EUROPEAN CENTRAL BANK

EUROSYSTEM

Working Paper Series

Mariarosaria Comunale

A panel VAR analysis of macro-financial imbalances in the EU

CompNet The Competitiveness Research Network

No 2026 / February 2017

Competitiveness Research Network

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Abstract

We investigate the interactions across current account misalignments, Real Effective Exchange Rate misalignments and financial (or output) gaps within EU countries. We apply panel techniques, including a Bayesian panel VAR, to 27 EU members over the period 1994-2012. We find that, for the euro area, the reaction of current account misalignments to a shock in the Real Effective Exchange Rate misalignments is the largest and the financial gap can influence the current account misalignments more than the output gap. In non-euro area countries and euro periphery an increase in current account misalignments leads to a temporary increase in the Real Effective Exchange Rate misalignments, lowering competitiveness and thus amplifying current account fluctuations. For the core, a raise in the rate or an expansion of the financial gap may help in rebalancing the current account. In the CEE members, an increase in the Real Effective Exchange Rate misalignments may bring larger current account deficits in the medium-long run.

Keywords: Current account; real effective exchange rate; financial gaps; panel VAR; foreign capital flows.

JEL Codes: F32, F31, C33.

Non-technical summary

Examining the link between current-account (CA) imbalances and exchange-rate misalignments is of crucial importance especially at EU level, as it is the analysis of the asymmetries in the transmissions of their shocks. The real exchange rate analysis itself, together with the current account assessment, is relevant for economic surveillance in the European Union (EU), as part of the Macroeconomic Imbalance Procedure, and in the IMF assessment for Article IV as well. The external imbalance may contribute significantly to the emergence of bubbles and the cross-country transmission of financial crises (Ca' Zorzi et al., 2012), and it may also be a sign of serious macroeconomic and financial stress (Obstfeld, 2012). The persistence of differences in productivity among EU members have resulted in divergent dynamics in the Real Effective Exchange Rates (REERs)[1] (Salto and Turrini, 2010) and possible misalignments (Comunale, 2015a). In order to assess these factors it is key to build a proper measure of both REER and current account misalignments and analyse how they interact. Here the misalignments are based on country-specific characteristics rather than ad-hoc thresholds (Comunale, 2015b). If we find different misalignments and directions of the shocks transmission, these would require different policy measure to address them.

Therefore, the misalignments for both CA and REER are built as the difference between the actual (or projected) value of the variable and the model-implied equilibrium values. The equilibrium values are country-specific and time-varying and based on the specific theoretical determinants of CA or REER. In both cases the set of determinants includes foreign capital flows divided in net Foreign Direct Investment, portfolio net flows and other net flows (basically banking flows) over GDP. Here we look at how foreign capital flows affect both CA and price competitiveness and the equilibrium values. This is of particular interest within the EU, especially if we look at evolution of tthe new member states before and after the crisis. In these countries, abundant capital inflows after transition and during catching up were often coupled with substancial current account deficits and price competitiveness losses. The same holds for a number of countries in the periphery of the euro area (EA).

Lastly, the importance of financial variables and the financial cycle has been found for current accounts (Comunale and Hessel, 2014; Mendoza and Terrones, 2012) and for REERs via capital flows (Comunale, 2017). Vice versa, Lane and McQuade (2014) show that current accounts play a role in domestic credit growth. Therefore, it is worthwhile including a measure of financial gap as well, as an alternative to a regular output gap to explain the economic and financial fluctuations. The financial gap here is based on real GDP or on domestic demand or credit growth. Hence, our analysis contributes to understanding how these macro-financial gaps react to shocks and how they interact with the misalignments.

In this paper we assess these issues, by applying a panel vector autoregression setup with these three variables (REER misalignments, CA misalignments and financial gap) on a sample of 27 EU countries over the period 1994-2012, with annual frequency. We also make use of the same framework for some sub-samples of countries (namely: core euro area, core non-euro area, periphery and Central Eastern

[1] We use nominal effective exchange rates (NEERs) deflated by the Consumer Price Index (CPI) in calculating the REER *vis-á-vis* the main 37 partners. This is a widely recognized way to proxy for price competitiveness. An increase in the REER means here a decrease in competitiveness.

European (CEE) new member states). We find some robust findings for the whole EU (and euro area) across the specifications: i) CA misalignments and REER misalignments are closely related and affect each other; ii) the reaction of CA misalignments to a shock in REER misalignments is more noticeable than the one to a shock in the gap, iii) the financial gap can influence the current account to a greater extent than the output gap.

The most interesting results are obtained by dividing the sample into main subgroups, which helps us to understand the different role and transmission of each misalignment. There is a high level of asymmetries in the responses and transmission of macro-financial shocks within the EU, in line with the recent literature (Staehr and Vermeulen, 2016). The reaction of the EU core to every shock is very robust compared to the full EU sample and the EA. In Denmark, Sweden and the UK, as in the periphery, an increase in CA misalignments leads to a temporary increase in the REER misalignments, lowering competitiveness and thus amplifying current account fluctuations. This is not found in the case of the euro area core. For the latter, the financial gaps and the REER misalignments may affect the economy, via a decrease in an excessive surplus. For the CEE new member states, the reaction of CA misalignments to a shock in the REER misalignment has instead the opposite sign with respect to the full sample and the core. This is also much bigger in magnitude and very persistently positive over time. This means that, in case of a positive shock in REER misalignment, the CA misalignment itself increases, causing further problems for these countries with regard to a possibly larger CA deficit in the long run. Therefore, while for core non-EA countries and the euro periphery CA imbalances play a major role in affecting other misalignments, in CEE members and in the euro area core the opposite holds true.

Ultimately, for CEE members, a shock in GDP growth itself increases REER misalignments in the short-run, but it decreases CA imbalances in a long-run perspective. So, these economies, which are normally still growing faster than the rest of the EU, can expect a decrease in competitiveness in the short-run (likely related to a Balassa-Samuelson effect or increase in CPI inflation reducing price competitiveness in the short-run) but this can have a positive effect to the CA misalignments in a longer time-span.

1 Introduction

In this paper, we investigate the interactions and asymmetries between current account (CA), Real Effective Exchange Rates (REER) misalignments and financial or output gaps in a EU perspective. The main aim of this paper is to identify the direction of transmissions and to analyse the impact of any gaps for EU and sub-groups, keeping the full heterogeneity in each step. We track the role of the financial (and output) gaps in effecting the misalignments via foreign capital flows and change in production and the (possible) different direction of transmission between the other misalignments.

Examining the link between current-account imbalances and exchange-rate misalignments is of crucial importance at EU level, as is the analysis of the asymmetries in the transmissions within the EU. The current account imbalances that are at the heart of the European sovereign debt crisis are often attributed to differences in price competitiveness, which are easily proxied by Real Effective Exchange Rates (REERs). The focus on competitiveness therefore usually leads to a plea for structural reforms of product and labour markets that would speed up the adjustment of relative prices. However, recent research suggests that domestic demand booms related to the financial cycle may have been as important (Comunale and Hessel, 2014). The exchange rate assessment itself is becoming increasingly relevant for economic surveillance in the European Union (EU) and and as part of the IMF assessment under Article IV. The persistence of different wage and productivity dynamics across the euro area countries or EU members with a fixed exchange regime to the euro, coupled with the impossibility of correcting competitiveness differentials via the adjustment of nominal rates, have resulted in divergent dynamics in the REERs (Salto and Turrini, 2010) and possible misalignments. For example, in the new member countries, abundant capital inflows after transition and during catching up were often coupled with conspicuous current account deficits and price competitiveness losses. The same holds for a number of countries in the periphery of the euro area (EA). This is the reason why it is also key to build a proper measure of both REER and current account misalignments, which should be based on country-specific characteristics rather than *ad-hoc* thresholds (Comunale, 2015b; 2017). As also recently stressed by Staehr and Vermeulen (2016), the consequence of different transmission mechanisms appears to be substantially different across countries and hence, policy responses could be very different in different countries, suggesting that country-specific policy measures are needed for economic and financial stability to be attained. A more refined analysis of the misalignments and their interactions may be of some use for improving the Macroeconomic Imbalance Procedure (MIP), which currently assess these variables on the basis of threshold levels.

It is clear that these two measure of macroeconomic misalignments, current-account imbalances and exchange-rate misalignments, are closely related and can easily influence each other. Given the importance of financial cyle measures for current accounts (Comunale and Hessel, 2014; Mendoza and Terrones, 2012) and REERs via capital flows, it is worthwhile including this financial measure as well as an alternative to a regular output gap. The misalignments are built here taken into account the impact of foreign inflows (as determinants of CA and REER) and the financial gap itself is a measure based on output but also domestic demand or credit. Our analysis contributes to understanding how these gaps, based on both macroeconomic and financial measures, reacts to shocks and how they interact each other. The key would be to track the role of the financial gap/cycle in effecting the misalignments via foreign capital flows and changes in production.

We apply a panel vector autoregression (panel VAR) on a sample of 27 countries[2] over the period 1994-2012, with annual frequency. We first estimate a homogeneous VAR model following Abrigo and Love (2015) by using GMM-style estimators as in Gnimassoun and Mignon (2013). This has been done to compare our results with the previous literature only. Secondly, given our small sample and high level of heterogeneity and interdependence within the EU, we also apply a partial pooling Bayesian panel VAR for EU and country sub-samples.[3] In the latter case, the IRFs are much less significant in the long-run and the confidence bands are extremely wide. In any case we also find some robust findings with respect to the homogenous VAR: i) CA misalignments and REER misalignments are closely related and affect each other; ii) the reaction of CA misalignments to a shock in REER misalignments is larger than the one to a shock in the gap for EU and also the EA, iii) the financial gap can influence the current account misalignments more than the output gap.

However, the most interesting results are obtained by dividing the sample into main subgroups, which helps understand the different role and transmission of each misalignment. There is a high level of asymmetries in the response to macro-financial shocks within the EU and in the directions of transmissions as well. With the Bayesian panel VAR, the reaction of the EU core is again very much comparable to the full EU sample. In Denmark, Sweden and UK, as in the periphery, an increase in CA misalignments leads to a temporary increase in the REER misalignments, lowering competitiveness and thus amplifying current account fluctuations. That is not the case for the euro area core; there the CA imbalances are mostly driven by misalignments in the REER and by the gaps. In this case a REER misalignment (and an increase in the financial gap) may help rebalance the current account in a situation of excessive surplus. The most interesting case is again the CEE new member states. For the CEE new member states, the reaction of CA misalignments to a shock in the REER misalignment has the opposite sign with respect to the full sample and the core. This is also much bigger in magnitude and very persistently positive over time. This means that in case of a positive shock in REER misalignment, i.e. an increase of 1%, the CA misalignment itself increase. This can be due to a worsening in CA equilibrium values in deficit, causing further problems for these countries. Therefore, while for core non-EA countries and the euro periphery the CA imbalances play a major role in affecting other misalignments, in case of CEE members and the euro area core it is other way round.

In the rest of this paper, section 2 introduces the main strands of the literature, in which our paper contributes; section 3 reports the data and how the misalignments are computed; section 4 describes the empirical framework and econometric diagnostics for the panel VAR with the analysis of the results. Section 5 concludes.

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[2] Luxembourg not included because the data on foreign capital flows are not available.

[3] In order to deal with interdependencies across units, we also use a single equation dynamic factor model in the spirit of Pesaran and Tosetti (2011).

