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SYNCHRONICITY OF REAL AND FINANCIAL CYCLES AND STRUCTURAL CHARACTERISTICS IN EU COUNTRIES

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Synchronicity of real and financial cycles and structural characteristics in EU countries

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Abstract

In this paper, we examine the relationships between real, credit and house price cycles, by using a synchronicity index, and structural characteristics and macroeconomic variables of 17 EU countries. We find that the cycles between credit variables and the real cycle with the property or equity prices cycles seem relatively well synchronised. Credit and GDP fluctuations seem to be less synchronised, mostly because credit volumes tend to lag the real cycle by several quarters. The high rates of private homeownership tend to be associated with larger cycles in GDP, credit, and house prices. Higher Loan-To-Value ratios, seen as a proxy of borrowing constraints, and a higher percentage of flexible-rate mortgages, could also indicate that a country is more sensitive to shocks and possibly increase pro-cyclicality and increase cycle volatility. Finally, the pro-cyclicality of the credit and housing market to the GDP cycle can be linked to the fluctuation in current accounts and their misalignments with respect to the theoretical equilibrium value. The synchronicity and the cycles of credit may also be considered for signaling recessions.

Keywords: cycles; synchronicity; housing market; credit; European Union.
JEL Codes: E32; E44; F36.

1 Introduction

Recently, several papers have focused on the importance of a deeper analysis of financial cycles (Borio, 2012; Borio et al., 2013), on co-movement of business cycles (Gayer, 2007; Cerqueira, 2012; Gächter et al., 2012; Mink et al., 2012; Belke et al., 2016) or of both financial and credit cycles across countries (Meller and Metiu, 2015, 2017; Samarina et al., 2015, 2017). The literature has not considered yet the synchronisation and co-movement of real and financial cycles *within* countries, especially in the European Union (EU) looking at different and more complete data on financial variables. Moreover, other studies find that housing finance characteristics vary widely across countries (Cerutti et al., 2017, among others) and this can be related to synchronicity in real and financial cycles.

In this paper, we examine the relationships between the main properties of real, credit and house price cycles within 17 EU countries and their structural characteristics.[1] The contribution of this paper is twofold. Firstly, it looks at within countries cyclical co-movements, especially linked to real and financial cycles, by using a novel index of synchronicity.[2] Moreover, it analyses the relationship between cyclical properties and this within- country synchronicity with macro-financial structural characteristics. We believe that a more accurate analysis of these aspects may be crucial for macro-prudential policy and macroeconomic assessment in EU countries, which mainly relate to country-specific actions.

The cycles have been computed by using the band-pass filter *á la* Christiano and Fitzgerald (2003), with 8-80 quarters as lower-upper bounds. The data refer to a complete shorter dataset for 17 EU countries (from 1999Q2 to max 2016Q2) and includes Greece and the new member states, if not otherwise specified.[3] Among housing markets characteristics, we especially consider homeownership rates, maximum loan-to-value (LTV) ratios[4] and the share of flexible-rate mortgages. Moreover, we look at some macroeconomic measures, i.e. the current account, and a measure of current account misalignments, as in Comunale (2016, 2017b).

We consider two properties of the computed cycles: their standard deviations and, as a novel feature, the pairwise synchronicities among them. We make use of the synchronicity index based on a within country version of Mink et al. (2012) and Samarina et al. (2015), and we then compute the "synthetic" *synchronicity* index for each pair of cycles as the share of instances in which the cycles are synchronised over the total number of observations.[5]

Ultimately, we provide a probability model to check if the synchronicity indices and the cycles can be seen as a signal for a forthcoming recession up to one year ahead. In the spirit of Schularick and Taylor (2012), this is applied for the countries with longer time series datasets with the recession indicator for each of the 10 countries from FRED-OECD.[6] We test for their predictive ability by using the area under

[1] The 17 countries are: Belgium, Germany, Denmark, Estonia, Spain, Finland, France, Greece, Croatia, Hungary, Italy, Lithuania, Luxembourg, Latvia, the Netherlands, Portugal and Slovenia.

[2] The synchronicity index takes differences in the signs of the cycles more adequately into account than does the correlation coefficient.

[3] Here countries include for the longer data series only old euro-area member states, namely: Belgium, Germany, Denmark, Spain, Finland, France, Italy, Luxembourg, the Netherlands, Portugal.

[4] The maximum LTV here is either a regulatory ratio or the maximum amount experienced in the market.

[5] Simple correlations do not reflect accurately those occasions when two cycles have the same sign. This is the main reason why a synchronicity measure is applied here instead: It captures the coincidence of positive and negative cyclical phases, regardless of their amplitudes (see Mink et al. 2012).

[6] The countries include: (long data series) Belgium, Germany, Denmark, Spain, Finland, France, Italy, Luxembourg, the

the ROC curve. Following Gourinchas and Obstfeld (2012) we also provide some extensions by using data from the mid-'90s with macroeconomic control variables.

We find that the cycles between credit variables seem relatively well synchronised. Credit and GDP cycles seem to be less synchronised, mostly because credit volumes tend to lag the real cycle by several quarters. Other cycles which experience, by contrast, a high synchronicity level are related to GDP and property or equity prices. The high rates of private homeownership tend to show larger cycles in GDP, credit, and house prices. The three cycles also turn out to be more synchronised in this case. Higher Loan-To-Value (LTV) ratios, seen as a proxy of borrowing constraints and a higher percentage of flexible-rate mortgages, could also make a country more sensitive to shocks and possibly increase pro-cyclicality. Countries with higher LTV ratios and a higher percentage of flexible-rate mortgages on average indeed experience more synchronised GDP cycle with loans to NFCs and higher volatility in loans to households. Finally, the pro-cyclicality of the credit and housing market to the GDP cycle seems to be linked to the fluctuation in current accounts and their misalignments with respect to the theoretical equilibrium value.

Lastly, the cycles and synchronicity of GDP and credit may also be considered for signalling recessions. This is especially true with respect to loans to non-financial corporations and real GDP. Moreover the cycle of long-term interest rates also has a substantial predictive ability. The synchronicity of real and credit cycles loses predictive value in the presence of macroeconomic controls and the application of a shorter time span. Under such conditions, the results for the cycles are instead robust.

In the rest of this paper, section 2 introduces the main strands of the literature to which our paper contributes; sections 3 reports the data sources and describes the series used; and section 4 gives an overview of the synchronicity indices within countries and the volatility of the cycles. Section 5 analyses the link between the structural characteristics of national housing markets and macroeconomic variables, on the one hand, and the synchronicity and volatility of the cycles, on the other. Section 6 describes and assesses the synchronicity index and the cycles as a signal for recessions. Section 7 concludes.

2 Literature review

Our paper contributes to two strands of literature: the first of these examines cycles of synchronicity and the second explores structural characteristics and financial cycles.

Several papers have investigated the co-movement of cycles. However, this research addresses solely the *cross* country dimension and, for euro-area countries, mainly targets monetary policy effectiveness. The results show that since the '90s, the synchronisation within and between country groups dramatically increased, reaching the highest values in 2007 after a decrease in 2003 (Gayer, 2007; Cerqueira, 2012).[7] Some studies then find a pronounced desynchronisation of business cycles during the crisis period (Gächter et al., 2012). Finally, Belke et al. (2016) find that countries belonging to the euro-area core were faced with increased synchronisation among themselves after the crisis, whereas in peripheral countries, synchronisation with regards to the core and among themselves decreased. De Haan et al. (2007)

Netherlands, Portugal.

[7] Gayer (2007) used correlation measures.

and Mink et al. (2012) proposed new measures of cycle co-movement across countries, applying them to the GDP gaps for the euro area and the US. These measures are synchronicity and similarity, which take into account both the sign and the magnitude of a cycle with respect to a reference cycle. They show that during the years under monetary union, output gaps in the euro area were more synchronous and more similar than were output gaps in the US.[8] Bekiros et al. (2015) apply instead a cross-wavelet coherence measure to detect and identify synchronisation and convergence amongst euro- area and non-euro area business cycles, confirming that while the cross country synchronisation is higher in the euro area, it actually intensified during the crisis period. Finally, Asteriou and Moudatsou (2015) look at 21 EU members until 2011, linking cross country synchronisation with trade characteristics. International trade helps to synchronise business cycles but only before the recent financial crisis and only for old EU countries. Cesa-Bianchi et al. (2016) follow another approach, using a measure of synchronicity based on the absolute differential of GDP growth rates across countries rather than making use of gaps or cycles. They make this measure interact with financial linkages and flows. This measure of synchronicity would take into account both sign and amplitude and it does embed both international propagation of idiosyncratic shocks and the international equilibrium response to common shock. The authors conclude that financial linkages, conditional to common shocks, tend to result in less synchronised business cycles in 18 OECD countries; conditional to idiosyncratic shocks, however, financial flows result in more synchronised cycles.

Samarina et al. (2015, 2017), for their part, considered *real and financial* cycles synchronicity and similarity *across* countries. EMU membership is associated with convergence of credit to firms but also a decrease in coherence of total credit and mortgage credit cycles.[9]

Lastly, Ahmed et al. (2017) used a probit framework for 11 euro-area members for the period 1960-2010 to analyse the cross country synchronisation in real and financial cycles, finding strong synchronisation between cycles across members. After the introduction of the euro, financial synchronisation increased more than business cycle synchronisation. Moreover, as pointed out by Meller and Metiu (2015) deeper financial integration and a higher degree of business cycle co-movement are associated with stronger credit cycle synchronisation.

These papers indeed tackle exclusively the *cross* country dimension. To the best of our knowledge, no current contribution looks at *within* countries cyclical co-movements linked to real and financial cycles. Recently, Benczur and Rátfai (2010) documented *within*-country empirical regularities but limited their inquiry to the main macroeconomic fluctuations in new member states.[10] They find that private credit is procyclical and largely lag the business cycle.[11]

The second main contribution of this paper concerns the relationship between cyclical properties and the *within* synchronisation with macroeconomic and financial characteristics of each country. There are few empirical cross-country studies covering the relationship between financial and macroeconomic

[8] Intra-US business cycle synchronicity is covered in Leiva-Leon (2017) by applying a Markov-switching framework to endogenously identify periods of synchronicity and independence. They show that the more similar the economic structures of states, the higher the correlation between their business cycles.

[9] Credit cycle coherence is measured by synchronicity of cycle movements and similarity of their amplitudes.

[10] Some stylized facts about business cycles and macroeconomic fluctuations for the euro area, also compared to the US, can be found in Agresti and Mojon (2003).

[11] They include in their analysis cycles of output, consumption, government spending, gross fixed capital formation, net exports, inflation, interest and exchange rates, credit and labor market variables.

variables.[12] Among them, Mian and Sufi (2011), Mian et. al. (2015) and Cerutti et al. (2017) provide the most extensive contribution. Mian and Sufi (2011) finds that in the short-run, a rise in the household debt to GDP ratio is associated with an increase in consumption and imports. In the medium-run, more household debt predicts lower subsequent imports, better current account balances and lower GDP growth, especially if the country was a net foreign borrower at the beginning of the considered period (Mian et al., 2015). To a certain extent, then, the global household debt cycle can help predict the severity of the global GDP growth slowdown. Heterogeneity in the links between real and financial factors is stressed in Cerutti et al. (2017). The authors find that housing finance characteristics vary widely across countries, and that some of them, namely those that favor mortgage market deepening, may influence cycles, especially credit growth. In addition, the authors underscore that GDP growth may lead to house-price booms and that there is a relationship between current account balances and real-estate booms.

Our paper also extends this latter narrative, showing the volatility of cycles and the synchronicity indices between real and financial cycles and linking both these measures to macroeconomic and financial characteristics, with a focus on EU member states.

