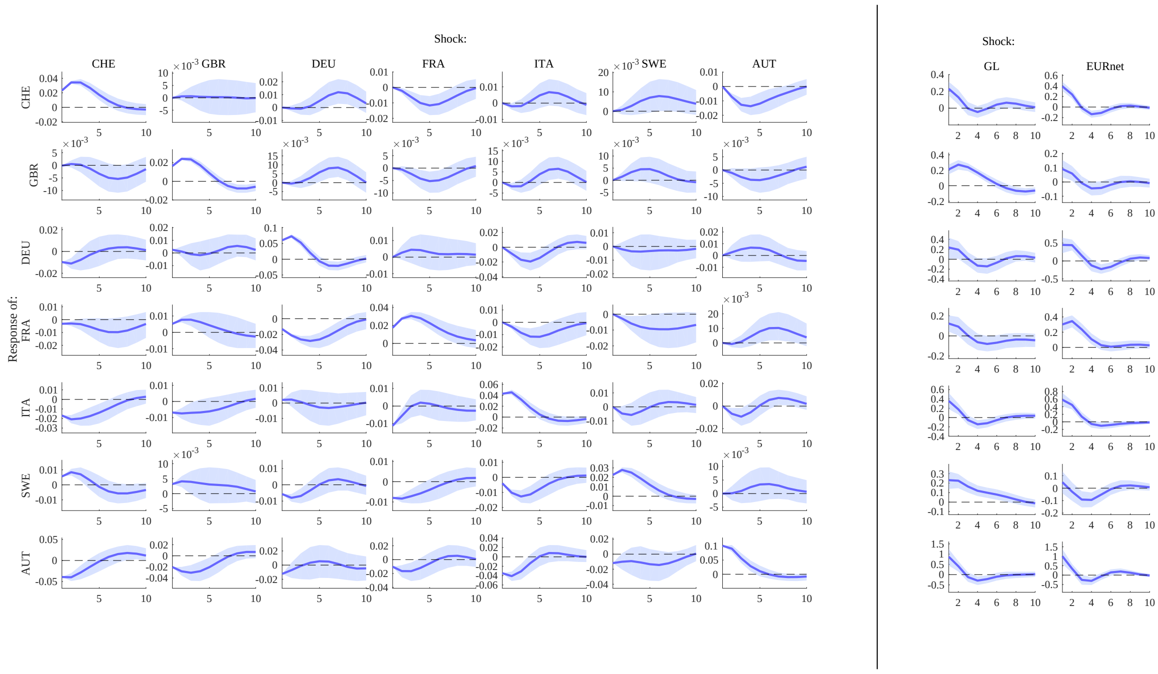


Figure 15: Spillovers between financial cycles: BVAR with the Minnesota prior

Note: The figure shows orthogonalized impulse response functions with the 95% confidence intervals. The impulse variables are listed in the first row, the response variables are listed in the first column. The IRFs associated with the shocks in the exogenous variables (global and European net financial cycles) are separated by a vertical line.



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Offenlegung nach § 25 Mediengesetz: Medieninhaber (Verleger): Verein "Wiener Institut für Internationale Wirtschaftsvergleiche", A 1060 Wien, Rahlgasse 3. Vereinszweck: Analyse der wirtschaftlichen Entwicklung der zentral- und osteuropäischen Länder sowie anderer Transformationswirtschaften sowohl mittels empirischer als auch theoretischer Studien und ihre Veröffentlichung; Erbringung von Beratungsleistungen für Regierungs- und Verwaltungsstellen, Firmen und Institutionen.

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