2 Literature review

The key imbalances analysed in this paper concern the Current Account, the Real Effective Exchange Rate and financial gap, in the spirit of the recent work of Gnimassoun and Mignon (2013). The latter is indeed the paper which is closer to ours. The authors study the interactions between current account imbalances, REER misalignments and output gap for a sample of 22 industrialized countries, also dividing the sample in euro area members (11 countries, i.e. old EU members excluding Luxembourg) and other countries[4], over the 1980-2011 period. They conclude that positive output-gap shocks as well as currency overvaluation make current-account deficits worse. In addition, while variations in current account imbalances mainly result from exchange-rate misalignments in the euro area, these are mostly explained by output gaps for non-eurozone members.

In our paper, we contribute to this line of research, in a EU context only, using measures of financial gaps rather than output gaps. Financial cycles have been proved to explain current account fluctuations better than the regular business cycle (Comunale and Hessel, 2014). Moreover in constructing our measures of misalignments we take into account the important role of foreign capital flows in determining both REER[5] and current account imbalances. In the literature, Gnimassoun and Mignon (2013) apply a panel VAR model to analyse the transmission mechanisms between disequilibria for a sample of 22 countries with complete homogeneity in the coefficients. We consider instead the inner heterogeneity of the EU member in computing the misalignments and in the VAR section by using a Bayesian framework with partial pooling. In any case, we do report both an analysis with regular panel VAR (the estimation method follows Abrigo and Love, 2015) and then we will apply the Bayesian panel VAR with heterogeneous coefficients and interdependencies.

Recently Staehr and Vermeulen (2016) analysed the relationship between output gap, credit gap, current account gap and measures of REER. The vector autoregressive models in this paper are estimated on quarterly data from 1995 to 2013 for 11 individual euro area countries[6] and the whole euro area. The authors find that deteriorating competitiveness is followed by a decline in GDP relative to trend in most of the 11 euro area countries; the relationship is less clear for credit growth and current account balances. The role of spillovers in the whole euro area setup is not considered here, however the cross-country heterogeneity is analysed estimating individual VARs.

Apart from these two comprehensive works, several strands of literature are related to our research and refer to the calculation of each misalignment: REER, current account and financial gaps and some of their interactions.

Recently in Comunale (2015a; 2017), the author provides an analysis for the EU by using either NFA position as a REER determinant (as in the "transfer problem" literature) or different foreign net flows (as also in Carrera and Restout, 2011). The key point of these studies is that the core countries are found to have been mostly undervalued, while periphery (excluding Ireland) were overvalued starting from 2003-2004, as expected, if foreign net inflows are added. As regards the new member states, these are persistently overvalued for the entire time span. The results seem to be generally driven by the

[4] 11 countries including Australia, Canada, Denmark, Iceland, Japan, New Zealand, Norway, Sweden, Switzerland, UK and the US.

[5] Gnimassoun and Mignon (2013) consider as REER determinants only NFA/GDP and a proxy for relative productivity.

[6] Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, Portugal and Spain.

inflows of banking loans more than by FDIs or portfolio investments. The results are consistent if the NFA position is used. The REER misalignments associated with the inflows have been a further cause of a decline in GDP, in a long-run perspective, while they do not play a role in the short run.

For the current account, there is a large body of literature, both theoretical and empirical, on the potential factors that can influence its dynamics, including: demographics, fiscal policy, the catching-up potential, as well as various institutional characteristics that can affect the ability to borrow abroad by Government and private sector (see IMF CGER, 2006; Rahman, 2008; Calderon et al., 2002; Chinn and Prasad, 2003 and Bussiére et al., 2010). Most of these variables are used in relative terms and constructed as deviations from the weighted averages of the main foreign trading partners. As regards these long-run determinants of CA, we looked at the more recent models by Lee et al. (2008) and Medina et al. (2010). In these articles the determining factors are indeed the fiscal balance, old-age and young-age dependency ratio and population growth, the initial NFA, the oil balance, a relative income measure, relative output growth, and net FDI flows/GDP (in Medina et al., 2010). A more comprehensive analysis of CA determinants can be found in Ca'Zorzi et al. (2012). There are only few studies on the combination of determinants and possible misalignments of REER and CA with the Macroeconomic Balance approach, compared with the literature on the BEER, which is quite extensive. Some recent studies, e.g. Darvas (2015), pointed out the issue regarding current account determinants and misalignments. This paper applies panel econometric models to analyse the determinants of medium-term current account balances and then studies the gap between the actual current account and its fitted value in the model as a measure of misalignment. It concludes that current account deficits in several EU countries were highly excessive before the crisis according to our results and were forcefully corrected. Recently, Gnimassoun and Mignon (2015), considered whether the persistence of the current account misalignments nonlinearly depends on REER misalignments. The main findings from this paper are that the persistence of current account imbalances depends on REER misalignments and tends to increase for overvaluations higher than 11%; misalignments in the current accounts tend to be persistent even for very low REER overvaluations in the euro area only. This strong relationship between the two misalignments reinforces the need to investigate and identify the direction of the transmission across these disequilibria. Comunale (2016) finally shows the possible determinants of current accounts for EU countries and computes the misalignments in the spirit of the IMF CGER method. In the case of core countries the initial Net Foreign Asset position and oil balance seem to matter more, instead for periphery and CEE new member states the effect of capital flows is much stronger. A reduction of the fiscal deficit (or "fiscal consolidation") larger than the partners seems to lead to a worsening of the current account balance for the periphery; while is the opposite for CEE new member states. The misalignments show a cyclical behaviour during the last 20 years in the most of the EU members and the magnitude of the cycles themselves are very heterogeneous across groups.

Lastly, as regards financial gaps and their interactions between them and macroeconomic variables, there are some recent contributions. Mendoza and Terrones (2012), for example, identify credit booms in a sample of 61 advanced and emerging economies between 1960 and 2010, and show that these booms tend to boost domestic demand and widen external deficits. Vice versa, Lane and McQuade (2014) show for 30 European countries between 1993 and 2008 that net capital inflows (as measured by, for instance, current account deficits) tend to increase domestic credit growth. They obtain similar results for a wider sample of 54 advanced and emerging economies. Jordá, Schularick and Taylor (2011) show for 14 advanced countries between 1870 and 2008 that the link between credit booms and current account deficits has become much closer in recent decades. Then, Comunale and Hessel (2014) investigate the relative role of price competitiveness and domestic demand as drivers of the current account imbalances in the euro area looking at fluctuations at the frequency of the financial cycle. They conclude that although differences in price competitiveness have an influence, differences in domestic demand are more important than is often realized and fluctuations at the frequency of the financial cycle are more suitable to explain the current account than fluctuations at the frequency of the normal business cycle.

3 Misalignments and data description

3.1 Calculation of the misalignments

For this analysis we use annual data for 27 EU[7] member states from 1994 to 2012 (in case of REER misalignments) or 2014 (for output gap and financial gaps, current account misalignments and GDP growths).[8]

We computed the misalignments for the REER as in the paper by Comunale (2015a, 2017). The author firstly estimated the coefficients with regard to the fundamentals of the REER, namely: the foreign net capital inflows ($flows$ divided in FDIs, portfolio investments and other investments), the terms of trade as exports unit value over imports unit value (tot) and the Balassa-Samuelson effect represented by the real GDP per capita relative to the partners (bs).[9] The theoretical background of this setup can be found in Lane and Milesi-Ferretti (2004) and in Corden (1994). The equilibrium rate is calculated as the estimated coefficients, by using the Group-Mean Fully Modified OLS (GM-FMOLS)[10], times the HP filtered value of the fundamentals (Carrera and Restout, 2011). The REER misalignments are therefore the difference between the actual rate $reer_{i,t}$ and its equilibrium value $\overline{reer}_{i,t}$. The resulted misalignments are shown in the Appendix (Figure A).

$$reer_{i,t} = \alpha_i + \beta_{i,t} X_{i,t} + \varepsilon_{i,t} = f(flows; tot; bs) \tag{1}$$

$$\overline{reer}_{i,t} = \widehat{\beta}_t \cdot X_{i,t}^{HP} \tag{2}$$

[7] We do not have data for portfolio and other flows in case of Luxembourg. This may affect the results of the current account imbalances. We did the analysis also excluding this country, and the differences are negligible.

[8] The full description of data coverage is in Table 1, provided in the annex.

[9] For an analysis on the impact of different proxies for the Balassa-Samuelson effect, based on relative productivities, in EU 28, see Comunale (2015a). In this paper two alternative measures are considered in estimating the REER determinants: productivity in industry as a proxy for productivity in manufacturing (value added in constant 2005 USD over number of employees) relative to weighted average of partners and the productivity in industry over productivity in services relative to weighted average of partners. The results are comparable with the ones with relative GDP per capita as a proxy for the Balassa-Samuelson effect.

[10] The panel is cointegrated and the differences among countries led us to assume that preference should be given to heterogeneous coefficients. In this case, as proved by Pedroni (2000), the simply panel OLS estimator for the static setup cannot be used because it would be biased. We therefore prefer the GM-FMOLS estimator, which is built as the average of the within FMOLS estimator over the cross-sectional dimension. The Fully Modified OLS (FMOLS) is a semi-parametric correction to the OLS estimator which eliminates the second order bias induced by the endogeneity of the regressors.

$$REEER\_mis_{i,t} = reer_{i,t} - \overline{reer}_{i,t} \tag{3}$$

The current account misalignments for the EU 27 members follow the Macroeconomic Balance (MB) approach of the IMF CGER and are calculated as the differences between the the underlying Current Account based on IMF and UNDESA projections ($CAunderlying_{i,t}$) and Current Account "norm" based on the estimation of the Current Account determinants ($CAnorm_{i,t}$). The first can be seen as the "actual" CA in the medium-run and the second as a CA equilibrium value. The outcomes here used are from a companion paper (Comunale, 2016)[11], which extends the MB method applied previously for the CEE new member states (Comunale, 2015b) to the whole EU.

The MB method starts with the estimation of determinants as in Lee et al. (2008), Medina et al. (2010) and Rahman (2008). These are also the main determinants in the subset of fundamentals taken into account in Ca' Zorzi et al. (2012). The factors considered here 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[12]) and the net FDI flows/GDP (considered in Medina et al., 2010); portfolio net flows/GDP and other net flows/GDP. Hence, we consider all net foreign capital flows as determinants for the current account.[13]

The CA "norm " is hence built as the estimated coefficients for each determinants (X) multiplied by the projected variables taken from IMF WEO or UNDESA[14] as also in the IMF CGER and Lee et al. (2008). For year 2014, for instance, the latest projections are for 2020 (as t+H), so we use for each year considered the projection for the 6th year ahead (H), as in equation (5). The $CAunderlying$ is again the projected CA/GDP value from IMF WEO at time t+H. If t+H is before 2014, the projected data are replaced by the actual ones.[15] The resulted misalignments are shown in the Appendix (Figure B).

$$(CA/GDP)_{i,t} = \alpha_i + \beta_{i,t} X_{i,t} + \varepsilon_{i,t} \tag{4}$$

$$CAnorm_{i,t} = \widehat{\beta}_t \cdot X_{i,t+H} \tag{5}$$

$$CA\_mis_{i,t} = CAunderlying_{i,t+H} - CAnorm_{i,t} \tag{6}$$

The financial gap measures are taken initially as simply as a longer cycle (compared with the regular business cycle, which is of around 8 years) based on real GDP, domestic demand or credit to the private sector. These measures have been computed from HP filtering the series with a smoothing parameter

[11] This paper is provided here as a separated Annex.

[12] We do have a dummy for the years after 2008, in order to control for a possible break after the beginning of the global crisis.

[13] As in Oeking and Zwick (2015), the financial account Granger-causes the current account during economic upturns (data on OECD countries). More specifically, short-term flows seem to finance the current account during economic downturns, while inducing its changes during upturns. This is particularly true for net other investment flows and for portfolio flows in some cases. The link to business or financial cycles is rather straightforward.

[14] Also the projected variables, if taken relative to partners in the estimation, are in relative terms.