3 Data description and sources

3.1 Data on cycles and structural variables

3.1.1 The real and financial cycles

The cycles are based on data from real GDP (YER), real total credit to private non-financial sector (TCN), real credit to non-financial corporations (LNF), real credit to households (LHH), property prices (RPP), equity price indices (EQP), nominal long-term rates (LTN).[13] The real GDP, equity price indices and the nominal long-term rates are from ECB Statistical Data Warehouse (SDW) while the other data are from BIS. The data refer to a complete shorter dataset for 17 EU countries (quarterly frequency from 1999Q2 to max 2016Q2) that includes Greece and the new member states, or when specified, to a longer dataset for almost all the EU countries before the enlargement in 2004 (from the '70s for Germany and Italy, for instance).[14][15] The cycles have been computed by using the band-pass filter *á la* Christiano and Fitzgerald (2003) with 8-80 quarters as lower-upper bounds.[16] We follow the previous studies by

[12] Macro-financial interactions stemming from a link between the ease with which borrowers obtain funds in imperfect credit and housing markets also have been exploited in the DSGE literature (Bernanke et al. 1999; Iacoviello, 2015 and ECB, 2017 among others). In a DSGE framework, Iacoviello (2015) also finds that losses sustained by banks can produce sizeable, pronounced and long-lasting effects on business activity.

[13] The credit, house and equity price series are deflated by the GDP deflator. The whole series, apart from long-term rates and the spread, are taken in logarithm.

[14] The countries include: (long data series) Belgium, Germany, Denmark, Spain, Finland, France, Italy, Luxembourg, the Netherlands, Portugal and (short data series) Estonia, Greece, Croatia, Hungary, Latvia, Lithuania and Slovenia. Data availability differs substantially across countries. For nine countries, the data start prior to 1982; for Portugal and Hungary, they start in 1988 and 1990, respectively. However, there are also six countries with data starting only after 1995, leaving less than 20 years of data for analysis.

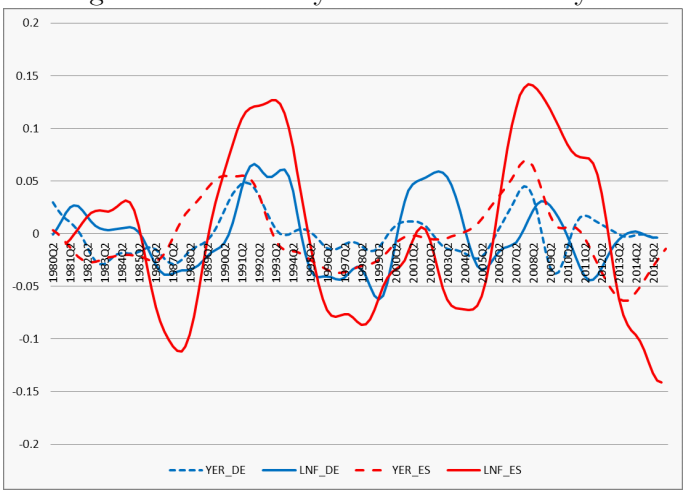
[15] The data are from ECB (2017).

[16] Christiano and Fitzgerald (2003) also find that their band-pass filter is an improvement over the HP filter when applied to quarterly data, particularly toward the end of the sample.

Drehmann et al. (2012) and Aikman et al. (2015) and use a so-called band-pass filter to extract the cycles.

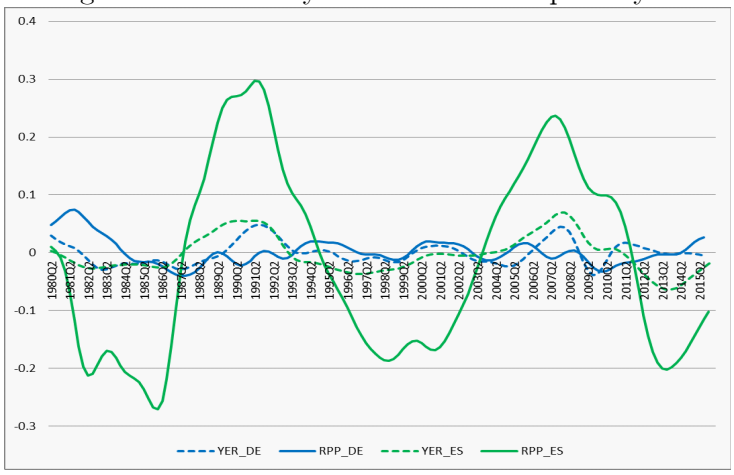
As an example, we show some cycles for real GDP, credit to NFCs and house prices here below in Figure A (GDP and credit) and B (GDP and house prices). We pick one country for the core EA (Germany, which, as we will see, is a sort of an outlier) and one for the so-called periphery (Spain, with particularly long financial cycles) in order to stress the differences. The complete dataset belong to ECB (2017). We can see some discrepancies in the sign of the cycles *across* countries and across types of cycle *within* a country.

Figure A: the real cycle and the credit cycle



Note: YER is the real cycle and LNF is the credit cycle in case of loans to NFCs. The real cycle is in dashed lines. DE is Germany and ES is Spain.

Figure B: the real cycle and the house price cycle



Note: YER is the real cycle and RPP is the house price cycle. The real cycle is in dashed lines. DE is Germany and ES is Spain.

3.1.2 The financial and macroeconomic variables

The homeownership rates (in percentage of the entire population) are taken from Eurostat (EU-SILC survey). We take the average over the entire sample period (2003-2015). The LTV ratios are the

regulatory limit on LTV for mortgage loans only when applicable (namely for Cyprus, Estonia, Lithuania, Latvia).[17] For the other countries, the maximum LTV is simply the average LTV ratio observed in the market either in the 2000s (for Belgium, Germany, Denmark, France, Italy and Portugal)[18] or over 2011-2016 from ECB and IMF or the one available for the last period from national sources (Hungary and Slovenia). The data are also shown in Table 5 with other characteristics of housing and credit markets in the EU. The country-specific upper limit of LTV ratio can serve as a proxy for borrowing constraints. The percentage of flexible-rate mortgages is taken from ECB SDW and regards loans to households for house purchase with different IRF periods (new business). These data cover a period 2001-2017 (max), and we consider an average value over the entire available period.[19] The gross value added of the financial sector, real estate and construction sector over GDP is taken from Eurostat and is averaged over the entire available time span (1995-2015). The Chinn-Ito Index – measuring a country's degree of capital account openness and hence financial integration – is from an updated version of Chinn and Ito (2006) and taken as an average over the period 1994-2014.[20] The current account balances over GDP are from the IMF WEO database and their misalignments are taken from Comunale (2016; 2017b) and averaged over the period 1994-2014. The current account misalignments in Comunale (2016) follow the Macroeconomic Balance (MB) approach of the IMF CGER (Lee et al., 2008) and they are calculated as the differences between the underlying current accounts based on IMF and UNDESA projections (six years ahead) and the current account "norm" based on the estimation of their determinants.

3.2 The synchronicity index

The simple correlations do not reflect accurately those occasions when two cycles have the same sign. Therefore, as a novel feature, the pairwise synchronicities among cycles is considered. This indeed captures whether positive and negative cyclical phases coincide, regardless of their amplitudes (see Mink et al. 2012).[21] The *synchronicity* across cycle-pairs at time t for each country k is $S_{k,i,j,t}$ has been calculated as the follows:

$$S_{k,i,j,t} = (c_{k,i,t} - c_{k,j,t}) / |c_{k,i,t} - c_{k,j,t}| \tag{1}$$

where c_i and c_j are two cycles for the same country (see Mink et al. 2012 and Samarina et al. 2015). This measure results in a value of either 1 or -1, where 1 means that the cycles are perfectly synchronised at time t and therefore have the same sign (either both positive or both negative). A value of -1 indicates instead that the cycles have opposite signs.

The values have been further aggregated and we then compute the "synthetic" *synchronicity* index $SSI_{k,i,j}$ for each pair of cycles (i, j) for each country k:

[17] See ECB (2016).

[18] Source: Huber (2016).

[19] We are very thankful to Lorenzo Isgró for his help with the data.

[20] Downloadable online at: http://web.pdx.edu/~ito/Chinn-Ito_website.htm. We used the index normalized to a range between zero and one (ka_open). The value for Luxembourg is not available.

[21] The direction of cycles, i.e. difference between being in a recovery or contraction phase, is not accounted for in either synchronicity or similarity.

$$SSI_{k,i,j} = \left(\frac{1}{T}\right) \sum_{t=1}^{T} (S_{k,i,j,t} \mid S_{k,i,j,t} = 1) \tag{2}$$

The SSI is basically the share of instances in which the cycles are synchronised (value equal 1) over the total number of observations.

4 Overview of the synchronicity and volatility of the cycles

4.1 The synchronicities in EU

A first glance at the synchronicity indices (Table 1) indicate that the cycles between credit variables seem relatively well synchronised. We should note, however, that the analysis focuses on a sample period mainly covering the recent crisis during which credit was generally affected in Europe. Moreover, the total credit series incorporate credit series to households and to NFCs, which creates synchronicity by construction between total credit to NFCs, on the one hand, and sector-specific credit, on the other.

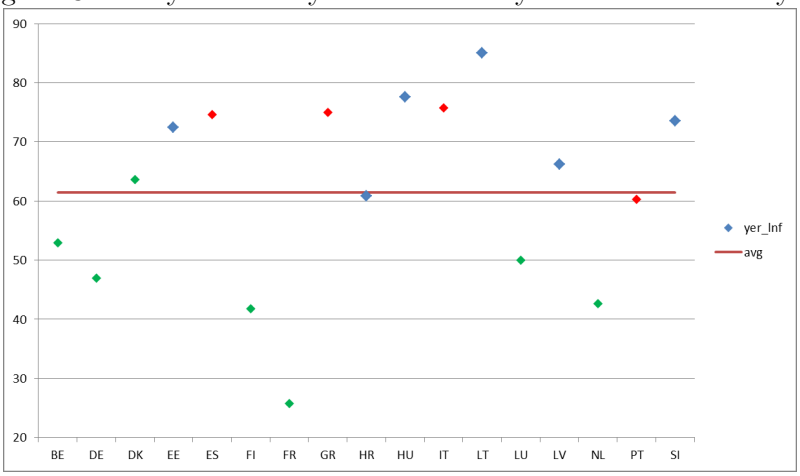
The synchronicity index for credit cycles for old EU member states have indeed substantially increased in the recent years, as reported on average in Table 1.

[Insert Table 1 around here]

On average, however, credit and GDP cycles seem to be less synchronised compared to other cycle's pairs, mostly because credit volumes tend to lag the real cycle by several quarters.[22] Indeed house prices and credit volumes tend to lag GDP by about half a year on average (see also EC, 2014). This very likely reflects a certain price inertia and the fact that credit volumes are a stock variable related to the economy's capital stock and not flows (EC, 2014; Biggs et al., 2009).

There are also differences between the so-called "core" EU, the "periphery" EU, and new member states. Generally we can see a higher average synchronicity between GDP and credit for periphery and new members, as shown in Figure C for loans to NFCs, with respect to the overall mean.