[15] For more details on how they are computed please refer to Comunale (2016).

lambda equal to 100,000. This represents indeed a cycle of more than 20 years. Following Drehmann et al. (2011), the financial cycle has a much longer duration and wider amplitude than normal business cycles. While normal business cycles have a frequency of up to 8 years, the frequency of the financial cycle is thought to be around 20 years. The last measure is a synthetic index and is computed using the Principal Component Analysis on output gap, credit to the private sector/GDP growth and domestic demand growth, just first component. The major advantage of this synthetic index is that the underlying series are stationary and resemble more closely to an output gap. Similar measures have been used by Comunale and Hessel (2014) for their analysis on the role of financial cycles in explaining CA imbalances. The data on the financial gap measures come from the database by Comunale (2015c).[16] A simple measure of output gap based on real GDP is also provided for comparison.

3.2 Data description

The data we used to compute each misalignment and gap are explained in the cited papers and here reported for convenience.

As regards the REER determinants, the data we use to estimate the model cover the period from 1994-2012 with annual frequency for 27 EU members. The dependent variable is the REER deflated by the CPI *vis-á-vis* 37 partners. The data is from Eurostat. The same weights have been used to compute the GDP per capita in constant euro relative to average of partners. The first explanatory variables are the foreign net capital inflows (divided in FDIs, portfolio investments and other investments), these data are taken from IMF World Economic Outlook (WEO). Lastly we used the terms of trade as exports unit value over imports unit value and the Balassa-Samuelson effect represented by the real GDP per capita relative to the partners. The data for the first variable are from World Bank World Development Indicators (WB WDI). The Balassa-Samuelson measure is calculated from WB WDI data as well.

For the current account determinants, the data used to estimate the model covers the period from 1994–2014 at annual frequency for 27 EU member states. The complete analysis for the EU is provided in a separate paper (Comunale, 2016) and the data description is summarised as follows. The dependent variable is the current account over GDP from IMF WEO. Among the regressors, the initial Net Foreign Asset position is taken from the External Wealth of Nation dataset, in the updated and extended version by Lane and Milesi-Ferretti (2007). The fiscal balance, old-age and young-age dependency ratio, population growth, real GDP per capita growth and GDP per capita PPP (taken as the ratio w.r.t. the US values) are used in relative terms with the same time-varying weights applied for the REER. The REER itself is the real effective exchange rate deflated by the CPI *vis-á-vis* 42 partners. The data for these variables are from IMF WEO, WB WDI and UNCTAD. The data for the REER comes from Eurostat. The oil balance and FDI/GDP, portfolio investments and other investments are taken from IMF WEO. The old-age dependency ratio is defined as the ratio of older dependents (people older than 64) to the working-age population–those ages 15-64. Data are shown as the proportion of dependents per 100 working-age population. The young-age dependency ratio is instead the ratio of younger dependents

[16] The database is publicly available and freely downloadable from the website of the Bank of Lithuania at www.lb.lt/databases.

(people younger than 15) to the working-age population–those ages 15-64. For the data 1994-2014, the source of the dependency ratios is WB WDI, as for population growth. The projected data for the demographics and the population growth are from UNDESA and averaged 2015-2020.[17] The last variable is taken at constant fertility rate (as Lee et al., 2008) with average exponential rate of growth of the population over a given period.[18] We do have a dummy for the years after 2008, in order to control for a possible break after the beginning of the global crisis.

As explained in the section above, the projected variables for the CA norm are from IMF WEO or UNDESA[19] (for year 2012 the latest projections are for 2018). For the portfolio flows (net) over GDP and other flows (net) over GDP no projections seemed to be available, therefore we used HP filtered values corresponding to the year taken into account (for instance HP filtered value for 2012 in case of CA equilibrium for year 2012).[20]

Lastly, we calculate the financial gap in two ways: as a longer cycle based on real GDP of about 20 years. The real GDP index 2010=100 is from IMF IFS.[21] We also use domestic credit to private sector in % of GDP (WB WDI) as index 2010=100[22] and domestic demand as an index 2010=100 from data in Euros seasonally and working days adjusted (Eurostat). The latest measure of the cycle is a synthetic index is based on a Principal Component Analysis on output gap and the growth rates of domestic demand and credit to the private sector (constructed in this way in order to have a stationary measure). The real GDP growth (as percentage change with respect to the previous year) and the world real GDP growth are from IMF IFS.

The description of the source of each variable in the panel VAR setup is provided in the annex, namely: current account misalignments; REER misalignments; financial gap measures; the regular output gap; real GDP growth and real world GDP growth. Only the two latter variables come from an external source, while the other variables are calculated as explained in this paper.

4 Panel VAR analysis of imbalances

4.1 Empirical framework

After calculating all the three gaps, we structure our framework to analyse the interactions among them. We apply a Panel VAR on a sample of 27 countries with annual frequency over the period 1994-2012.[23]

In VAR models all variables are treated as endogenous and interdependent, both in a dynamic and in a static sense, although in some relevant cases, exogenous variables could be included (Ciccarelli and Canova, 2013). In our baseline case we have only endogenous variables. This setup also allows us to

[17] We use the non-averaged data only for year 2015 and 2020.

[18] It is calculated as ln(Pt/P0)/t where t is the length of the period. It is expressed as a percentage.

[19] UNDESA, World Population Prospects: The 2015 Revision (July 2015).

[20] In the case of Slovenia, the data concerning 1995 are equal to the ones for 1994, because of a gap in the data series. For year 2013 and 2014, we use the last data series available, i.e. for year 2012. Only for 2014, we use HP filtered series in case of FDIs.

[21] For France, Germany, Italy, the Netherlands, Portugal, Spain, and UK, the Real GDP is seasonally adjusted.

[22] No gaps for HP: Austria, Belgium, France, Lux, NL 98-99-00 taken as the value in 97; Finland, Germany, Ireland, Italy, Portugal, Spain 99-00 as 98; Latvia, Lithuania 09 as 08.

[23] More details on the data coverage in Appendix.

study the Impulse Response Functions (IRFs) of different shocks and how these affect other imbalances. For instance we investigate how a shock to the output or the financial gap affects CA and REER and vice versa. The main point is to identify the direction of the transmission across these macroeconomic and financial variables (Hurlin and Dumitrescu , 2012), in order to better understand the periods of boom and bust in some EU countries in the periphery and in CEE new member states and the asymmetries between their behaviors and the core's.

In our case, we want to identify how the financial cycle influences other misalignments, therefore the cyclical components are assumed to be more exogenous in the setup.[24] As regards CA and REER misalignments, the identification is not that straightforward. On one hand, REER can be taken as the most endogenous variable, because its determinants are a Balassa-Samuelson proxy (as real GDP per capita relative to the partners) and NFA in the "transfer problem" literature (which includes cumulative CAs). However, in our case NFA is replaced by foreign capital flows. On the other side, the CA balance can be determined by price competitiveness and cyclical components (Comunale and Hessel, 2014; among others) and, we believe, should be more endogenous. Moreover, the REER misalignments themselves can be influenced by the cycles with a lag (for instance internal devaluations during the crisis). A variable that is higher in the ordering causes contemporaneous changes in subsequent variables. Variables that are lower in the ordering can affect previous variables only with lags.

In this identification, we add the variables in the following ordering from the more exogenous: financial cycle/output gap, REER misalignments and CA misalignments. In the setup with GDP growth, the overall effect is meant to be on GDP, therefore we place the series as the most endogenous in that regards (ordered at the very end of the matrix).

We also provide a causality test as in Dumitrescu and Hurlin (2012).[25] They propose a simple test of the Homogenous Non Causality (HNC) hypothesis. Under the null hypothesis, there is no causal relationship for any of the units of the panel. The alternative hypothesis is that there is a causality relationship from X to Y for at least one cross-sectional unit. The results are provided in Table (1) for the whole EU sample. We look at the misalignments, financial (fingap1) or output gap and world GDP.

[Insert Table 1 around here]

The direction of transmission and causality appears to be in line with our assumption, especially if we use financial gaps. We do find some key differences if the output gap is included. The REER misalignments do not Granger cause financial gaps,[26] while it can in case of output gap with any lag applied (the null of homogeneous non-causality is rejected at 10%). With regard to the transmission from CA misalignments to the financial gap we can strongly reject the null of homogeneous non-causality, while is much less evident in case of a transmission to output gap especially with 2 lags. CA misalignments can also Granger cause REER misalignments (null rejected at 5% with lags). So, CA misalignments can Granger cause financial gap and REER misalignments with 1 lag, supporting our preferred specification's

[24] In Gnimassoun and Mignon (2013) the authors find that it is the economic overheating that leads to an exchange-rate overvaluation in the euro area.

[25] It is a test statistic for heterogeneous panels based on the individual Wald statistics of Granger non causality averaged across the cross-section units.

[26] The non-causality hypothesis is strongly accepted only with 2 lags, however, and this is in line with our identification which uses only 1 lag.

ordering. REER misalignments on the other side can also strongly influence CA misalignments with any lags. So the direction of transmission is not clear by using this test. The financial gap strongly affects CA and REER misalignments, as in our preferred setup, while it does not always apply to output gap. Interestingly, output gap Granger causes financial gap while it is not the case vice versa with 1 lag applied. World GDP is not exogenous in our panel assumption, it strongly influences misalignments and output gap (while not financial gap) and can be lagged Granger caused by output gap back.

To sum up, in our identification, a variable that is higher in the ordering causes contemporaneous changes in subsequent variables (i.e., in our case, they are the financial and output gap to REER and CA; the REER affects contemporaneously only CA). Variables that are lower in the ordering can affect previous variables only with lags (which is the case of REER on the gaps and CA on both gaps and REER). In any case, we provide some sensitivity checks, especially in replacing CA with REER misalignments in the ordering.

After that, we test for stationarity in our series. The gaps are built via HP filtering the series or by using output gap and growth rates (i.e. in the case of the synthetic index) and they should indeed be stationary.[27] The same is for Real GDP growth and world real GDP growth, which should be also stationary. For REER and CA misalignments, this conclusion may not be straightforward. The first measure is constructed via HP filtered values of the fundamentals and coefficients as in Equation (3). The second instead is made by using the value of the fundamentals at $t+H$ period ahead (Equation (5)).

Firstly, we find the presence of cross-sectional dependence in our panel,[28] therefore, we check the stationarity of our variables using a second generation t-tests proposed initially by Pesaran (2007) for a single factor structure. This is designed for analysis of unit roots in heterogeneous panel setups with cross-section dependence (i.e. the cross-sectionally augmented panel unit root test also called CIPS).[29] Moreover, we check our results by using the CIPS test in case of multifactor error structure as in Pesaran et al. (2013).[30] The basic idea is to exploit information regarding the unobserved common factors shared by other time series in addition to the variable under consideration. As reported in Pesaran et al. (2013), it is natural to expect macro-financial variables, as in our case, to share the same factors. The results confirm the outcomes from the single-factor CIPS.[31] We conclude that the series in our panel VAR can

[27] It has been argued in favor of the filter, that a gap calculated with an HP-filter is a stationary time series even if the original series is I(1) or even integrated of a higher degree (Cogley and Nason 1995).

[28] Pesaran's test for cross-sectional dependence is based on Pesaran (2004). Pesaran's statistic follows a standard normal distribution and is able to handle balanced and unbalanced panels. It tests the hypothesis of cross-sectional independence in panel data models. We strongly reject independence in our panel setup.

[29] Null hypothesis assumes that all series are non-stationary. This t-test is also based on Augmented Dickey-Fuller statistics as IPS (2003) but it is augmented with the cross section averages of lagged levels and first-differences of the individual series (CADF statistics). For the REER and CA misalignments we reject the null of non-stationarity at 1% (for REER t-bar = -2.873 with no lags and -3.229 with 1 lag ; for CA t-bar = -2.874 with no lags and -2.536 with 1 lag). The full set of results is available upon request.

[30] We acknowledge the kind help by Markus Eberhardt, who coded a Stata command to implement the multifactor CIPS test -*xtcipsm*-.

[31] We do not include lags for the augmentation, especially because of the limited T-dimension of our panel. As explained in the routine by Markus Eberhardt, we estimate heterogeneous country regressions where Y is the variable for which you are studying stationarity and X and Z are the two additional variables you include to account for common factors. Hence we perform the test with each Y as in the VAR and X and Z as the other variables. We therefore apply the *xtmg* routine in Stata (Eberhardt, 2012) and average the t-ratios across our N=27 countries. We compare the averaged t-ratios (called t-bars) to the simulated critical values as in Pesaran et al. (2013) with N=30, T=20, 2 factors, no linear trend, k=1 (i.e. number of factors minus 1). For the CA misalignments the t-bar is -3.342 (0 lag) and -2.487 (1 lag) and we reject the null

be considered stationary and the gaps should stabilize in the long-run.[32]

Having performed the tests, we can describe the main structure of our panel VAR, as follows (Ciccarelli and Canova, 2013):

$$Y_{i,t} = A_{0i}(t) + A_i(l)Y_{i,t-1} + F_i(l)W_{t-1} + u_{i,t} \tag{7}$$

where $Y_{i,t}$ is the vector of our variables described in the preferred identification scheme as $Y_{i,t}$ = $(gap_{i,t}, REER\_mis_{i,t}, CA\_mis_{i,t})$. W_{t-1} represent the vector of exogenous variables (if present). We compact into $A_{0i}(t)$ all the deterministic components of the data (constants, seasonal dummies and deterministic polynomial in time). $A_i(l)$ and $F_i(l)$ are polynomials in the lag operators (assumed heterogeneous across units as in Ciccarelli and Canova, 2013; however we are also use homogeneous coefficients in our first panel VAR specification). $u_{i,t}$ are the dentically and independently distributed errors $u_{i,t} \sim iid(0, \sum_u)$. Lags of all endogenous variables of all units enter the model for i, i.e. we allow for "dynamic interdependencies". As an extensions we use also i) $Y_{i,t} = (wgdpgr_t, gap_{i,t}, REER\_mis_{i,t}, CA\_mis_{i,t})$ where $wgdpgr$ is world real GDP growth and ii) $Y_{i,t} = (gap_{i,t}, REER\_mis_{i,t}, CA\_mis_{i,t}, gdpgr_{i,t})$ with $gdpgr$ is the real GDP growth of each country.

Initially, we run this exercise with the homogeneous balanced panel VAR method for the sample 1994-2012 using the Abrigo and Love (2015)'s GMM-type estimators, mainly as a comparison with previous studies.[33][34] This choice of method is based on the fact that they have been proved to be consistent especially in fixed T and large N settings, however one main assumption is that errors are serially uncorrelated (we do not count for possible cross-sectional dependence). In addition, in our case both T and N are relatively small. We apply the two lags of each variable as instrumental variable.[35] Standard error bands are generated by Monte Carlo with 1000 simulations with confidence bands at 68% and the IRFs are considered to a one-unit shock. The forecast horizon is computed at 10 years to investigate the reaction to financial cycle, which is often argued to be normally longer than a regular business cycle (Drehmann et al., 2012). Ultimately, we control for global factors, here proxied by world GDP growth ($wgdpgr$), in order to weaken (the strong part of) possible cross-sectional dependence.[36] This variable

of non-stationarity at 1% (0 lag) and 5% (1 lag); for the REER misalignments we reject the null of non-stationarity at 5% in case of no lags (t-bar = -2.707 with 0 lag and -1.929 with 1 lag).

[32] This is in line with Gnimassoun and Mignon (2013).

[33] Similar to Gnimassoun and Mignon (2013), which apply Love and Zicchino (2006). Abrigo and Love (2015) is an extended and updated version of Love and Zicchino (2006).

[34] As a robustness check, we also apply an alternative method and command by Cagala and Glogowsky (2014) (We acknowledge the help provided by Tobias Cagala in implementing the command), which fits a multivariate panel regression of each dependent variable on lags of itself and on lags of all the other dependent variables using the least squares dummy variable estimator (LSDV) as in Bun and Kiviet (2006). however, it is good to recall that LSDV is consistent when T goes to infinity. This can be an issue having only a small T (Nickell, 1981). As in regular Cholesky identification scheme, our variables have to follow a causal ordering. Variables that are lower in the ordering affect previous variables with lags (here assumed only one because of the small size of our panel). We use the nonparametric residual bootstrap algorithm with the temporal resampling scheme. This allow us to have no temporal dependence in the residuals, however still considering the presence of cross-sectional dependence. The results are very much in line with our findings by using Abrigo and Love (2015).

[35] Fixed effects are removed by Helmert transformation. The variables are taken as deviations from forward means and each observation has been weighted to standardize the variance (Love and Zicchino, 2006; Gnimassoun and Mignon, 2013).

[36] This method is inspired by Solberger (2011), which however only adds an omitted variable, constant in the cross-section, forcing exogenous common factor dependence. As reported by the same author, simply demeaning the dependent variable

helps us to disentangle the effects of global factors on the financial gap and other misalignments for instance. This variable will be treated as both endogenous, assuming that the EU can also influence global GDP, or exogenous. Ultimately, we apply the same setup to each of the sub-groups: core, periphery and CEE new member states, in order to look at the asymmetries within the EU.

However, if we want to take into account the full interdependencies inside the panel (across variables in every unit) and therefore heterogeneous dynamics, a partial pooling analysis appears to be a more suitable framework because is feasible with small T and small N and when the degrees of freedom in the panel VAR are small (Canova and Ciccarelli, 2013). Exact pooling is indeed problematic with dynamic heterogeneities and when T is short. "Partial" pooling can give better (less biased and more precise) estimates. It can be done shrinking individual estimates (constructed with short T) toward some pivot value. There are Classical and Bayesian shrinkage procedures. The main advantage of Bayesian methods is that they use both weighted mean of prior and (small) sample information.

Hence, at a second stage, given our small sample N=27; T=19 (balanced panel 1994-2012), we decide to use a Bayesian panel VAR, rather than a simple panel VAR, with heterogeneous dynamics and fixed effects applying the Bayesian partial pooling estimator for coefficients.[37] We also use a Cholesky identification scheme with 1000 Monte Carlo draws for standard errors and an horizon of 10 years for the IRFs.[38] The pooling parameter is set small (0.01), implying almost perfect pooling. The model is now as Equation (7) without $F_i(l)W_{t-1}$ in our case, but we also impose that:

$$\alpha_i = \overline{\alpha} + \nu_i \tag{8}$$

where $\alpha_i = [vec(A_i(l)), vec(A_{0i})]'$ and $\nu_i \sim iid(0, \sum_\nu)$.

The Bayesian way to treat this structure is using α_i as an exchangeable prior and then the posterior of α_i itself and the average $\overline{\alpha}$ are obtained by a combination of this prior and the likelihood of the data. The weights are given by the relative precision of the two types of information abovementioned. Indeed if $\overline{\alpha}$ and $\sum_\nu$ are unknown, the Gibbs sampler is applied as in this case (the alternative is by using a training sample).

The misalignments are based on equilibrium values, which can change over time due to fluctuations in the fundamentals. These measures take into account determinants relative to partners for the CA and REER (with trade weights) and the REER itself is a trade weighted measure. Moreover the cycles at the national level are closely related to the global cycle (Kose at al., 2013).[39] Therefore in a way some spillovers and global effect are already captured in our model. However, a setup which explicitly look at these cross-sectional determinants would be needed.

As a robustness check, we also apply a single equation dynamic factor model in the spirit of Pesaran and Tosetti (2011) with slope heterogeneity. This approach deals with cross-sectional dependence (CSD) in the panel, and hence interdependencies across units of the variables in our model (Canova and Cic-

would be unsatisfactory.

[37] The initial code has been provided by Fabio Canova (version 25/01/2016) and then we made some changes in order to match our setup for 3 endogenous variables.

[38] Gibbs sampler is applied.

[39] The authors show that national business cycles are tightly linked to the global cycle, but the sensitivity of national cycles to the global cycle is much higher during global recessions than expansions.

carelli, 2013). By using the so-called Augmented Mean Group (AMG) estimator by Eberhardt and Teal (2010) we also treat the unobserved common factors, not as a nuisance but as key factor in our preferred setup.[40] Therefore, the general specification in equation (9) will become as follows:

$$\mathbf{y}_{i,t} = \beta_i' \mathbf{x}_{i,t} + \gamma_i' \mathbf{f}_t + \mathbf{e}_{i,t} \tag{9}$$

where $\mathbf{x}_{i,t}$ is the vector of observed individual effects $(gap_{i,t}, REER\_mis_{i,t}, CA\_mis_{i,t})$ and $\mathbf{f}_t$ is a vector of m unobserved common factors (our spillovers or global factors), which affect all the individuals at different times and degrees allowing for heterogeneous slopes represented by the vector $\gamma_i' = (\gamma_{i1,....}\gamma_{im})'$.[41] A major drawback of this approach is that it does not take into account dynamic interdependencies across the variables. Hence, together with this dynamic factor model, we also include in our preferred Bayesian panel VAR setup a variable to count for possible spillovers across the members.

4.2 Results: Homogeneous panel VAR

We start with a homogeneous panel VAR setup in order to compare our results with the previous literature (especially Gnimassoun and Mignon, 2013). We relax this assumption later by using a more appropriate setup with heterogeneous coefficients and corrected for cross-sectional dependence and small sample bias via a Bayesian panel VAR structure. For the homogeneous VAR, we apply GMM-style estimators to deal with the Nickell (1981) bias as in Abrigo and Love (2015).[42] We report initially the IRFs for the EU27 in case of financial gap obtained from real GDP (Figure 1) and the regular output gap (Figure 2). Therefore we run the exercise with different measures of financial gap[43] or including world real GDP growth (Figure 3) or country's real GDP growth (Figure 4).

[Insert Figure 1-4 around here]

Both the CA and REER misalignments react positively to a shock in financial gap or output gap, however it is much more persistent and decreases more smoothly in the former case. The reaction of the misalignments to shock to financial gap lasts for 5 years, while it does for 3 years in case of shocks in output gap. Moreover, the response of REER misalignment is bigger in magnitude. These findings are very robust across different identification schemes.[44] A 1% shock in REER misalignments causes a decrease of CA misalignments by -0.1%, which is rather counterintuitive, and also for this impulse response it is more persistent if we include a financial gap measure instead of output gap. In addition, in the financial specification the dip is reached later in time. The effect on the financial gap itself on a shock on REER is much bigger in magnitude (-0.4%) with respect to the second case (-0.15%). The 1% shock

[40] There are various way to estimate this factor model, we decided to use the AMG estimator in our analysis. The AMG uses an explicit estimate for the unobserved common factors, while in the CCEMG they are proxied by the cross-section averages of the dependent variable and of the regressors. These estimators are indeed designed for 'moderate-T, moderate-N' macro panels, where moderate typically means from around 15 time-series/cross-section observations.

[41] Normally in the dynamic factor models we have also as the vector of observed common effects $d_i' = (d_{i1,....}d_{im})'$. In our setup we do not have observed common time-varying factors.

[42] It is good to recall that LSDV is consistent when T goes to infinity. This can be an issue having only a small T (Nickell, 1981).

[43] Results available upon request.