Figure C: the synchronicity between real cycle and the credit cycle



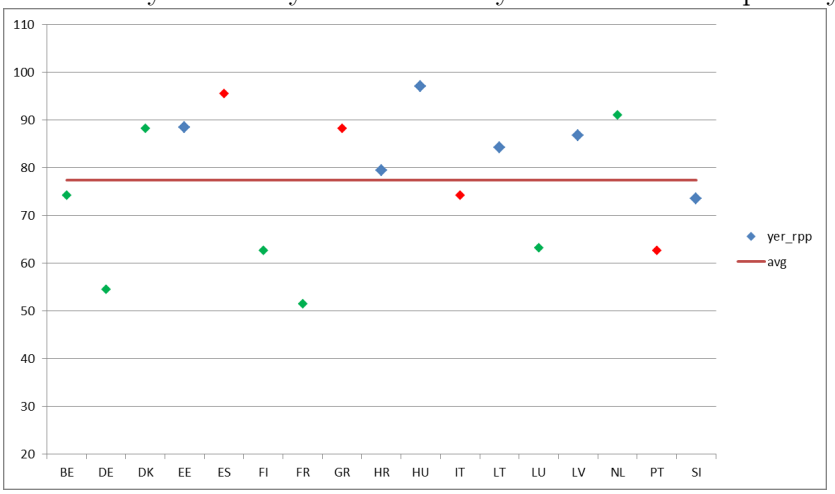
[22] This is in line with the findings of Benczur and Rátfai (2010) for new member states.

Note: yer_lnf is the synchronicity of real cycle and credit cycle in case of loans to NFCs. The avg is the mean across the entire panel. Green denotes the core countries, red the periphery and blue the new EU member states.

As regards equity price and credit cycles, we do not find many synchronicity episodes. These episodes account for slightly more than 50 per cent of the total only for new member states. This may be due to the effects on firms of credit rationing (Stiglitz and Weiss, 1981; Dong et al., 2016) and the relative impact on equity prices and/or behavioural aspects of equity prices not related to credit to NFCs. Synchronicity seems to be relatively low between equity prices and long-term interest rates. This partly reflects the importance of the zero-lower bound in our sample (data since 1999). Indeed, the relationship between interest rates and equity prices has been found to be substantially attenuated from the beginning of the zero-lower bound period (Kiley, 2014).

Other cycles that experience, by contrast, a high synchronicity level, are related to GDP and the property or equity prices. This high level of synchronisation is in line with the findings by Claessens et al. (2011). This is especially true for new member states (see Figure D).

Figure D: the synchronicity between real cycle and the house price cycle



Note: yer_rpp is the synchronicity of real cycle and house price cycle. The avg is the mean across the entire panel. Green denotes the core countries, red the periphery and blue the new EU member states.

House prices cycles also tend to co-move with credit cycles, in particular cycles of household loans. Some countries, like Italy, Spain and the Netherlands, display the higher percentages. House price cycles and credit cycles in Germany seem to be less synchronised than in the rest of the sample, a result that we find for almost all pairs of cycles. Credit cycles and house price cycles tend to be more synchronised in a few countries with high private homeownership rates, as in the case of Spain, as shown by the (slight) positive correlation between synchronisation indices and homeownership rates. The latter are much higher in some former transition economies, like Croatia, Latvia or Lithuania. In these cases, the high homeownership rates are mainly due to the acquisition of houses after a country's achieving independence and during the transition to a market economy.

4.2 The volatility of the cycles

For countries with short data sets, the properties of cyclical estimates, such as volatility (Table 2), depend to some extent on the choice of priors (see ECB, 2017). However, the posterior results are very similar to the long data sets. One major difference between the short and long data sets is the higher volatility of cycles, and specifically of credit cycles, in the latter. This reflects the particularly volatile recent boom/bust cycles in a few of those countries,like the Baltic states. Germany and Portugal experience lower volatilities, especially for GDP and house price cycles. Spain and the Netherlands have much higher volatility in house prices than in the real cycle or other credit cycles. Indeed, the financial cycles in the Baltic states are much more volatile than the rest of the sample. Equity prices and long-term rates show the highest standard deviations overall.

[Insert Table 2 around here]

5 Synchronicity and structural characteristics

5.1 The results

The correlations and the coefficients from the regressions of the structural characteristics with synchronicity indices are reported in Table 3, while the correlations with standard deviations are shown in Table 4. We show only the main cases in which the coefficients are significant. The coefficients are from regressions of synchronicity or standard deviations on each indicator and a constant; the significance levels are calculated from bootstrapped errors, given the small size of our sample.[23]

[Insert Table 3-4 around here]

We begin with equity price cycles and GDP cycles. These do not tend to be more synchronised in countries where the **value added of the private financial sector** represents a large part of the GDP, i.e. in countries like Luxembourg, the Netherlands or Portugal. By contrast, Claessens et al. (2011) argue that, for OECD countries, both real and financial integration appear to drive the increased co-movement of equity prices with GDP. The synchronisation index between equity prices and GDP cycles tend to become more correlated following capital account liberalisation. This progressive liberalisation since the '90s can explain the higher synchronisation in the new member states, especially in the Baltics, which indeed have seen an improvement in this regard due to the accession requirements. However, there have been some reverse actions following the financial crisis. Hence, looking at the correlation between **the Chinn-Ito Index** and the synchronicity index between the real cycle and the equity price cycle in the case of new member states, this correlation is positive, almost equal to that for the Baltic states. However, this correlation seems weaker for the old EU members, for which we can see a decrease in synchronicity if we consider the complete dataset from the '70s-'80s, including the financial crisis.[24]

For house price cycles, the high correlation with GDP cycles may depend on some changes in key institutional features of the mortgage markets, as reported in IMF (2008). The cross-country

[23] The complete set of results are available upon request.
[24] The results are available upon request.

differences for advanced economies may be summarized by a synthetic indicator provided in IMF (2008): the "Mortgage Market Index". A higher value means easier access to mortgage credit for households. Among the considered countries, Denmark and the Netherlands have easier access to credit and are among the countries with higher synchronisation between house prices and GDP. The opposite is the case for France and Italy, with low synchronisation and Mortgage Market Index value. This index does not seem to be related to the share of value added from the construction or real estate sectors in the total GDP or to their standard deviations.

Our analysis confirms the stylised fact that countries with **high rates of private homeownership tend to show larger cycles in GDP, credit, and house prices**. The three cycles also turn out to be more synchronised in this case. One possible explanation for these findings rests on the assumption that a high rate of private homeownership implies a higher share hold by middle-class households and thereby a higher importance of mortgage-based housing finance. This should elevate the relevance of collateral constraints. However, if we look at the relationship between homeowners with mortgages over the population and the synchronicity indices, the result is not straightforward. The link between homeownership rates and, especially, the pro-cyclicality of credit and output seems to be driven by the percentage of population that owns a house, regardless of the presence of a mortgage. One possibility is that flat ownership imparts to middle-class householders a sense of security that might induce them to ask for credit, not for buying a house, but for consumption, which also can prompt a rise in the GDP.[25] The coefficients for the synchronicity of GDP with total credit and homeownership rate in cases of mortgage is mainly negative and significant for the whole sample.[26] The increase of mortgages, and then the credit cycle, reduce the co-movement of credit with GDP. This may be indeed due to a drop in consumption of households burdened by mortgages (especially in old EU member states).

IMF (2008) and Leamer (2007), however, suggest that the synchronisation of GDP with property prices may be more related to the contribution of private residential investments to output fluctuations. Private residential investment has provided a substantial contribution to GDP growth in several countries, such as the Netherlands, Denmark and Ireland. This is not the case for Germany, Italy, France and Finland (IMF, 2008). The synchronisation between GDP and house price cycles seems to be highly related to the rate of private homeownership, as also shown in Figure 1 and 2. This is even more evident after the financial crisis. The synchronicity indices between house prices and credit volume or loans to NFCs are also linked to homeownership and these also slightly increased after 2008, while that is less the case for loans to households.[27] The last result may be driven by Germany and Portugal. Germany behaves rather similarly to its European counterparts and Portugal experiences a very low degree of synchronicity between house prices and loan to households, while the homeownership rate is in line with the average. As shown in Table 4, homeownership rates are also positively related to other features of the cycles, especially the standard deviation of house prices and of credit to NFCs, in line with Rünstler and Vlekke (2016) and Huber (2016).

[Insert Figure 1-2 around here]

[25] Alternative possibilities might relate to traditions or even to the state of the lease market.

[26] These results are available upon request. The data about the percentage of homeowners with mortgages over the total population are taken from the Eurostat EU-SILC survey.

[27] The data for the periods before the crisis (1999-2007) and relative to the synchronicity indices and correlations with macro-financial variables are available upon request.

Other national structural characteristics of the mortgage markets, such as **higher maximum LTV ratios and higher percentage of flexible rates mortgages** (see Table 5), could also make a country more sensitive to shocks and possibly increase pro-cyclicality (Rubio and Comunale, 2017a). As in Table 5, the situation is highly heterogeneous across EU countries (in line with Cerutti et al., 2017). Belgium, Germany, France and the Netherlands have mostly fixed-rate mortgage contracts, while periphery and new EU member states issue mostly mortgages at variable rates. The maximum (or regulatory in some cases) LTV ratios also vary strongly across countries, with the highest values for the Netherlands and Belgium but also some of the periphery (Portugal) and new member states (Baltic states and Slovenia).

[Insert Table 5 around here]

For the full sample, however, **the LTV ratio, seen as a proxy of borrowing constraints, is negatively related only to the synchronicity between GDP and loans to non-financial corporations** and does not seem to be significantly related to any other synchronicity index of real/financial cycles (see Table 3) or standard deviation of any real or financial cycle (Table 4). In this respect, it is worthwhile noting that the correlation between homeownership rates and LTV ratios is small (see also Huber, 2016). However, a relationship between homeownership rates and type of mortgage contract has been found in Chambers et al. (2009). The authors stress that the introduction of fixed-rate mortgages accounted for a substantial increase in homeownership during the period 1994-2005.[28] Contrariwise, we found that homeownership rates are positively correlated with the percentage of flexible (new) mortgage contracts.

However, if we look at countries with *both* higher LTV ratios and flexible-rate mortgages, such as Portugal, Spain, Slovenia and the Baltic states, real and financial cycles are indeed more synchronised (IMF, 2008; Rubio and Comunale, 2017a,b). This is shown in the last row of Table 3, in which we show the correlations and coefficients for the *interaction* between LTV ratios and percentage of flexible-rate mortgages and the synchronisation indices. Countries with higher LTV ratios and a higher percentage of flexible-rate mortgages (Table 5) on average experience a more synchronised GDP cycle, with loans to NFCs. However, we do not find any significant relationship for the index between GDP and loans to households. Lastly, the interaction term seems to play a relevant role in explaining the volatility of both real and financial cycles (Table 4) and this is especially true for the cycle of loans to households.

Finally, the pro-cyclicality of credit and housing market to the GDP cycle seems to be linked to the **fluctuation in current accounts and their misalignments** with respect to the theoretical equilibrium value (Comunale, 2016; 2017b).[29] Generally, in periods of boom, economies tend to lose competitiveness: real effective exchange rates rise above equilibrium levels and current accounts become more misaligned due to a shift of funding towards the less tradable and productive sectors (see also

[28] A relation between homeownership rates and type of mortgage contract has been also found in Chambers et al. (2009) for the U.S. from a general equilibrium overlapping generation model with housing. The study argues that the introduction of fixed-rate mortgages accounted for a substantial increase in homeownership during the period 1994-2005. This result does not hold for the considered EU countries and for our period of interest.

[29] The current account "norm" is calculated as in the IMF CGER (see Lee et al., 2008) and it is based on the estimation of the determinants of the current account balance itself. The determinants considered are the relative fiscal balance, relative old-age and young-age dependency ratio and relative population growth, the initial NFA, the oil balance, a relative income measure, the relative output growth, a crisis dummy (equal one after year 2008) and the net FDI flows/GDP, portfolio net flows/GDP and other net flows/GDP. "Relative" means in relative terms with respect to the main trade partners. These are also the main determinants in the subset of fundamentals taken into account in Ca' Zorzi et al. (2012).