[44] Results available upon request.

in CA misalignments affects negatively the REER only in the medium-run and it is almost not significant in the setup with output gap. If we include other measures of financial gaps, obtained by using domestic demand or credit, in the first case the results are similar to our baseline, while for the latter only the IRF of a shock in the gap to CA and REER is significant but smaller than in the baseline. Cycles related to the domestic demand seem to matter in transmitting shocks to other macro-financial variables. The weaker reaction to the credit to the private sector is because the indicator itself is taken over GDP.[45] We also include world real GDP growth, as an endogenous variable (Figure 3a) or exogenous (Figure 3b). In the first setup, only the financial gap reacts promptly and persistently. Meanwhile, REER and CA misalignments react only after 2 years. Especially the CA imbalances, in the short-run, seem to decline as the world GDP growth increases. If we use the world GDP growth as an exogenous variable, the results are very much comparable with our baseline in Figure 1. More interesting is the reaction to shocks of the GDP growth (Figure 4), the biggest negative impact is due to a shock in the financial gap (-0.4%), which is also very persistent in the long-run. The CA misalignments cause a reaction that last only in the 2 years afterwards and the IRF to REER is back to zero in fewer than 5 years' time. The financial gap shock appears to play a key role in affecting growth in the EU, but also the other two imbalances can decrease the GDP growth, especially in the short-run. The reaction of GDP growth to a REER misalignment shock is more persistent.

We also perform the VAR only for euro area members (19 countries); the reactions to shock in the financial gap are very similar with respect to the whole sample (Figure 5a). The CA misalignments react more intensively to a shock in REER (-0.25% compared to -0.1% for the whole EU). All the IRFs show a more persistent reaction of the variables to macro-financial shocks, especially in the case of transmission from REER to CA and vice versa. The reaction of the CA misalignments to a shock in the REER is bigger than to a shock in the gaps. These findings are very much in line with the ones in Gnimassoun and Mignon (2013) for the euro area.[46] In Figure 6, we add also here GDP growth. The reaction of GDP growth to CA and financial gap shocks in the euro area are the same as for the whole EU. However, for euro area members, the REER misalignment shock seems to matter even more (-0.25%) and it is still persistent. This finding is also in line with Comunale (2017), where the author shows that the REER misalignments associated with the inflows have been a further cause of a decline in GDP, in a long-run perspective.

[Insert Figure 5-6 around here]

[45] As a robustness in the homogeneous setup, we also apply the setup in Cagala and Glogowsky (2014) with also different ordering in Cholesky as sensitivity checks. The results are very much in line with our findings by using Abrigo and Love (2015). With our preferred identification scheme: REER and CA misalignments respond to shocks in financial gap positively; REER shocks impact only CA misalignments in the medium-run up to year 4 and the CA gap shocks influence negatively the REER misalignments only after 3 years from the shock. These results are quite robust if we apply alternative identifications, switching CA and REER or having the financial gap as the most endogenous variable. The only differences are on the significance at impact, because of the way Cholesky identification works. The impact of output gap shocks on REER and CA are slightly bigger in magnitude but they are much less persistent; the misalignments tend to decrease after only 2 periods for both the misalignments.

[46] They use data for the period 1980-2011 with a homogeneous setup and they conclude that positive output-gap shocks as well as positive REER misalignment shocks make the CA deficits worst. The main role is played by the REER misalignments however.

We would need now to split the sample in groups of countries. This is in order to understand better the different drivers of the misalignments and transmission mechanisms within the EU sub-groups, which have also very different CA balances (core countries have been in surplus for the major part of the sample; while is not always the case of periphery and CEE members). Drawing such a comparison would help to understand, for instance, the reason why an increase in REER misalignments would bring a decrease in the CA misalignments, which is rather puzzling. However, in this case we would have even smaller samples and, even if the individuals are more homogeneous that in the EU or euro area specification, the results may be biased due to the sample size.[47] For this purpose we use another setup based on a Bayesian analysis in the next Section.

4.3 Results: Partial pooling Bayesian panel VAR

At a second stage, given the small sample N=27; T=19 (balanced panel 1994-2012) and the high level of heterogeneity across the groups, we decide to use a Bayesian partial pooling estimator, rather than a simple panel VAR. We run our preferred setup (Figure 7a) with 3 endogenous misalignments, without any exogenous variable; moreover we provide an alternative by using a reverse ordering between CA and REER as sensitivity analysis (Figure 7b). Taking into account both fixed effects and heterogeneous coefficients, the IRFs are much less significant in the long-run and the confidence bands are wide. The only significant effects for the EU (and also the EA and core countries) are from REER to CA misalignments and from financial gap to CA misalignments and they are negative and rather persistent.[48] These shocks seem to decrease the CA misalignments (see Figure 7a), i.e. if a positive shock in the gap or REER misalignments hits the economy, the CA will be less misaligned. The outcome looks like the opposite as expected as it was in the homogeneous VAR setup. However, if we split the sample in sub-groups, we can see that it is mainly driven by the *EA core countries* performance. The CA misalignments are, as explained in Section 3.1., given by the (actual) projected CA balance minus the equilibrium value in the medium-run. The CA balances in most of the core countries are actually positive (Comunale, 2016). Therefore, an increase in the financial gap or REER misalignment may affect the CA misalignments negatively, acting as a decreasing force to the (actual) projected value of the CA balance, likely keeping the CA equilibrium unchanged and/or influencing the equilibrium CA balance in the medium-run, increasing it. This is indeed one of the main reasons why we we conduct sub-sample analysis, given the high level of heterogeneity in the EU countries and the different signs in the

[47] Being aware of that limitation, we tried to divide our sample in 3 sub-groups: (a) core, (b) periphery and (c) CEE new member states. All the results are available upon request. The EU core countries basically do not react to a shock in the financial gap, and also the other IRFs are mostly not significant during the 10 years horizon considered. For the periphery the response to a shock in the financial gaps is the most evident and extremely persistent even after 10 year horizon. REER and CA misalignments seem to not affect each other; we can only see a light response in the REER influencing the CA misalignments in the short-run. Lastly the CEE new member states are the most interesting case. The REER imbalance affects less the CA misalignment compared to the general EU or euro area sample; however the reaction of CA misalignments to the financial gap is almost doubled as it is the one of REER to a shock to CA imbalances. Using the output gap instead of financial gap, the core countries react more to this type of shock and this also influences the other IRFs.

[48] The magnitude is in line with the results of the homogeneous panel VAR (Figure 1).

macroeconomic gaps. The REER misalignments themselves can be the results of a country which is too competitive with respect to its equilibrium or not enough competitive. The results for the macroeconomic misalignments need to be looked being aware of how they are actually built and of the difference between actual values and medium-run equilibria. For the core, an increase in the REER misalignments may be helpful in the rebalancing process, because the country starts from a situation of almost equilibria or negative misalignments, which means that the country can be too competitive with respect to the equilibrium driven by fundamentals in the medium-run. Starting from a surplus in the CA, a positive shock in the REER may decrease an excessive surplus. For the financial gap, a positive shock may also give a boost in the domestic demand decreasing the actual CA balance and resulting in a less misaligned CA with respect to the medium-run norm.

[Insert Figures 7 around here]

Sensitivity analysis and robustness checks Looking at the sensitivity analysis, the reaction of CA to REER shock and vice versa, is slightly sensitive to the identification (Figure 7b). The REER shock no longer has an impact on CA in the alternative ordering but it is much more persistent. Instead a CA shock positively affects REER both in the short and long-run, as expected. In our preferred identification, the CA misalignments do not affect the REER instead. The financial gap shock has an impact on REER and CA misalignments in the alternative, however with a negative sign, i.e. an increase in the gap decreases the macroeconomic misalignments. This is driven by the high heterogeneity across country groups in our panel.

Lastly, we apply the Bayesian partial pooling estimator in the setup with the output gap. The reaction of the macroeconomic variables is never significant for the output gap for the EU (or the euro area). The main difference is in the impact of the gaps on CA imbalances. While the financial gaps may increase them, the output gap does not play any significant role.

Ultimately, we run the baseline with a more comprehensive financial cycle measure based on the first principal component (*pca*) of output gap, domestic demand growth and credit to GDP growth (this is the preferred measure of financial cycle in Comunale and Hessel, 2014). The results are in line with the simplest measure of the financial gap[49], but we do not see an impact of this measure of gap on the CA.

[Insert Figures 8-9 around here]

4.3.1 Sub-groups Bayesian panel VAR

Firstly, as for the homogeneous panel VAR, we estimate the model with only the current euro area (19 countries without Luxembourg) and we report the IRFs in Figure 13a for the setup with financial gap and Figure 10b in the output gap case. We also re-run our VAR only for old euro area members as in Gnimassoun and Mignon (2013).[50] The results with these sub-samples are in line with the full EU and the reaction of CA misalignments to a shock in REER misalignments is bigger than the one to a shock in the gap (as in Gnimassoun and Mignon, 2013). The output gap does not affect the CA misalignments, while the financial gap does as for the full EU sample.

[49] Other robustness checks with domestic demand and credit based gaps are available upon request.
[50] All the results are available upon request.

[Insert Figure 10 around here]

The last point to be analysed, given the different behaviours across country groups we found in the homogeneous case and splitting the sample, is if the partial pooling is also affected by the more intense reaction of the CEE new member states (and possibly the core countries as well) to the macro-financial shocks. We therefore run the panel VAR dividing the sample in the 3 main groups for now: core (8 countries, excluding the Netherlands as outlier and Luxembourg because of data availability), periphery (7 countries) and CEE new member states (11 countries). We find very heterogeneous responses across groups as well as different responses with respect to the EU sample or the old euro area members, even if in this setup we allow for both fixed effects and heterogeneous coefficients. We use the output gap also in the 3 sub-samples case, whose IRFs are reported in Figure 12.

[Insert Figure 11 and 12 around here]

The reaction of *the core* is again very robust compared to the full EU sample, as also reported above in the previous section. The only significant effects for the core are from REER to CA misalignments and from financial gap to CA misalignments and they are negative and rather persistent. The intuition behind these results has been explained in Section 4.3.

In case of *EA periphery* the reaction of CA imbalances to a shock in financial gap is more persistent. A shock in the financial gap affects the CA misalignments even in the long-run, returning to the initial state only after more than 5 years. A shock in the financial gap of 1% decreases the CA misalignments by 0.2% in the short-medium run and is significant. The CA balance in the periphery was/is mainly negative, therefore, a decrease in the CA misalignment may be driven by a further decrease in actual CA balance (increase deficit) and/or by a better CA norm in the medium-run. As for the homogeneous case, a shock in the output gap is much less persistent and the significance is not guaranteed. The reaction of CA misalignments to a shock in the REER misalignment has the same sign with respect to the full sample and the core, but it is not significant. The reaction is similar if we add the output gap (Figure 12 (b)). The REER misalignment does not react to a shock in financial or output gap however it does not have any significant impact in case of a shock to output gap. We can only see a positive impact of a CA misalignment on financial gap and partially on REER misalignments within 5 years. In the periphery an increase in CA misalignments leads to a temporary increase in the REER misalignments, lowering competitiveness and thus amplifying current account fluctuations. The REER misalignments for these members are normally positive, i.e. the periphery is less competitive than it should be and even more after a CA shock. For the gap, an increase in CA misalignments may cause the financial gap to increase even more, via a spiral of increasing credit and house prices.

The most interesting case concerns again the *CEE new member states*. Shocks to REER misalignments influence CA and the gaps positively, i.e. a decrease in competitiveness (increase in actual REER and REER misalignments) does play a key role. While a shock in CA misalignment has a positive effect on the financial gap, i.e. the more misaligned the CA is, the further away is the GDP or the financial variables from trend.[51] Going more in depth, an increase in REER misalignments, i.e. the CEE new member states are less competitive than they should be, brings an increase in CA misalignments.

[51] The reactions are bigger in magnitude in case of VAR with the output gap.

In this case, the countries experienced deficits before the crisis, moving towards positive values of the balance only in the last two years. The CA norm itself is still negative and it has become positive only for Estonia (Comunale, 2015b). Therefore, we have some countries like Latvia, Lithuania and Poland still with a CA deficit in 2014 but going towards positive balances[52] while Slovenia and Hungary experienced a notably surplus already in 2014. In this situation with negative CA norm and actual or projected CA (negative or becoming) positive, in order to have an increase in CA misalignments, we need either an even more negative CA norm or a more positive CA or less deficit expected in the medium-run. Therefore an increase in REER misalignment may bring some negative changes in the equilibrium value of the CA, via a structural decline in price competitiveness. This effect may be due to the determinants we have chosen that include foreign capital flows. These can be directed to more or less productive sectors, having a more lasting effect on the economy. However, as we have seen in the section explaining the results of REER and CA misalignments (see also Comunale, 2016; 2017) the CA misalignments are getting smaller and the REER misalignments are instead rather stable. Unfortunately, we cannot attribute this outcome to a positive role of the financial or output gap; giving room to further discussions of the causes.

Summing up, the source of macro-financial imbalances in EU are diversified, for the periphery the CA misalignments seem to be key, while for the CEE new member states the REER misalignments play a major role. The cycles are influenced by these misalignments and, oppositely as expected, they do not cross-affect them in most of the cases. In an alternative specification,[53] as a sensitivity analysis, we use the gap as the most endogenous variable in a Cholesky way, this only has effects on REER misalignments (an increase in the gap by 1% produces a reaction of 0.15% in the REER misalignments at the peak, i.e. after 1 year).

Other sub-groups and GDP growth results The latest sub-group concerns non-euro area member states,[54] in order to compare our results for the euro area with countries with a different currency. The outcome appears to be very much influenced by the presence of CEE new member states in the sample. Hence, we also run the model with non-euro area countries excluding the CEE new member states (i.e. only Denmark, Sweden and UK) (Figure 13a). Then, we also check the responses for only euro area core countries (i.e. excluding the above mentioned Denmark, Sweden and UK) (Figure 13b). In case of non-euro area countries, the responses are much less persistent but in one case which is the IRF of REER misalignments to a shock in CA; it is positive and very significant and persistent over time for Denmark, Sweden and UK and it is therefore the opposite of the euro area core results. As in the case of periphery, the CA misalignments play an important role for other imbalances. A small effect of financial gap only on CA misalignment and only within 1 year is also found. For the core EA countries, the response is instead negative and significant.

[Insert Figures 13 around here]

[52] The data are from IMF WEO (April 2016). The CA are estimated after 2014 or 2015 for CEE new member states.
[53] Results available upon request.
[54] These are namely: Bulgaria, Croatia, Czech Republic, Denmark, Hungary, Poland, Romania, Sweden and the UK.

Lastly, we include in our set of variables the GDP growth, as we did for the homogeneous framework.[55] However, GDP growth and the gaps are naturally linearly dependent (adding them together results in a redundancy) and this causes our companion form of the VAR to be a singular matrix (the system is not stable and contains unit roots).[56] We therefore decide to use the growth as the most endogenous variable in the VAR and to look at the reactions to REER and CA misalignments, with a setup like the following: $Y_{i,t} = (REER\_mis_{i,t}, CA\_mis_{i,t}, gdpgr_{i,t})$. The results for the full EU sample show that GDP growth is not influenced by macroeconomic imbalances.[57] We believe that the most useful results may come from the sub-sampling and we run the exercise for euro area core, other core (Denmark, Sweden and UK), periphery and CEE new member states. The results for core euro area are again in line with the full sample. For the periphery (Figure 14) the effect of macroeconomic misalignments is also negligible; while the response of imbalances to a GDP growth shock is negative, significant and very persistent, especially in case of a shock to the REER misalignments (0.4% while for the CA misalignments shock is 0.2%). The role of CA misalignments in increasing the REER imbalances is confirmed. For the group of Denmark, Sweden and UK, the impact of CA misalignments on growth is only at impact (-0.4%), while a REER misalignments shock is of the same size but much more persistent.[58] Lastly, for the CEE countries, the CA misalignments influence positively GDP growth and this is smaller than the response to REER. A positive shock in CA misalignments, for these countries, means that the actual/projected CA deficit decreases. This is probably the driver to a higher GDP growth rate. A shock in GDP growth increases the REER misalignments in the short-run, but decreases CA misalignments in a long-run perspective. Hence these economies, which are still growing faster than the rest of the EU after the crisis period,[59] can expect a decrease in competitiveness in the short-run (likely related to a Balassa-Samuelson effect or increase in CPI inflation reducing price competitiveness in the short-run) but this can have a positive effect to the CA misalignments in a longer time-span.

[Insert Figure 14 around here]

4.3.2 Robustness check: the dynamic factor model

We apply a single equation dynamic factor model, which takes into account explicitly other possible common factors, for the whole EU (and EA) as a means to address the cross-sectional dependence across the units. Although the major drawback of this approach is that it does not take into account dynamic interdependencies across the variables in each unit, so our variables cannot influence each other.

Firstly, we use as a dependent variable the CA misalignments and as regressors REER misalignments and financial gaps (as the more comprehensive synthetic index from the principal component analysis or the simpler financial gap measure from real GDP) at time t then we proceed along the Cholesky ordering (also in case of regular output gap). The results are summarized in Table 2 for the whole EU.[60]

[55] All the results with GDP growth are available upon request.
[56] See Canova (2007).
[57] Results available upon request.
[58] The results for Denmark, Sweden and UK are available upon request.
[59] The real GDP growth for EU 28 in 2015 was of 2.2%, while on average the CEE new member states did grow by 3%. In the recent years, only during the period 2009-2010, the CEE countries experienced a more negative rate or a slower growth with respect to the rest of the EU (source: Eurostat).
[60] The results for EA18 (without Luxembourg) are very similar (available upon request).

[Insert Table 2 around here]

The financial gap seems to increase the CA misalignments more than the output gap, confirming the result from the Bayesian VAR, while the effect on REER misalignments is negative and significant if we use the regular measure of financial gap (see Figure 9a). This is the opposite as expected. The REER misalignments have a negative effect on the gaps. If we run the regressions for only EA core, periphery and CEE new member states, we can see that this result is mainly driven by the EA core members, as before. The effect of the financial gaps on CA misalignments is indeed positive for the CEE new member states and higher in magnitude if we use the synthetic index. In these countries, the peak of the cycle corresponds to a decrease in price competitiveness due to large foreign capital flows (mainly bank loans) directed to less productive sectors like real estate and constructions.

[Insert Table 3 around here]

4.3.3 Robustness check: the Bayesian panel VAR with spillovers

Possible spillovers inside the EU (and the EA) are likely to play a role in the full sample. Together with the dynamic factor model, abovementioned, we also include in our preferred Bayesian panel VAR setup, a variable to count for possible spillovers across the members. The CA misalignments are likely to influence each other between core and periphery and CEE new members, and also REER misalignments can be somehow linked via trade patterns. We decide therefore to apply 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 10) as in Comunale (2017) or the weighted average of the financial cycles of the rest of the EU (Equation 11). In the latter, values are based on either the simplest version from real GDP or the principal component analysis. 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 way to address spillovers is similar to the way used in the GVAR literature.[61]

$$fgdpgr_{i,t} = \sum_{j=1}^{N-1} w_{i,j,t} \cdot gdpgr_{j,t} \tag{10}$$

$$ffcycle_{i,t} = \sum_{j=1}^{N-1} w_{i,j,t} \cdot fcycle_{j,t} \tag{11}$$

We do not believe that the average of absolute values of the deviations from CA or REER equilibria will be useful in this regard, because they come from variables, as the CA and REER themselves, already in relative terms with respect to partners. However, GDP growth and the gaps are naturally linearly dependent (adding them together results in a redundancy) and this causes our companion form of the

[61] A worthwhile extension of this paper, not using a Bayesian-approach, would involve the application of a Global VAR (GVAR) structure, as in Di Mauro and Pesaran (2013) and Garratt et al. (2006). This also is a way to fully solve the issue of cross-sectional dependence (strong, as global factors, and weak, as spillovers). In that case GVAR links different VAR models for each country by inclusion of a foreign variable which is constructed as a (trade or financially) weighted average of endogenous variables in other countries. GVAR can be thought of as an approximation to a global unobserved common factor model with interactions.

VAR to be a singular matrix (the system is not stable and contains unit roots).[62] Hence, we perform our preferred model by using the abovementioned weighted averages instead of the gaps, with a setup like the following: $Y_{i,t} = (fgdpgr_{i,t}, REER\_mis_{i,t}, CA\_mis_{i,t})$ or $Y_{i,t} = (ffcycle_{i,t}, REER\_mis_{i,t}, CA\_mis_{i,t})$.

This approach allows our model to tell us if spillovers from other EU member states, initiated from real GDP growths or financial cycles, can be transmitted to CA or REERs. The impulse responses in all these cases are pretty similar, a shock in the rest of the EU with regard to an increase in GDP growth or a boost in the cycle has an effect on CA and REER misalignments, decreasing them EU-wide. The biggest effect in magnitude is the one to a 1% shock in the financial gap by using a principal component of output gap, credit and domestic demand growth; which can bring a decrease in the REER misalignments of 0.6% and in the CA imbalances of 0.2% at impact.[63]

5 Conclusions and policy implications

In this paper we investigate the interactions between different misalignments in CA, REER and different gap measures in an EU perspective. The main aim of this paper is to identify the direction of the transmission across these macroeconomic and financial imbalances, in order to better understand the period of boom and bust in some EU countries and the asymmetries within the EU itself. The misalignments are built here taken into account the impact of foreign inflows (as determinants of CA and REER) and the financial gap itself is a measure based on output but also domestic demand or credit. This allows us to analyse more in depth the impacts of foreign capital inflows and the financial variables on misalignments, also via the gaps. We apply a panel vector autoregression (panel VAR) on a sample of 27 countries over the period 1994-2012, with annual frequency. We first estimate a homogeneous panel VAR model as in Gnimassoun and Mignon (2013) and then we provide a partial pooling Bayesian panel VAR as in Canova and Ciccarelli (2004, 2009, 2013) together with some extensions to deal with spillovers across countries.

In the homogeneous panel VAR setup, provided for comparison with the previous literature, we find that the financial gaps are more persistent in affecting both CA and REER misalignments than the regular output gap. The financial gap shock significantly affect growth in the EU in the medium/long-run. CA and REER misalignments are closely related and affect each other. All the reactions are more persistent for the euro area and GDP growth reacts more to REER misalignment shocks with respect to the whole EU sample, in line with the previous studies.

However, taking into account both fixed effects and heterogeneous coefficients and the size of our sample (by using a partial pooling estimator in a Bayesian panel VAR setup), the impulse responses are much less significant in the long-run and the confidence bands are very wide. In any case we also find some robust findings compared to the homogeneous case for EU and EA: i) CA misalignments and REER misalignments are closely related and affect each other; ii) the reaction of CA misalignments to a shock in REER misalignments is the largest and iii) the REER misalignments negatively affect the CA imbalances.

[62] See Canova (2007).

[63] These results are all available upon request.