Dell'Ariccia et al. 2012). For our samples, the synchronicity between GDP and credit cycles is indeed positively correlated with an average measure of current account misalignments: the higher the co-movement of cycles, the more misaligned the current account balances (Table 3).[30] As expected, the simple average of current account balances are negatively correlated with these synchronicity indices as well as with the standard deviations of real and credit cycles (see Table 3 and 4). The cross-countries differences for misalignments and current account balances can be seen in Figures 3 and 4 respectively.

[Insert Figure 3-4 around here]

Many euro-area countries, particularly those in the periphery, experienced an appreciation of their real effective exchange rates before the crisis. The countries with current account surpluses, and especially Germany, also show the smallest correlation between credit and GDP cycles. By contrast, countries with large current account deficits generally show a high correlation between credit and GDP cycles. Given that credit booms tend to increase current accounts deficits, the countries with unfavourable current account conditions also experienced larger credit booms, which translated into even more deteriorated current accounts.

Conversely, countries with favourable external conditions experienced much milder credit booms, their current accounts thus not suffering much (See Figure 3). Should this tendency for different synchronisations between real and financial cycles persist, one ought to be especially cautious about external conditions in countries with the highest synchronisation, because a boom (both real and financial) would deteriorate much more the current accounts there. The causality underlying these correlations may well go in both directions. Certainly, the economic expansions in the periphery were to some extent driven by easier access to external finance after creation of the euro area, resulting in both current account deficits and a high synchronicity of GDP and credit cycles. At the same time, however, there might be some more fundamental economic relation behind these results: countries with chronic current account deficits and a negative net foreign asset position may have to rely more on external finance for an expansion in real activity and are more prone to sudden stops (e.g. Mendoza, 2016). This may result in higher synchronicity of fluctuations in credit and GDP (Figure 5). In line with this argument, Avdjiev et al. (2017) find that large foreign capital flows and a higher share of external lending is associated with a greater likelihood of credit booms. Capital flows that fuel the non-tradable sectors of the economy would worsen both the internal and the external terms of trade and shift the current account into negative territory (Comunale, 2017a, Dell'Ariccia et al., 2012).

Nevertheless, after the crisis, we have seen a large decrease in both credit and GDP together with a substantial improvement in the current accounts in debtor countries (see Figure 6).[31] This is in line with Mian et al. (2015): in the short-run, an increase in household debt over GDP increases consumption and has a negative effect on the current account balance (Figure 5). In the medium-run, more household debt predicts lower subsequent imports, better current account balances and lower GDP growth, especially if the country was a net foreign borrower at the beginning of the considered period. This may call for debt

[30] The correlations between standard deviations and current account balances and misalignments have the same sign as the correlations between synchronicity measures and current account balances and misalignments; however, they are smaller in magnitude (see Table 3 and 4).

[31] In our case, the results from using the synchronicity between real cycle and the cycle of loans to NFCs are comparable to those that used loans to households. We report only the former.

cycles driven by credit supply shocks rather than credit demand. With lower loan rates, the periphery countries experienced excessive borrowing pre-crisis.[32]

[Insert Figure 5-6 around here]

5.2 Robustness checks

Lastly, we run the regressions adding a control for spillovers across member states, applying two different ways to account for this specific issue. Firstly, we add either a weighted measure of GDP growth of the rest of the EU (Equation 3), as in Comunale (2017a), or the weighted average of the financial cycles of the rest of the EU (Equation 4), as in Comunale (2017b). In the latter, values are based on a principal component analysis from annual data in which we use output gaps, credit and domestic demand growths, and we take the first (common) principal component.[33] We rely on this measure to extrapolate the most common information possible, averaging the measure from annual data to be consistent with the other macro-financial variables. In the following equations, $N-1$ countries correspond to the rest of the EU, $w_{i,j,t}$ are the trade weights taken from DG ECFIN, Price and Competitiveness database and are the same as the ones for the REERs computed for 28 EU partner countries. This approach to spillovers is similar to that found in the GVAR literature.

$$fgdpgr_{i,t} = \sum_{j=1}^{N-1} w_{i,j,t} \cdot gdpgr_{j,t} \tag{3}$$

$$ffcycle_{i,t} = \sum_{j=1}^{N-1} w_{i,j,t} \cdot fcycle_{j,t} \tag{4}$$

We compute the spillover measures for each year available (1994-2012) and then we average the measure over the time dimension for each country, as for the other variables. The results are fairly robust with respect to the baseline. This first proxy plays a role in influencing synchronicity indices in few cases. For instance, it is positive and significant in the case of real GDP-loan to NFCs synchronicity.[34]

6 The synchronicity indices and cycles as signal for recession

6.1 Methodology

Lastly, we consider cycles and indices as possible signals for economic crises. In order to do so, we follow Schularick and Taylor (2012) and Minoiu et al. (2013), initially using a simple panel probit. Recall that in the probit model, the (conditional) probability of a "successful" outcome will be the probability of recession in our case. Therefore, we compute the probability that the outcome variable is 1 as a certain function of a linear combination of the regressors. We use the longest time series with quarterly frequency for 10 countries (Belgium, Germany, Denmark, Spain, Finland, France, Italy, Luxembourg,

[32] They consider a panel of 30 countries for the period 1960-2012.

[33] The complete database and its sources are described in Comunale (2015) and are available online at: http://www.lb.lt/en/research-database Luxembourg is not included.

[34] The results with the proxies for spillovers are available upon request.

the Netherlands, Portugal) for the period 1970Q1-2016Q2 (max). We estimate a probabilistic model of a recession event in country k, in quarter t, as a function of a lagged information in t, in this case the various synchronicity measures from 1 quarter to 1 year before t. Initially, we present an OLS Linear probit model with simple pooled data as equation (3):

$$p_{kt} = b_{0k} + b_1(L)S_{kijt} + b_2(L)\mathbf{X}_{kt} + e_{kt} \tag{5}$$

where S_{kijt} is the binary sinchronicity index as in equation (1) which can take either value 1 (synchronisation, i.e. same sign) or -1 (desynchronisation, i.e. different sign). L is the lag operator with $L \geq 1$, in this case we use from 1 to 4 lags separately in order to predict the recession by using information from the cycles from 1 quarter to 1 year ahead, and $\mathbf{X}_{kt}$ are possible controls. The dependent variable is the probability of a recession. The latter takes value 1 if a recession occurred in the country during the specific quarter and 0 otherwise. The data for the recessions events are from FRED, OECD based Recession Indicators for each of the 10 countries from the period following the peak through the trough.[35] [36] A value of 1 is a recessionary period, while a value of 0 is an expansionary period. We organize the data in order to have quarterly series.[37] We also use instead of the binary sinchronicity index, the level of the cycles and lagged by from one quarter to one year. We test the predictive ability by using the area under the Receiver Operating Characteristic (ROC) curve (AUROC). A perfect predictive power is when AUROC is equal to 1; Schularick and Taylor (2012) pointed out that in this case an AUROC of around 0.7 can be considered high. The test is based on a null value of 0.5, i.e. no predictive power.

We then perform a panel logit model with fixed effects as a robustness check. The controls are omitted for the baseline, while in an extension for a shorter time span (1994-2016) we also add the government consolidated gross debt over GDP, the Real Effective Exchange Rates (REERs) vis-à-vis 42 partners and deflated by CPI from Eurostat, and current account over GDP from OECD.[38] This follows the approach of Gourinchas and Obstfeld (2012).[39]

6.2 Results

6.2.1 Baseline probit

We start by using the baseline, i.e. probit without controls for the full sample starting from the '70s. As such, we firstly analyse real and credit cycles and synchronicity and then we look at property prices. The synchronicity between real cycles (YER) and loans to households (LHH) seems to be linked to the

[35] Source: Federal Reserve Bank of St. Louis, OECD based Recession Indicators from the Period following the Peak through the Trough, retrieved from FRED, Federal Reserve Bank of St. Louis. The components of the indicators from OECD are time series which exhibit leading relationship with the reference series (GDP) at turning points. Country CLIs are compiled by combining de-trended smoothed and normalized components. The component series for each country are selected based on various criteria such as economic significance; cyclical behaviour; data quality; timeliness and availability. More details at: http://www.oecd.org/std/leading-indicators/CLI-components-and-turning-points.pdf

[36] We use the index for recession's instances for aggregate euro area only as a robustness check.

[37] The quarterly series are constructed as the mode in the data range of three months.

[38] The shorter sample has two main objectives: firstly, it can provide a useful comparison with the full sample starting from the mid-'90s, when the EU integration accelerated; secondly, it allows us to use control variables which are available at quarterly frequency only from 1994 onwards (max).

[39] The authors provide in the paper only a panel logit with fixed effects, but they also stress that they found very similar results by using a panel probit. We also use both in the analysis.

probability of recession. More specifically, having the two cycles synchronised is indicative of a recession instance three or four quarters ahead (Table 6 (a)).[40] This means that when, for instance, GDP is growing and credit is also booming at time t, we might have a higher probability of experiencing a recession in one year.

As expected, the real cycles are good predictors of recessions with the bigger coefficients, i.e. there is a higher probability of recession in cases of an increase in the real GDP (Table 6 (b)). For the latter, the AUROC is significant and between 0.6 and 0.7 for one to four quarters ahead respectively. This mainly comes from how the periods of recessions are computed by FRED-OECD. The area under the ROC curve is, however, only slightly above 0.54 for the synchronicity index YER-LHH. In case of the synchronicity between real cycles (YER) and loans to NFCs (LNF), this seems to matter for all the lags (Table 7 (a)). Moreover, the LNF cycle seems to perform better as a signal than LHH (Table 7 (b) and (c)), also looking at the ROC curve. In the former the ROC reaches 0.6 for three-four quarters before a recession. The results for the cycle of total credit volume to NFCs (TCN) are very much comparable with the ones for LNF, while its synchronicity with the real cycle is never significant.

[Insert Table 6 and 7 around here]

Likewise, we find no significant predictive role for the synchonicity of real cycles and property price cycles (RPP). The RPP cycle itself expresses the lowest ROC among the different cycles. Interestingly, equity price (EQP) cycles may give some signal of recessions only looking one-two quarters ahead, and a decrease in equity prices seems to signal a higher probability of recession (Table 8 (b)). Notably, however, the AUROC is very close to 0.5 (0.51 max) even if significant. Lastly, the synchronicity with real GDP cycles shows no significant predictive power (Table 8 (a)). The long-term interest rate (LTN) cycles also seem to be quite a signal for upcoming recession and they have the highest value for the AUROC at any lag up to 0.7 (Table 9 (b)). The synchronicity of LTN and real cycle has a very limited predictive ability (ROC around 0.53), only two-three quarters in advance (Table 9 (a)).

[Insert Table 8 and 9 around here]

6.2.2 Extensions and robustness checks

We extend the baseline, for a shorter sample from 1994Q1 to 2016Q4, in case of synchronicity YER-LNF and the corresponding credit and real cycle,[41] by including as control variable the general government debt over GDP, which may have influenced the probability of experiencing a recession, especially in the euro area. High debt levels can create vulnerabilities, which may amplify and transmit macroeconomic and financial shocks (see OECD, 2013). Moreover, in the spirit of Gourinchas and Obstfeld (2012), we add the REERs, as a proxy of price competitiveness,[42] and current account over GDP, which also can signal a forthcoming recession. The latter factor works in the case of massive deficits vis-à-vis the rest of the world and the former can stress an increased fragility if particularly high with respect to the long-run

[40] Importantly, our measure of synchronicity does not differentiate between cycles being simultaneously in a recovering or contraction phase.

[41] We show only the analysis for LNF, i.e. for the credit to NFCs, which is the most representative of the general credit cycles for firms and households. All the remaining results are available upon request.