The most interesting results are obtained by dividing the sample into main subgroups, which helps understand the different role and transmission of each misalignment. There is a high level of asymmetries in the responses and transmission of macro-financial shocks within the EU, in line for the recent literature (Staehr and Vermeulen, 2016). With the Bayesian panel VAR, the reaction of the EU core is again robust compared to the full EU sample. In Denmark, Sweden and UK, as in the periphery, an increase in CA misalignments leads to a temporary increase in the REER misalignments, lowering competitiveness and thus amplifying current account fluctuations. This is not found in case of the euro area core. For the latter, the financial gaps and the REER misalignments may affect the economy, via a decrease in an excessive surplus. The most interesting case is again the CEE new member states. For the CEE new member states, the reaction of CA misalignments to a shock in the REER misalignment has instead the opposite sign with respect to the full sample and the EU core. This is also much bigger in magnitude and very persistently positive over time. It means that in case of a positive shock in REER misalignment, i.e. an increase of 1% in the imbalance, the CA misalignment itself increases, causing further problems for these countries related to a possible bigger CA deficit in the long run equilibrium. Therefore, while CA imbalances play a major role in affecting other misalignments for core non-EA countries and the euro periphery, the REER misalignments seem to be rather transmitted to the current accounts and the gaps in case of CEE members and the euro area core.

Ultimately, by applying the dynamic factor model, we find that the financial gap seems to increase the CA misalignments, more than the output gap, confirming the result from the Bayesian VAR. The effect of the financial gaps on CA misalignments is indeed positive (i.e. the misalignments increase) for the CEE new member states (and whole EU) and it is even higher in magnitude if we use the synthetic index. In these countries, the peak of the cycle corresponds to a decrease in price competitiveness due to a huge foreign capital flows (mainly bank loans) directed to less productive sectors like real estate and constructions. Lastly, for these countries a shock in GDP growth itself increases REER misalignments in the short-run, but decreases CA imbalances in a long-run perspective. So, these economies, which are normally still growing faster than the rest of the EU, can expect a decrease in competitiveness in the short-run (likely related to a Balassa-Samuelson effect or increase in CPI inflation reducing price competitiveness in the short-run) but this can have a positive effect to the CA misalignments in a longer time-span.

The consequence of different transmission mechanisms appears to be substantially different across countries and, hence, policies responses could and should be reflecting this aspect. Hence country-specific policy measures are needed for economic and financial stability to be attained. Investigating whether a country's exchange rate or current account is close to its equilibrium value and how they are related to the cycle can help determine future adjustment needs and possible trajectories of economic fundamentals. We believe that a more refined analysis of the misalignments may be also of some uses for improving the Macroeconomic Imbalance Procedure (MIP), which currently assesses these variables on the basis of threshold levels.

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6 Annex

Tables and Figures

Table 1: Causality test (Dumistrescu and Hurlin, 2012)

Ztild [pvalue]
With 1 lag

X--> Y	Y: REER_mis	CA_mis	Fingap1	outputgap	wgdp
X:					
REER_mis		3.1225	0.2518	-1.7476	-1.3002
		[0.0018]	[0.8012]	[0.0805]	[0.1935]
CA_mis	3.5253		10.0277	-0.9874	0.2872
	[0.0004]		[0.0000]	[0.3234]	[0.7739]
Fingap1	5.5177	10.5895		0.4509	1.9165
	[0.0000]	[0.0000]		[0.6520]	[0.0553]
outputgap	1.7263	0.4100	11.6192		10.5863
	[0.0843]	[0.6818]	[0.0000]		[0.0000]
wgdp	8.8622	4.9606	0.3134	-2.9425	
	[0.0000]	[0.0000]	[0.7540]	[0.0033]	

Ztild [pvalue]
With 2 lags

X--> Y	Y: REER_mis	CA_mis	Fingap1	outputgap	wgdp
X:					
REER_mis		2.6221	-0.0697	-1.8402	2.0185
		[0.0087]	[0.9444]	[0.0657]	[0.0435]
CA_mis	2.4367		2.5172	-1.7332	0.3909
	[0.0148]		[0.0118]	[0.0831]	[0.6959]
Fingap1	4.7742	7.1446		4.1944	0.8057
	[0.0000]	[0.0000]		[0.0000]	[0.4204]
outputgap	0.6487	-1.6728	57.3173		9.3013
	[0.5165]	[0.0944]	[0.0000]		[0.0000]
wgdp	3.6469	3.2165	-0.5033	-0.6783	
	[0.0003]	[0.0013]	[0.6148]	[0.4976]	

The null hypothesis is non-causality
Reject the null, i.e. Causality at 1%

Ztild statistics is standardized for fixed T value. All the results left out from the table are available upon request.