[42] Here, an increase in the REER means a decrease in price competitiveness.

trend.[43] The results for the baseline with a shorter sample and the extension with controls are rather different with respect to the simple baseline with the entire set of data since the '70s. In the shorter sample, an increase in this synchronisation between credit and output cycles decreases the possibility of a recession in the next quarter, only adding the controls. For the whole sample at any lag, a higher synchronicity instead increases the probability (see Table 10). This result still holds if we apply a panel logit with fixed effects.[44]

Government debt and the REERs are the best signals for recession. The REER gap emerges as a significant predictor especially one year ahead. A real devaluation, i.e. an increase in price competitiveness, reduces significantly the unconditional probability of crisis at the one-year horizon. An increase in domestic credit above trend decreases the likelihood of a recession, which is a rather unexpected outcome but in line with Gourinchas and Obstfeld (2012). Using instead the government debt two years ahead can significantly predict the probability of a recession (see Table 10, column 9). The current account gap does not seem to play a role in signaling recessions for the euro area. Lastly, we use the credit and the real cycles instead of the synchronicity.

[Insert Table 10 around here]

By using the credit cycle instead of the synchronicity, we confirm that an increase in this cyclical component can signal a higher probability of recessions, especially in the short-run. The outcomes without controls are almost identical to those for the whole sample. The results for the controls are robust with respect to the previous specification with the synchronicity indices. By using real cycles, the results are also confirmed. Moreover, the coefficient for the real cycle is bigger than the credit cycle, i.e. an increase in the cycle of real GDP increases the probability of a future recession more than an increase in credit to NFCs. If we combine the two cycles, as do Gourinchas and Obstfeld (2012), this finding is confirmed only for more than two quarters in advance, with or without controls (Table 11). The other variables perform as in the other specifications. The cycles have no predictive power two years ahead for an episode of recession.[45]

[Insert Table 11 around here]

7 Conclusions, policy implications and further research

We provide a more structural analysis of countries' characteristics, by using a within-measure of synchronicity or volatility of cycles interacting with some macro-financial variable of interest. The GDP and property cycle and the GDP and equity price cycle display a high level of synchronicity. This is especially true for new member states. The progressive liberalisation since the '90s (see Claessens et al., 2011) might explain the higher synchronisation in the new member states, especially in the Baltics, which indeed have seen an improvement in this regard due to accession requirements. The higher correlation between house prices and GDP cycles can also be related to some changes in key institutional

[43] These variables are taken as the difference between the actual values and the HP filtered series, as also found in Gourinchas and Obstfeld (2012).

[44] The results for the panel logit setup are available upon request.

[45] The full set of results is available upon request.

features of the mortgage markets, as reported in IMF (2008). In this regard, countries with both higher maximum LTV ratios and flexible- rate mortgages (IMF, 2008; Rubio and Comunale, 2017a,b), such as Portugal, Spain and the Baltic states, also tend to display more synchronised real and financial cycles.[46] In addition, we find that homeownership rate is positively related to features of the cycles, especially to the standard deviation of house prices and credit to NFCs (see Rünstler and Vlekke, 2016, and Huber, 2016) and to the synchronicity between real cycles and house prices.

This can be crucial from a macroprudential point of view. Rubio (2014) and Rubio and Comunale (2017a, b) stress the benefits for financial stability of national-level macroprudential instruments that take into account characteristics of the mortgage markets. In particular, higher maximum LTV ratios and a higher percentage of flexible-rate mortgages can make a country more sensitive to shocks and possibly increase pro-cyclicality. The pro-cyclicality of credit and housing market found in our analysis can also be linked to the fluctuation in other macroeconomic variables. For the whole sample, the synchronicity index between real cycle and credit cycle, especially credit volume and loan to NFCs, is positively correlated with an averaged measure of current account misalignments, i.e. the higher the co-movement of cycles, the more misaligned are the current account balances (Comunale, 2016; 2017b). This highlights the asymmetry within the EU both with respect to macroeconomic variables, such as current accounts and competitiveness, and to real/financial cycles' synchronisation.

[46] Here, maximum LTV (sometimes taken as a regulatory limit) is treated as an occasionally binding constraint. Especially after the crisis, however, the banks themselves tightened their credit standards.

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8 Annex

Tables and Figures

Table 1: The synchronisation indices (% of episodes over the total)

	eqp_ltn	eqp_yer	eqp_lhh	eqp_lnf	eqp_rpp	eqp_tcn
BE	42.6	66.2	42.6	33.8	42.4	40.9
DE	56.1	62.1	54.5	48.5	71.2	42.4
DK	61.8	80.9	42.4	53.0	77.9	45.5
EE		88.4	79.7	75.4	79.7	76.8
ES	40.3	61.2	61.2	50.7	56.7	53.7
FI	40.3	74.6	35.8	25.4	40.3	37.3
FR	32.4	58.8	39.4	28.8	30.3	34.8
GR	39.7	64.7	55.9	39.7	52.9	61.8
HR	47.4	87.0	75.4	65.2	83.8	79.7
HU	39.1	60.9	64.2	70.1	56.7	65.7
IT	25.0	68.7	50.0	45.5	47.0	48.5
LT	20.8	66.7	62.5	62.5	64.6	64.6
LU	63.2	61.8	52.9	55.9	63.2	61.8
LV	63.2	80.9	67.6	47.1	79.4	55.9
NL	44.1	64.7	61.8	48.5	56.7	42.4
PT	50.0	69.1	42.6	38.2	50.7	31.8
SI	34.1	77.9	38.2	51.5	51.5	51.5
avg total	43.8	70.3	54.5	49.4	59.1	52.7
avg old EU	45.6	66.8	48.3	42.8	53.7	43.9
avg new EU+GR	40.7	75.2	63.4	58.8	67.0	65.1
avg full sample old EU	35.9	60.8	53.9	41.8	49.6	51.0

	yer_ltn	yer_lhh	yer_lnf	yer_rpp	yer_tcn	yer_eqp
BE	61.8	73.5	52.9	74.2	54.5	66.2
DE	66.7	53.0	47.0	54.5	68.2	62.1
DK	69.1	56.1	63.6	88.2	56.1	80.9
EE		76.8	72.5	88.4	73.9	88.4
ES	47.1	88.1	74.6	95.5	80.6	61.2
FI	35.8	40.3	41.8	62.7	50.7	74.6
FR	61.8	30.3	25.8	51.5	28.8	58.8
GR	30.9	91.2	75.0	88.2	85.3	64.7
HR	42.1	88.4	60.9	79.4	75.4	87.0
HU	20.3	68.7	77.6	97.0	64.2	60.9
IT	53.7	74.2	75.8	74.2	78.8	68.7
LT	41.7	82.1	85.1	84.2	70.1	66.7
LU	48.5	17.6	50.0	63.2	35.3	61.8
LV	76.5	86.8	66.2	86.8	75.0	80.9
NL	50.0	97.1	42.6	91.0	75.8	64.7
PT	54.4	73.5	60.3	62.7	62.1	69.1
SI	50.0	60.3	73.5	73.5	73.5	77.9
avg total	50.6	68.1	61.5	77.4	65.2	70.3
avg old EU	54.9	60.4	53.4	71.8	59.1	66.8
avg new EU+GR	43.6	79.2	73.0	85.4	73.9	75.2
avg full sample old EU	52.4	61.4	60.4	75.0	62.3	60.8

	ltn_lhh	ltn_lnf	ltn_rpp	ltn_tcn	lhh_lnf	lhh_rpp	lhh_tcn	lnf_rpp	lnf_tcn	rpp_tcn
BE	64.7	85.3	56.1	72.7	70.6	86.4	69.7	56.1	87.9	59.1
DE	40.9	59.1	39.4	40.9	69.7	65.2	78.8	56.1	57.6	56.1
DK	66.7	77.3	72.1	69.7	86.4	65.2	93.9	60.6	89.4	65.2
EE					95.7	68.1	97.1	63.8	95.7	65.2
ES	58.2	71.6	47.8	65.7	86.6	89.6	92.5	76.1	94.0	82.1
FI	80.6	70.1	64.2	76.1	89.6	77.6	89.6	79.1	88.1	88.1
FR	66.7	56.1	63.6	65.2	86.4	78.8	95.5	74.2	90.9	77.3
GR	36.8	29.4	30.9	45.6	77.9	94.1	91.2	83.8	69.1	85.3
HR	45.6	75.4	62.5	71.9	63.8	73.5	78.3	75.0	85.5	86.8
HU	52.2	37.3	23.9	56.7	76.1	71.6	95.5	77.6	74.6	67.2
IT	60.6	68.2	66.7	65.2	92.4	93.9	95.5	92.4	97.0	95.5
LT	45.8	45.8	56.3	52.1	97.0	80.7	88.1	80.7	85.1	86.0
LU	66.2	72.1	55.9	72.1	58.8	54.4	76.5	63.2	82.4	72.1
LV	77.9	77.9	69.1	80.9	79.4	73.5	88.2	58.8	91.2	67.6
NL	52.9	66.2	58.2	60.6	45.6	94.0	78.8	50.7	65.2	84.8
PT	77.9	76.5	46.3	63.6	86.8	44.8	86.4	49.3	84.8	57.6
SI	70.5	72.7	56.8	72.7	83.8	86.8	83.8	79.4	100.0	79.4
avg total	60.3	65.1	54.3	64.5	79.2	76.4	87.0	69.2	84.6	75.0
avg old EU	63.5	70.2	57.0	65.2	77.3	75.0	85.7	65.8	83.7	73.8
avg new EU+GR	54.8	56.4	49.9	63.3	82.0	78.3	88.9	74.2	85.9	76.8
avg full sample old EU	58.0	68.0	58.6	61.3	73.7	72.6	84.4	67.6	79.9	72.2

Note: The data concern all the 17 countries from 1999Q2.The cycles are based on data from real GDP (YER), equity price indices (EQP), real total credit to private non-financial sector (TCN), real credit to non-financial corporations (LNF), real credit to households (LHH), property prices (RPP), nominal long-term rates (LTN). The synthetic synchronicity indices regard cycle pairs. The total is over the entire sample of 17 countries; old EU includes: BE, DE, DK, ES, FI, FR, IT, LU, NL, and PT; 'new EU+GR' averages the values over: EE, GR, HR, HU, LT, LV, SI; 'full smpl old EU ' regards the indices for the full sample of old EU countries using all the data available.

Table 2: The standard deviation of the cycles

	YER	RPP	LHH	LNF	TCN	EQP	LTN
BE	1.3	4.8	5.4	6.9	4.1	21.8	55.4
DE	**1.8**	**1.4**	**2.4**	**3.1**	**2.8**	**22.7**	**46.1**
DK	2.0	9.1	4.9	7.0	6.0	20.9	62.9
EE	7.2	25.1	27.8	25.9	26.9	37.9	
ES	**3.4**	**14.4**	**8.6**	**8.2**	**8.5**	**20.7**	**83.5**
FI	3.8	6.1	15.6	12.7	12.7	37.4	71.0
FR	2.0	10.6	8.8	7.6	5.0	23.0	59.5
GR	9.3	12.9	25.0	9.6	17.2	37.4	422.3
HR	4.6	9.0	12.9	8.5	10.5	30.1	116.4
HU	4.1	16.9	25.1	6.4	10.2	24.4	131.5
IT	2.0	7.1	6.9	5.3	5.6	24.2	89.5
LT	6.7	25.3	41.2	22.4	13.1	29.6	260.2
LU	3.8	7.5	7.3	14.9	8.9	30.6	87.1
LV	8.4	24.1	25.8	16.0	18.3	31.5	306.5
NL	**3.2**	**14.0**	**12.7**	**6.1**	**6.5**	**26.5**	**53.6**
PT	**2.1**	**3.0**	**8.2**	**8.4**	**3.8**	**21.1**	**197.2**
SI	4.0	10.3	12.7	18.1	15.3	31.0	109.8

Note: these are the standard deviations of the cycles multiplied by 100. This is a measure of how widely values are dispersed from the average value.

Table 3: Correlations and coefficients between synchronicity indices and macro-financial variables

(a) Correlations

CORRELATIONS

	yer_lhh	yer_lnf	yer_rpp	yer_tcn	ltn_yer	lhh_rpp
LTV	0.11	**-0.47**	-0.07	-0.14	0.42	0.16
HOR	**0.48**	**0.70**	**0.60**	0.40	**-0.51**	0.13
VA_fins_GDP	-0.51	-0.23	-0.25	-0.46	0.02	-0.41
CA_mis	**0.48**	**0.59**	**0.41**	**0.58**	-0.20	0.08
CA	**-0.62**	**-0.66**	**-0.43**	**-0.58**	0.25	-0.04
LTV x Flex	0.13	**0.54**	0.33	0.25	-0.28	-0.31

(b) Coefficients

REGRESSION COEFFICIENTS

	yer_lhh	yer_lnf	yer_rpp	yer_tcn	ltn_yer	lhh_rpp
LTV	0.225	**-0.665****	-0.0881	-0.202	0.557	0.202
HOR	**1.057****	**1.102*****	**0.847*****	0.623	**-0.714****	0.175
VA_fins_GDP	-2.406	-0.787	-0.735	-1.498	0.0583	-1.210
CA_mis	**0.0470***	**0.0412****	**0.0258***	**0.0343***	-0.0124	-0.000626
CA	**-2.653*****	**-2.014*****	**-1.172***	**-1.723*****	0.676	-0.114
LTV x Flex	0.107	**0.327****	0.179	0.147	-0.157	-0.163

Note: The upper panel (a) shows the correlations between structural characteristics (rows) and the standard deviations of the series (column) across all 17 countries. The second table shows the coefficients when we regress the pairwise synchronisation of series (column) on the structural characteristics (rows). *LTV* is the maximum Loan-To-Value ratio; *HOR* is the homeownership rate as a percentage of total population; *VA_fins_GDP* is the gross value-added of the financial sector over GDP; *CA_mis* is the average current account misalignment; *CA* is the current account balance over GDP; *LTV x Flex* is the interaction term between maximum LTV ratios and the share of flexible rates mortgages over the total mortgage volumes. The lower panel (b) shows the coefficients from regressions of synchronicity on the indicators and a constant. Significance levels are calculated from bootstrapped errors.[47] The sample includes all 17 countries (data from 1999 Q2 to the latest available). Significance at 1% level ***, 5% ** and 10% * (also in red and bold).

[47] Details about the standard errors and the coefficients of the constant term are available on request.

Table 4: Correlations and coefficients between cyclical volatility and macro-financial variables

(a) Correlations

CORRELATIONS

	YER	RPP	TCN	LHH	LNF	LTN
LTV	-0.16	0.17	0.03	-0.06	0.18	-0.33
HOR	**0.54**	**0.61**	**0.50**	**0.67**	**0.47**	0.11
VA_fins_GDP	-0.12	-0.24	-0.13	-0.29	0.05	-0.12
CA_mis	0.28	0.20	0.26	0.26	0.14	-0.05
CA	**-0.53**	**-0.49**	-0.38	**-0.56**	-0.23	0.02
LTV x Flex	0.37	0.37	**0.55**	0.40	**0.57**	0.27

(b) Coefficients

REGRESSION COEFFICIENTS

	YER	RPP	TCN	LHH	LNF	LTN
LTV	-0.0346	0.113	0.0156	-0.0607	0.100	-3.234
HOR	**0.128*** **	**0.442*** **	**0.315*** **	**0.692*** **	**0.298** **	**4.569*** **
VA_fins_GDP	-0.0590	-0.371	-0.178	-0.652	0.0721	-3.741
CA_mis	0.00308	0.00578	0.00730	0.0105	0.00504	0.110
CA	**-0.245** **	**-0.694** **	**-0.461***	**-1.129** **	-0.283	**-13.51*** **
LTV x Flex	**0.0339***	0.104	**0.133** **	**0.159** **	**0.137*** **	1.119

Note: The first upper panel table (a) shows the correlations between structural characteristics (rows) and the standard deviations of the series (column) across all 17 countries. The second table shows the coefficients when we regress the standard deviations of the series (column) on the structural characteristics (rows). The data start in 1999Q2. *LTV* is the maximum Loan-To-Value ratio; *HOR* is the homeownership rate as a percentage of total population; *VA_fins_GDP* is the gross value-added of the financial sector over GDP; *CA_mis* is the average current account misalignment; *CA* is the current account balance over GDP; *LTV x Flex* is the interaction term between maximum LTV ratios and the percentage of flexible rates mortgages over the total. See Table 1 for notations and further details. Significance at 1% level ***, 5% ** and 10% *(also in red and bold)..

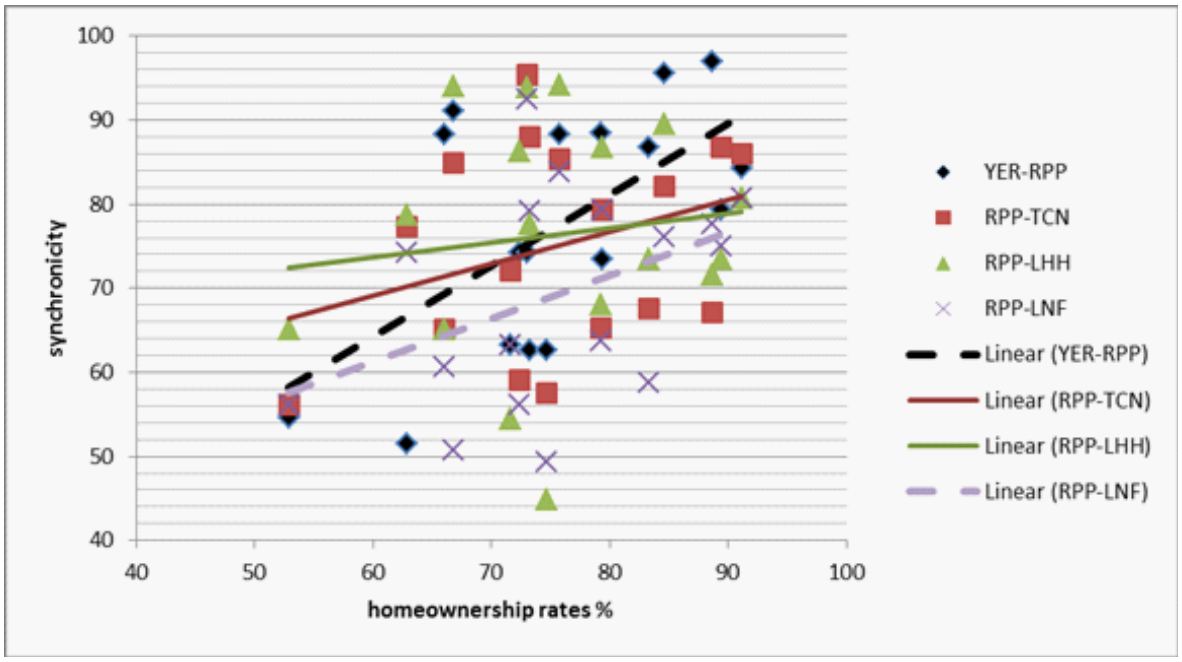
Table 5: Some characteristics of housing and credit markets in EU

	flex	fix 1-5	fix 5-10	fix more 10	total	%Flex	LTV	LTV x Flex	majority
BE	373.55	313.52	304.12	1530.04	2521.24	15%	100.00	14.82	F
DE	2451.93	2361.84	6151.95	5005.86	15971.58	15%	80.00	12.28	F
DK*	265.49	72.00			337.49	79%	80.00	62.93	V
EE	79.88	2.73	2.67	5.49	90.76	88%	100.00	88.01	V
ES	5637.38	749.61	58.01	158.39	6603.39	85%	87.50	74.70	V
FI	1868.09	54.34	9.78	21.02	1953.23	96%	90.00	86.08	V
FR	1383.39	831.65	1308.73	8306.45	11830.23	12%	100.00	11.69	F
GR**	384.89	184.03	46.56	64.71	680.19	57%	70.00	39.61	V
HR***	374.41	42.51	19.65	68.06	504.63	74%	80.00	59.36	V
HU****	2521.70	19.74	14.80	129.97	2686.21	94%	72.50	68.06	V
IT	2860.21	111.47	109.31	1396.34	4477.32	64%	80.00	51.11	V
LT	66.92	14.33	2.86	0.80	84.91	79%	85.00	66.99	V
LU****	193.82	10.92	27.21	51.92	283.87	68%	80.00	54.62	V
LV	73.20	9.82	1.14	7.64	91.80	80%	95.00	75.75	V
NL	1422.19	1396.41	2734.79	1044.24	6597.62	22%	113.50	24.47	F
PT	800.69	23.81	6.26	2.53	833.29	96%	90.00	86.48	V
SI	47.32	0.53	1.47	6.78	56.10	84%	90.00	75.91	V

Note: The flexible interest rates mortgages *flex* are set for short periods, e.g. of up to 1 year. Fixed rate mortgages (*fix*) can be set for 1-5 years, 5-10 years or more than 10 years. The total refers to the total amount of mortgages flex and fix in million EUR. *%Flex* is the share of flexible rate mortgages over the total. *LTV* is the maximum LTV ratio. For the rates, V means that the majority of loans are at flexible/variable rates while F stands for fixed. The table is based from Rubio and Comunale (2017b). The data for the LTVs are from ECB (2016, 2009), Huber (2016) and IMF (2008, 2011). They are integrated with information coming from national sources. Source for rates: ECB SDW (loans to households for house purchase with different IRF periods (new business)); average over 2003M1-2017M2 (max). * no data available for fix >5y, only few data points for fix 1-5y (annual data 2013 and 2014), ** no complete dataset since 2012 (for fixed rates more than 10y last data from 2013), *** data from 2011M12, **** discontinous data series.[48]

[48] We are very thankful to Lorenzo Isgró for the data on the rates and to Dmitry Kulikov for the Estonian data.

Figure 1: Homeownership rates and synchronicity



Note: YER, RPP, TCN, LNF and LHH denote cycles of real GDP; house prices, and credit volume and loans to NFCs; LHH is the cycle for loans to households.

Figure 2: Homeownership rates and standard deviation of cycles

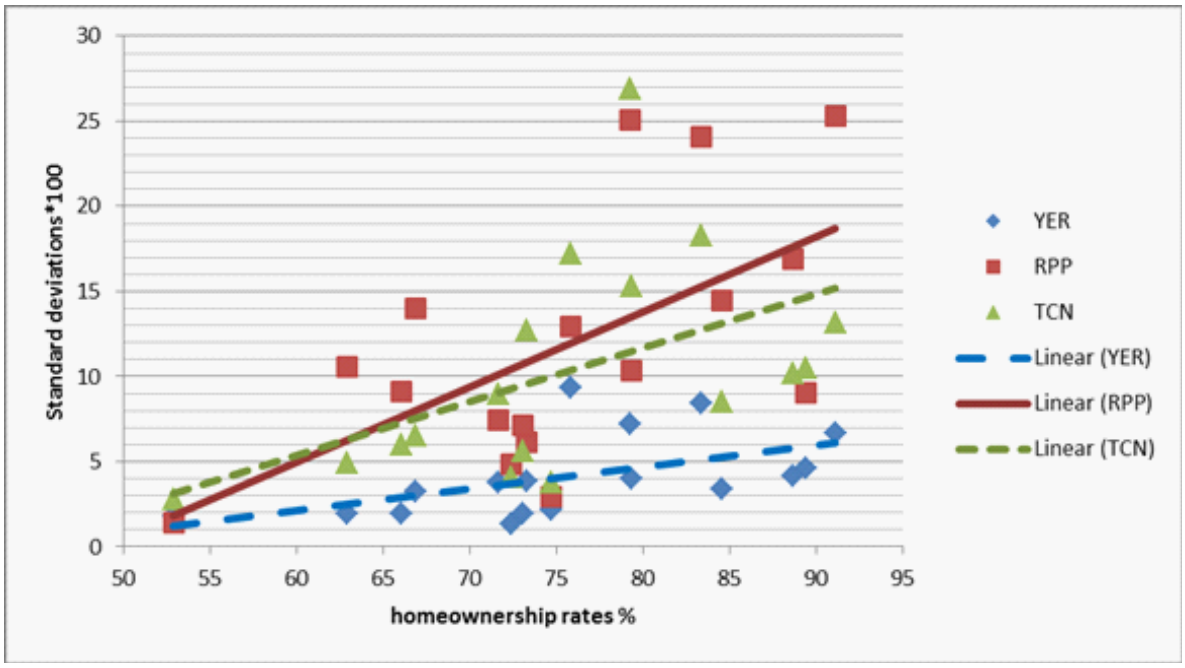


Figure 3: Current account misalignments and synchronicity

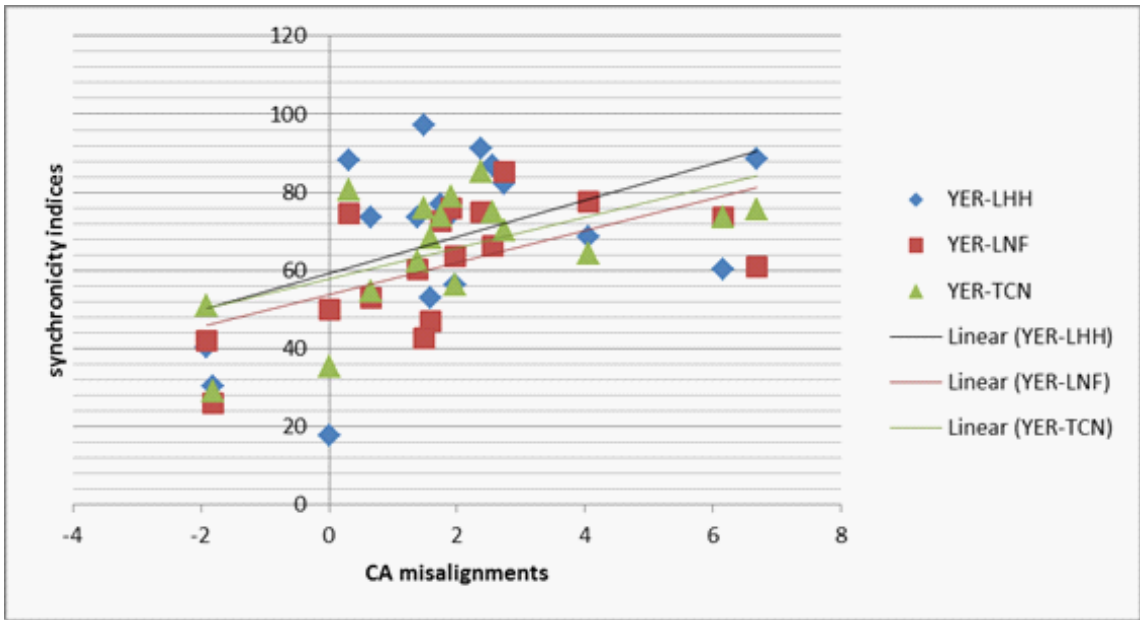


Figure 4: Current accounts over GDP and synchronicity

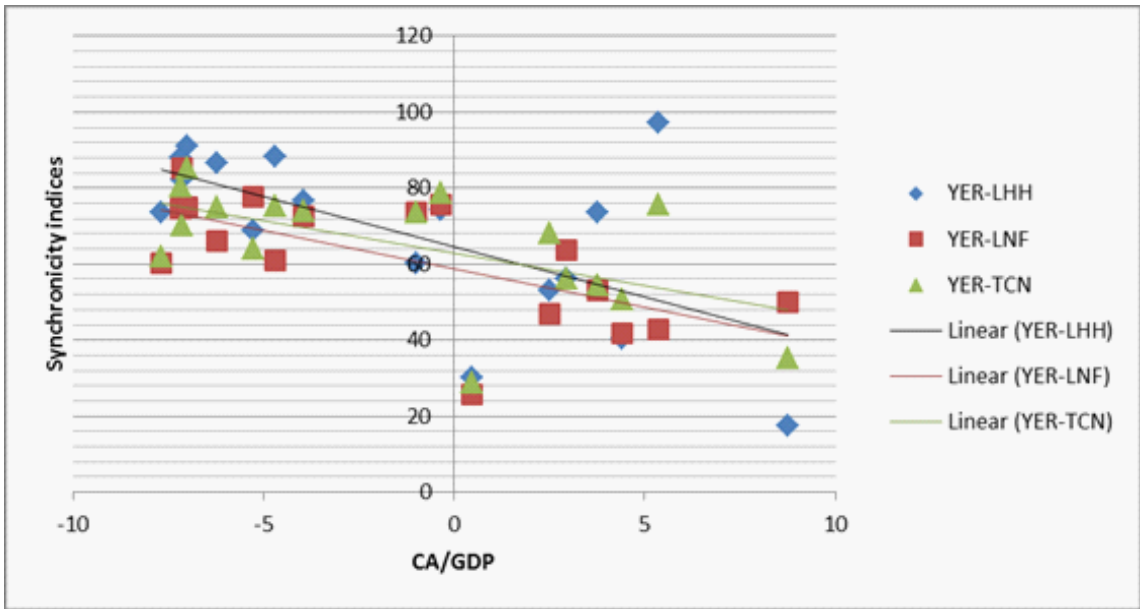
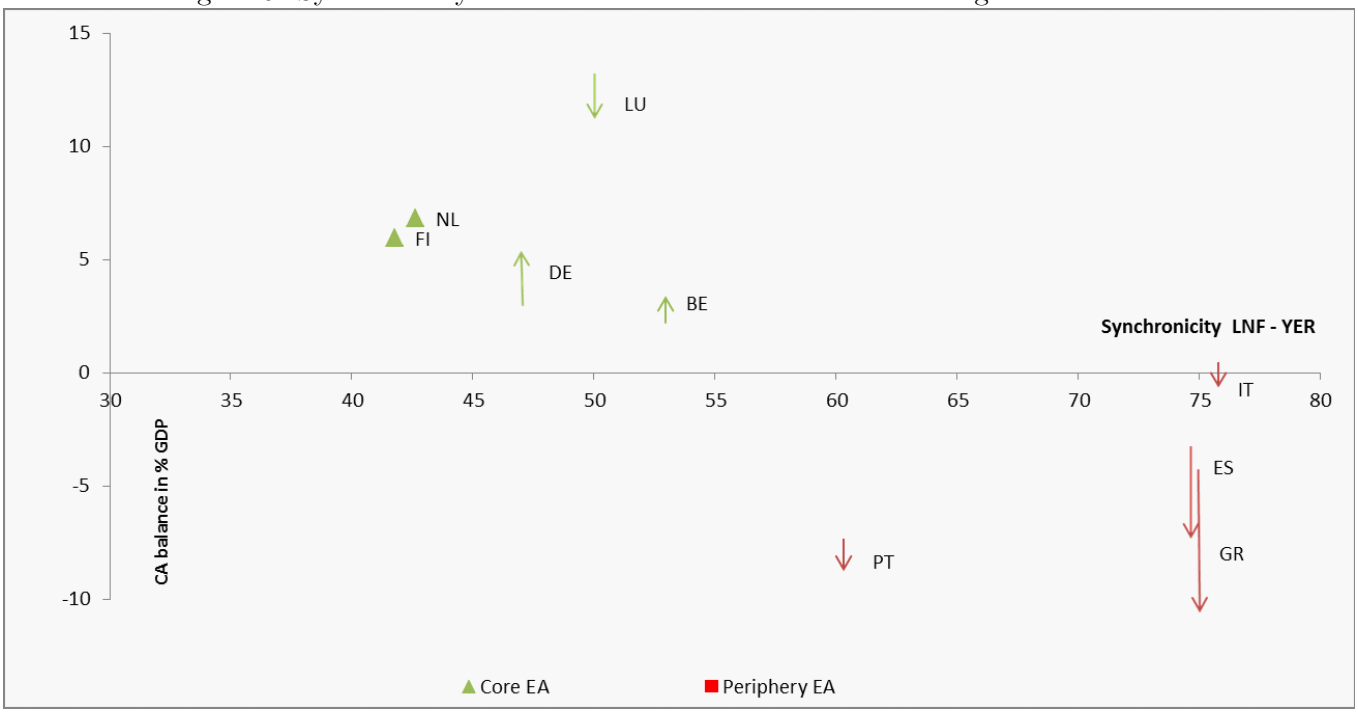
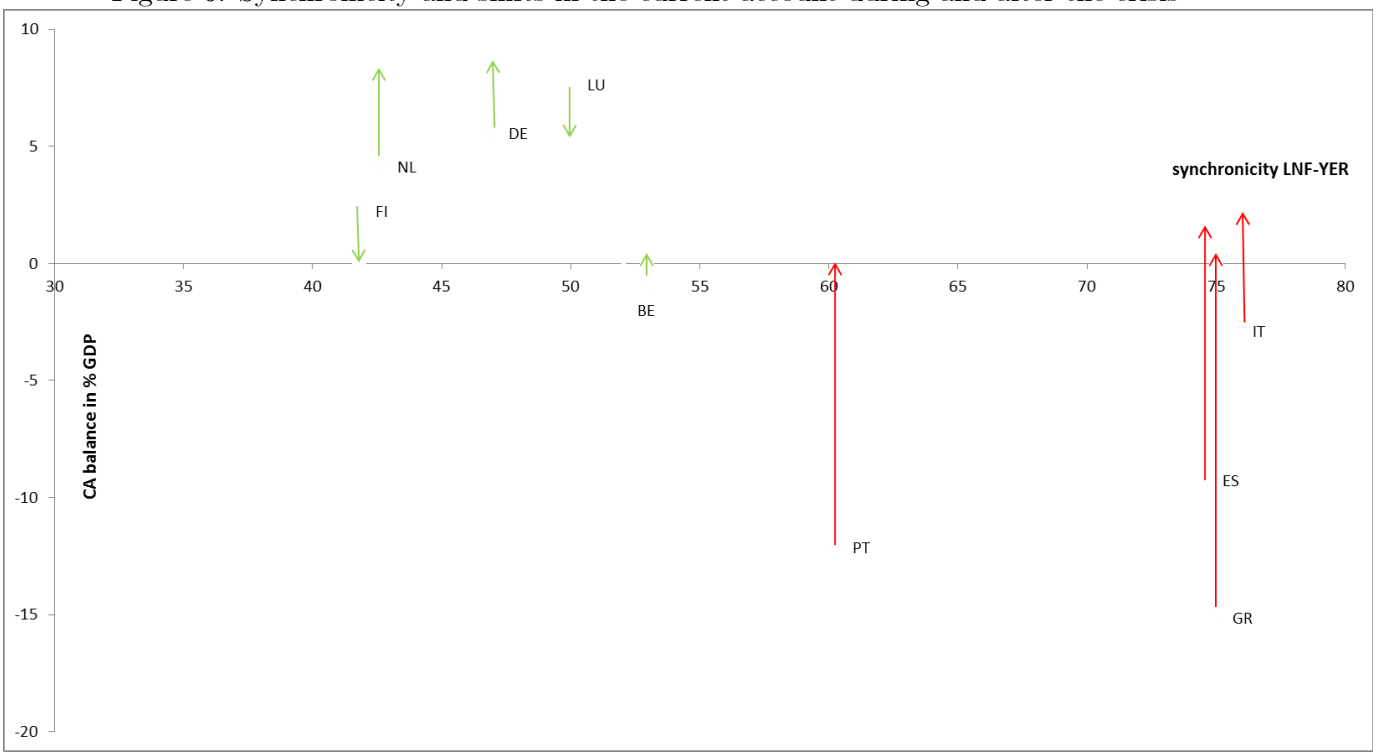


Figure 5: Synchronicity and shifts in the current account during the boom



Note: The arrows show the changes in CA balances between 2004 and 2007.

Figure 6: Synchronicity and shifts in the current account during and after the crisis



Note: The arrows show the changes in CA balances between 2008 and 2015.

Table 6: Probability of recession: synchronicity YER-LHH and real cycle

(a) YER-LHH

VARIABLES	(1) rec	(2) rec	(3) rec	(4) rec
L.yer_lhh	0.00511			
	(0.0343)			
L2.yer_lhh		0.0522		
		(0.0344)		
L3.yer_lhh			0.0896***	
			(0.0345)	
L4.yer_lhh				0.0873**
				(0.0345)
Constant	-0.110***	-0.129***	-0.143***	-0.148***
	(0.0343)	(0.0344)	(0.0345)	(0.0345)
Observations	1,415	1,415	1,415	1,411

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Real cycle

VARIABLES	(1) rec	(2) rec	(3) rec	(4) rec
L.yer_bp_tc_cycle	6.222***			
	(1.105)			
L2.yer_bp_tc_cycle		11.16***		
		(1.182)		
L3.yer_bp_tc_cycle			14.61***	
			(1.252)	
L4.yer_bp_tc_cycle				15.66***
				(1.290)
Constant	-0.137***	-0.141***	-0.144***	-0.147***
	(0.0316)	(0.0320)	(0.0324)	(0.0326)
Observations	1,607	1,607	1,607	1,600

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7: Probability of recession: synchronicity YER-LNF and credit cycles

(a) YER-LNF

VARIABLES	(1) rec	(2) rec	(3) rec	(4) rec
L.yer_lnf	0.0630*			
	(0.0343)			
L2.yer_lnf		0.0911***		
		(0.0343)		
L3.yer_lnf			0.0905***	
			(0.0343)	
L4.yer_lnf				0.0729**
				(0.0344)
Constant	-0.123***	-0.136***	-0.142***	-0.143***
	(0.0343)	(0.0343)	(0.0343)	(0.0344)
Observations	1,415	1,415	1,415	1,411

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Credit cycle: LNF

VARIABLES	(1) rec	(2) rec	(3) rec	(4) rec
L.lnf_bp_tc_cycle	2.324***			
	(0.395)			
L2.lnf_bp_tc_cycle		2.485***		
		(0.403)		
L3.lnf_bp_tc_cycle			2.454***	
			(0.408)	
L4.lnf_bp_tc_cycle				2.315***
				(0.411)
Constant	-0.130***	-0.132***	-0.132***	-0.132***
	(0.0333)	(0.0333)	(0.0333)	(0.0333)
Observations	1,459	1,459	1,459	1,457

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(c) Credit cycle: LHH

VARIABLES	(1) rec	(2) rec	(3) rec	(4) rec
L.lhh_bp_tc_cycle	0.508			
	(0.309)			
L2.lhh_bp_tc_cycle		0.740**		
		(0.312)		
L3.lhh_bp_tc_cycle			0.915***	
			(0.314)	
L4.lhh_bp_tc_cycle				1.082***
				(0.317)
Constant	-0.121***	-0.124***	-0.125***	-0.128***
	(0.0330)	(0.0330)	(0.0330)	(0.0331)
Observations	1,459	1,459	1,459	1,457

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 8: Probability of recession: synchronicity YER-EQP and equity price cycle

(a) YER-EQP

VARIABLES	(1) rec	(2) rec	(3) rec	(4) rec
L.eqp_yer	-0.0350			
	(0.0325)			
L2.eqp_yer		-0.0101		
		(0.0325)		
L3.eqp_yer			0.0215	
			(0.0325)	
L4.eqp_yer				0.0428
				(0.0326)
Constant	-0.116***	-0.119***	-0.124***	-0.131***
	(0.0325)	(0.0325)	(0.0325)	(0.0326)
Observations	1,565	1,565	1,565	1,559

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Equity price cycle: EQP

VARIABLES	(1) rec	(2) rec	(3) rec	(4) rec
L.eqp_bp_tc_cycle	-0.855***			
	(0.121)			
L2.eqp_bp_tc_cycle		-0.498***		
		(0.118)		
L3.eqp_bp_tc_cycle			-0.146	
			(0.116)	
L4.eqp_bp_tc_cycle				0.154
				(0.116)
Constant	-0.139***	-0.133***	-0.128***	-0.127***
	(0.0318)	(0.0315)	(0.0314)	(0.0315)
Observations	1,606	1,606	1,606	1,599

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 9: Probability of recession: synchronicity YER-LTN and long-term interest rates cycle

(a) YER-LTN

VARIABLES	(1) rec	(2) rec	(3) rec	(4) rec
L.ltn_yer	0.0518			
	(0.0318)			
L2.ltn_yer		0.0566*		
		(0.0318)		
L3.ltn_yer			0.0775**	
			(0.0318)	
L4.ltn_yer				0.0506
				(0.0319)
Constant	-0.145***	-0.144***	-0.144***	-0.142***
	(0.0318)	(0.0318)	(0.0318)	(0.0319)
Observations	1,574	1,574	1,574	1,567

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Long-term interest rates cycle: LTN

VARIABLES	(1) rec	(2) rec	(3) rec	(4) rec
L.ltn_bp_tc_cycle	0.286***			
	(0.0300)			
L2.ltn_bp_tc_cycle		0.294***		
		(0.0300)		
L3.ltn_bp_tc_cycle			0.270***	
			(0.0289)	
L4.ltn_bp_tc_cycle				0.220***
				(0.0272)
Constant	-0.163***	-0.163***	-0.160***	-0.157***
	(0.0321)	(0.0322)	(0.0320)	(0.0318)
Observations	1,615	1,615	1,615	1,607

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 10: Probability of recession: synchronicity YER-LNF and controls

VARIABLES	(1) rec	(2) rec	(3) rec	(4) rec	(5) rec	(6) rec	(7) rec	(8) rec	(9) rec
L.yer_lnf	-0.0174				**-0.129****				
	(0.0433)				**(0.0556)**				
L2.yer_lnf		0.00906				-0.0711			
		(0.0433)				(0.0566)			
L3.yer_lnf			0.00195				-0.0449		
			(0.0433)				(0.0560)		
L4.yer_lnf				-0.0120				-0.0409	
				(0.0434)				(0.0557)	
L.gapreer42_cpi					**-0.0652****				
					(0.0288)				
L.gapca_gdp					-0.00222				
					(0.0159)				
L.gapdebt					-0.157***				
					(0.0239)				
L2.gapreer42_cpi						**-0.142*****			
						(0.0293)			
L2.gapca_gdp						0.0240			
						(0.0159)			
L2.gapdebt						-0.197***			
						(0.0245)			
L3.gapreer42_cpi							**-0.189*****		
							(0.0301)		
L3.gapca_gdp							0.0152		
							(0.0153)		
L3.gapdebt							-0.179***		
							(0.0237)		
L4.gapreer42_cpi								**-0.244*****	
								(0.0308)	
L4.gapca_gdp								-0.00617	
								(0.0164)	
L4.gapdebt								-0.132***	
								(0.0232)	
L8.yer_lnf									-0.0253
									(0.0564)
L8.gapreer42_cpi									-0.224***
									(0.0320)
L8.gapca_gdp									-0.0104
									(0.0177)
L8.gapdebt									**0.0347***
									(0.0199)
Constant	-0.182***	-0.184***	-0.177***	-0.167***	-0.137***	-0.158***	-0.164***	-0.169***	-0.192***
	(0.0433)	(0.0433)	(0.0433)	(0.0434)	(0.0526)	(0.0541)	(0.0543)	(0.0543)	(0.0543)
Observations	877	877	877	873	612	612	612	608	572

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: The sample covers 10 countries for the period 1994Q1-2016Q4. yer_lnf is the synchronicity between real GDP cycle and loan to NFCs cycle. gapreer42_cpi is the difference between the actual REER vis-à-vis 42 partners and deflated by CPI and its long run trend. gapca_gdp is the difference between the actual current account/GDP and its long run trend. gapdebt is the difference between the actual general government debt and its long run trend. Lags are from 1 quarter to 2 years.

Table 11: Probability of recession: real and credit cycles with controls

VARIABLES	(1) rec	(2) rec	(3) rec	(4) rec	(5) rec	(6) rec	(7) rec	(8) rec	(9) rec
L.yer_bp_tc_cycle	4.993***				-2.321				
	(1.639)				(2.253)				
L.lnf_bp_tc_cycle	1.825***				1.900**				
	(0.578)				(0.779)				
L2.yer_bp_tc_cycle		10.25***				2.329			
		(1.685)				(2.257)			
L2.lnf_bp_tc_cycle		1.304**				1.387*			
		(0.577)				(0.776)			
L3.yer_bp_tc_cycle			**13.75*** **				**7.284*** **		
			(1.748)				**(2.221)**		
L3.lnf_bp_tc_cycle			**0.808**				**0.663**		
			(0.576)				**(0.792)**		
L4.yer_bp_tc_cycle				**14.57*** **				**10.21*** **	
				(1.816)				**(2.229)**	
L4.lnf_bp_tc_cycle				**0.451**				**0.0805**	
				(0.573)				**(0.800)**	
L.gapreer42_cpi					-0.0761**				
					(0.0300)				
L.gapca_gdp					0.00364				
					(0.0156)				
L.gapdebt					-0.148***				
					(0.0268)				
L2.gapreer42_cpi						-0.138***			
						(0.0304)			
L2.gapca_gdp						0.0287*			
						(0.0157)			
L2.gapdebt						-0.174***			
						(0.0279)			
L3.gapreer42_cpi							-0.170***		
							(0.0309)		
L3.gapca_gdp							0.0192		
							(0.0156)		
L3.gapdebt							-0.139***		
							(0.0271)		
L4.gapreer42_cpi								-0.218***	
								(0.0314)	
L4.gapca_gdp								-0.00583	
								(0.0178)	
L4.gapdebt								-0.0766***	
								(0.0260)	
L8.yer_bp_tc_cycle									-0.0294
									(2.382)
L8.lnf_bp_tc_cycle									1.012
									(0.816)
L8.gapreer42_cpi									-0.226***
									(0.0323)
L8.gapca_gdp									-0.00899
									(0.0178)
L8.gapdebt									0.0453*
									(0.0245)
Constant	-0.165***	-0.156***	-0.148***	-0.140***	-0.158***	-0.179***	-0.187***	-0.195***	-0.209***
	(0.0433)	(0.0437)	(0.0440)	(0.0442)	(0.0536)	(0.0551)	(0.0559)	(0.0563)	(0.0572)
Observations	873	873	873	871	608	608	608	606	572

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: The sample covers 10 countries for the period 1994Q1-2016Q4. yer_bp_tc_cycle is the real cycle, lnf_bp_tc_cycle is the credit cycle based on loans to NFCs. gapreer42_cpi is the difference between the actual REER vis-à-vis 42 partners and deflated by CPI and its long run trend. gapca_gdp is the difference between the actual current account/GDP and its long run trend. gapdebt is the difference between the actual general government debt and its long run trend. Lags are from 1 quarter to 2 years.