Figure 1: IRFs - financial gap-

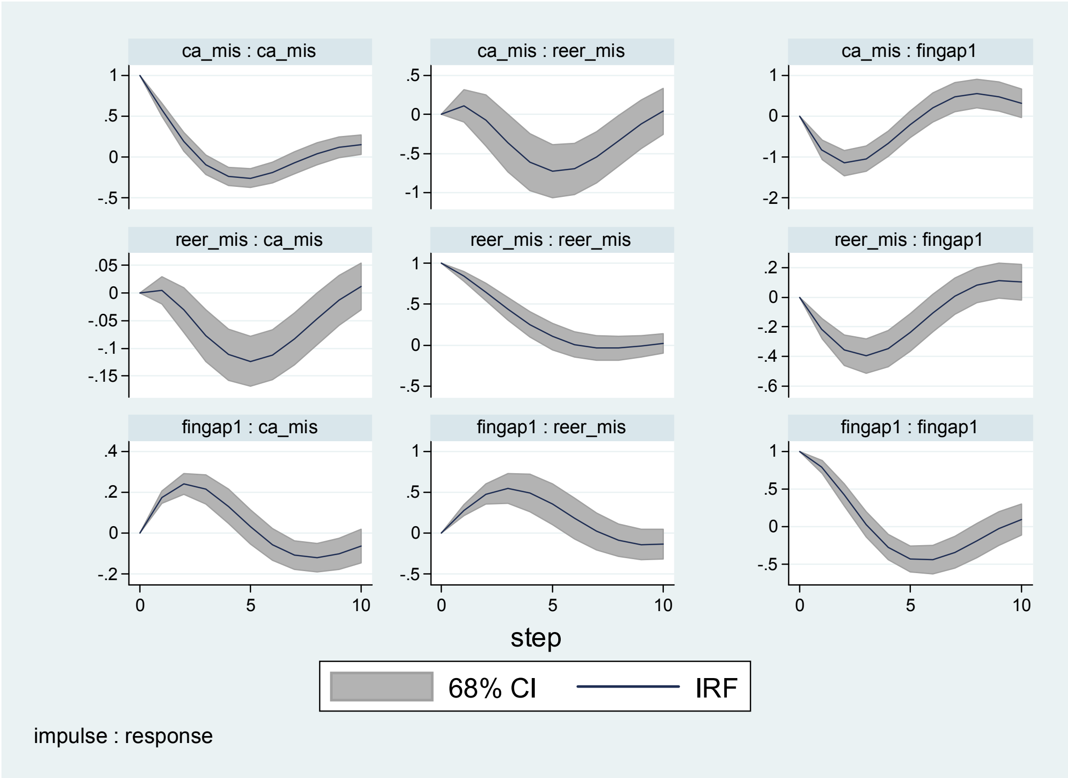


Figure 2: IRFs - output gap-

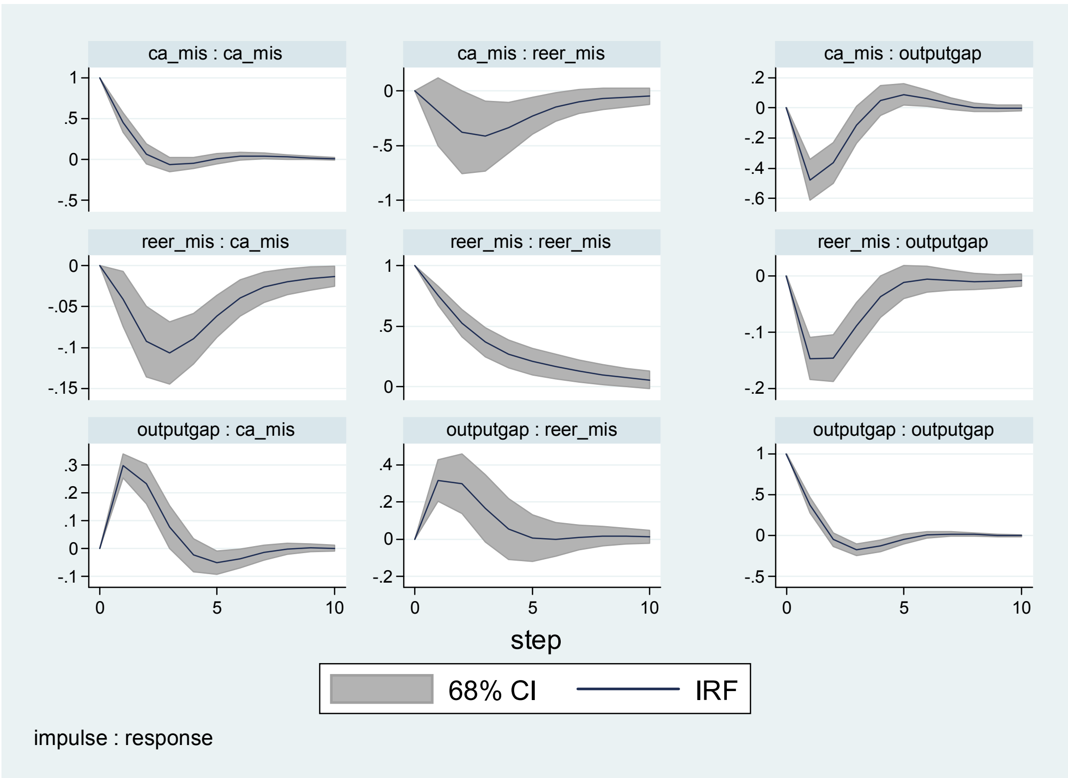


Figure 3a: IRFs - with world GDP growth (endo) -

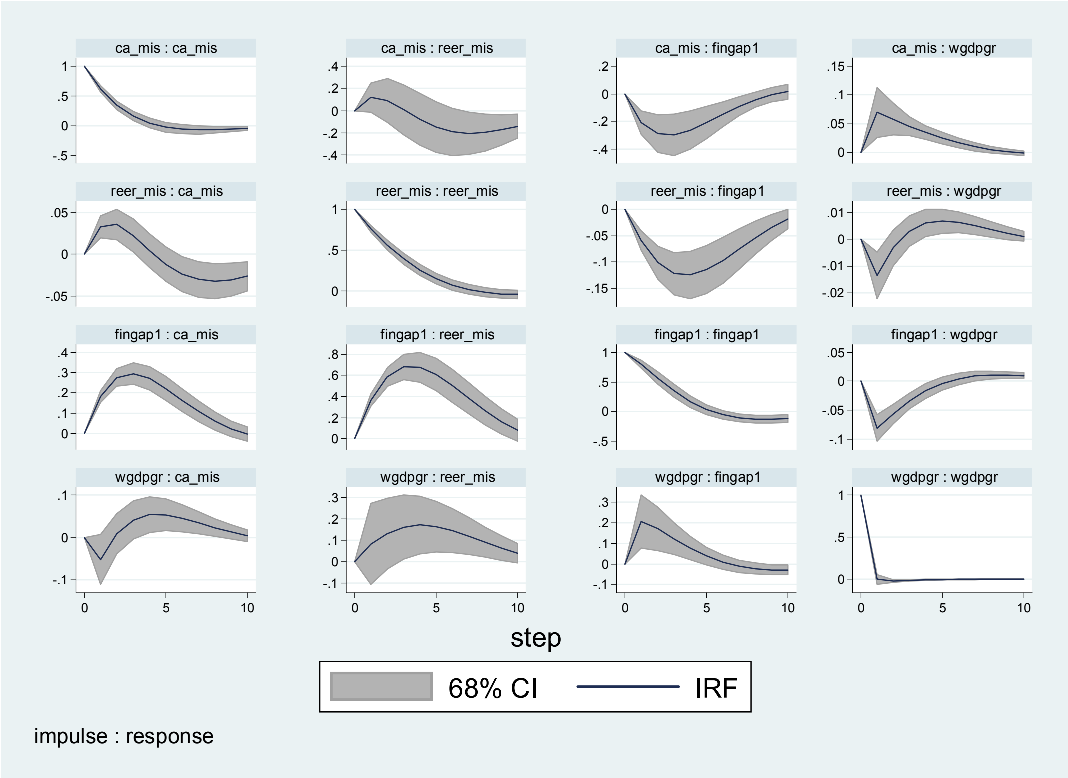


Figure 3b: IRFs - with world GDP growth (exo) -

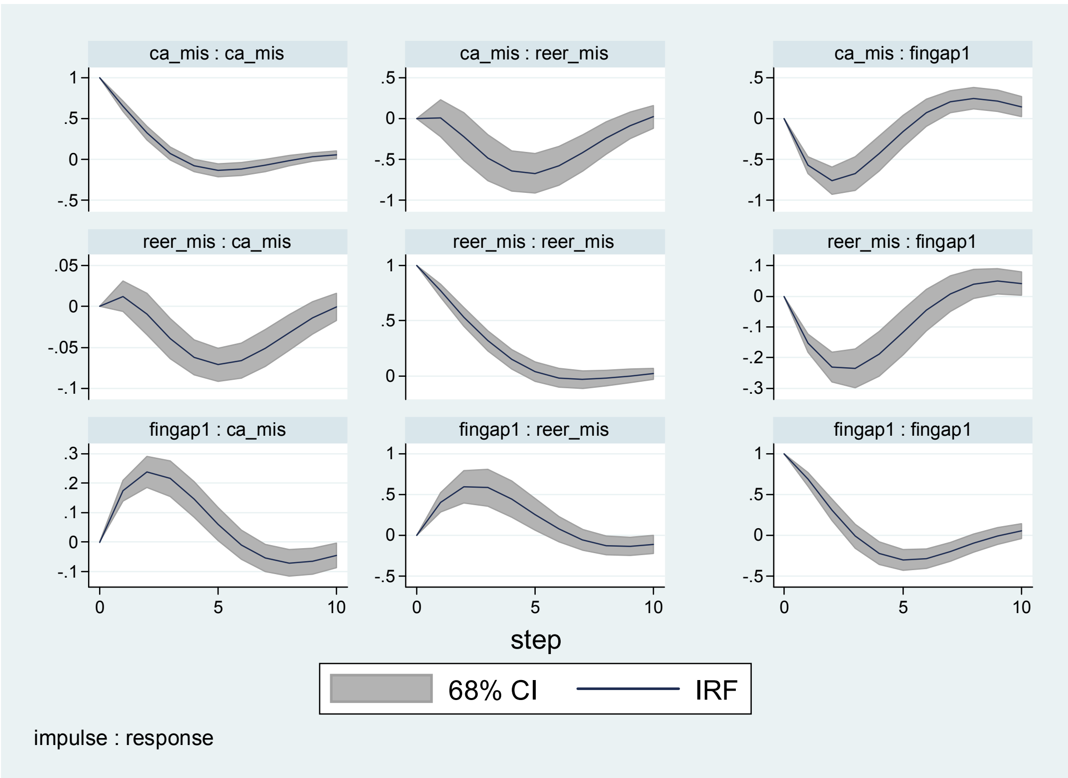


Figure 4: IRFs - with country's GDP growth-

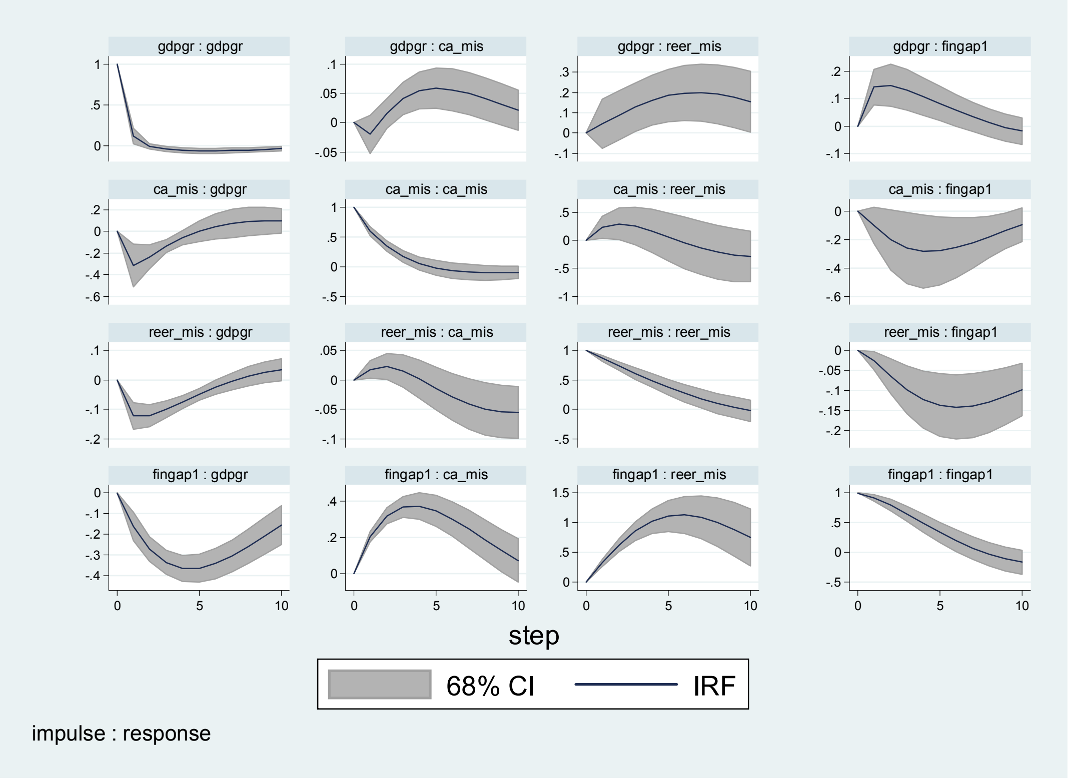


Figure 5a: IRFs - euro area (EA19) with financial gap-

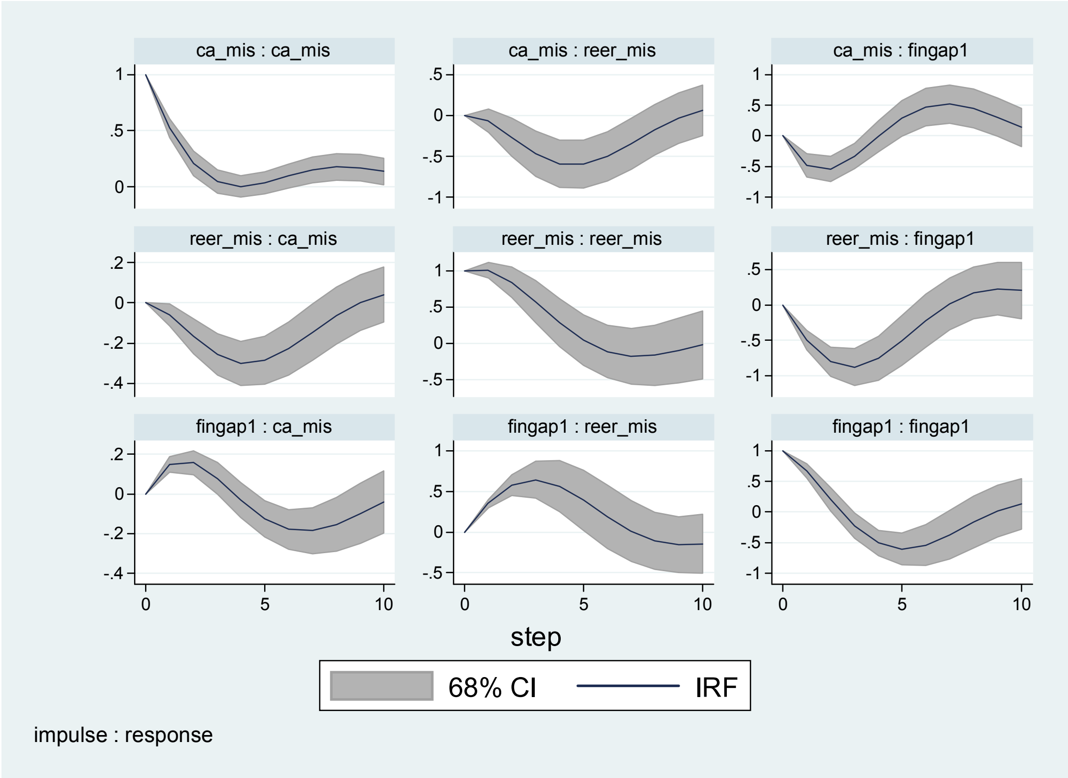


Figure 5b: IRFs - euro area (EA19) with output gap-

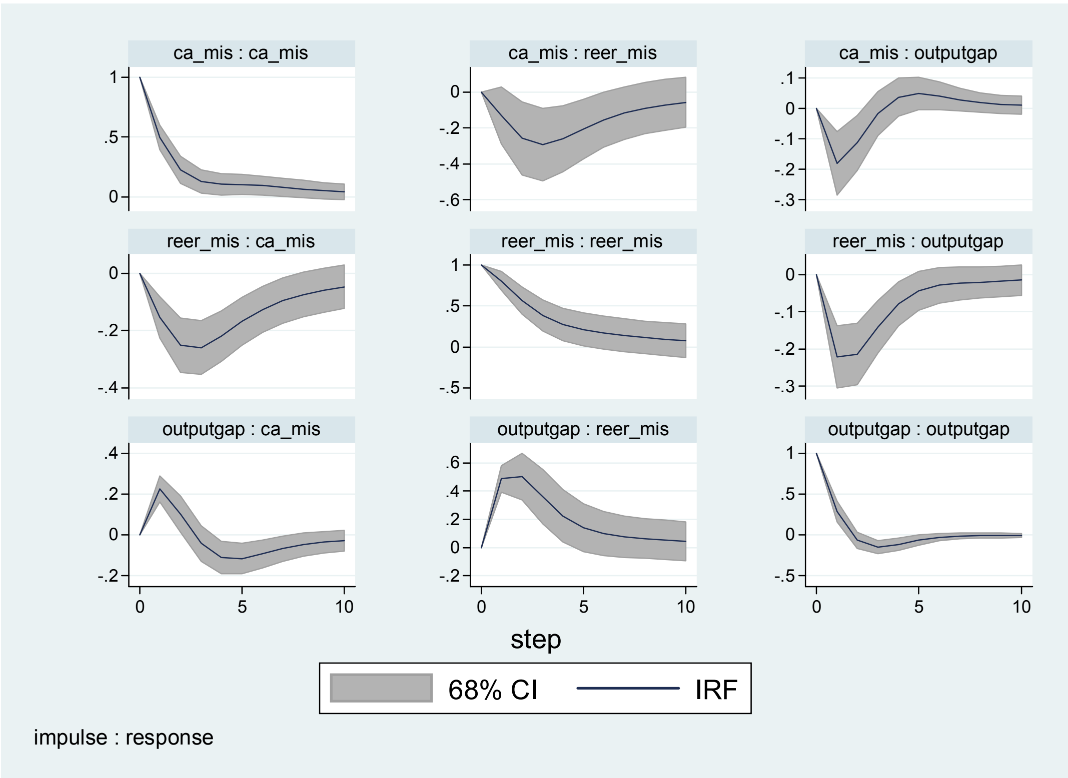


Figure 6: IRFs - only euro area with GDP growth -

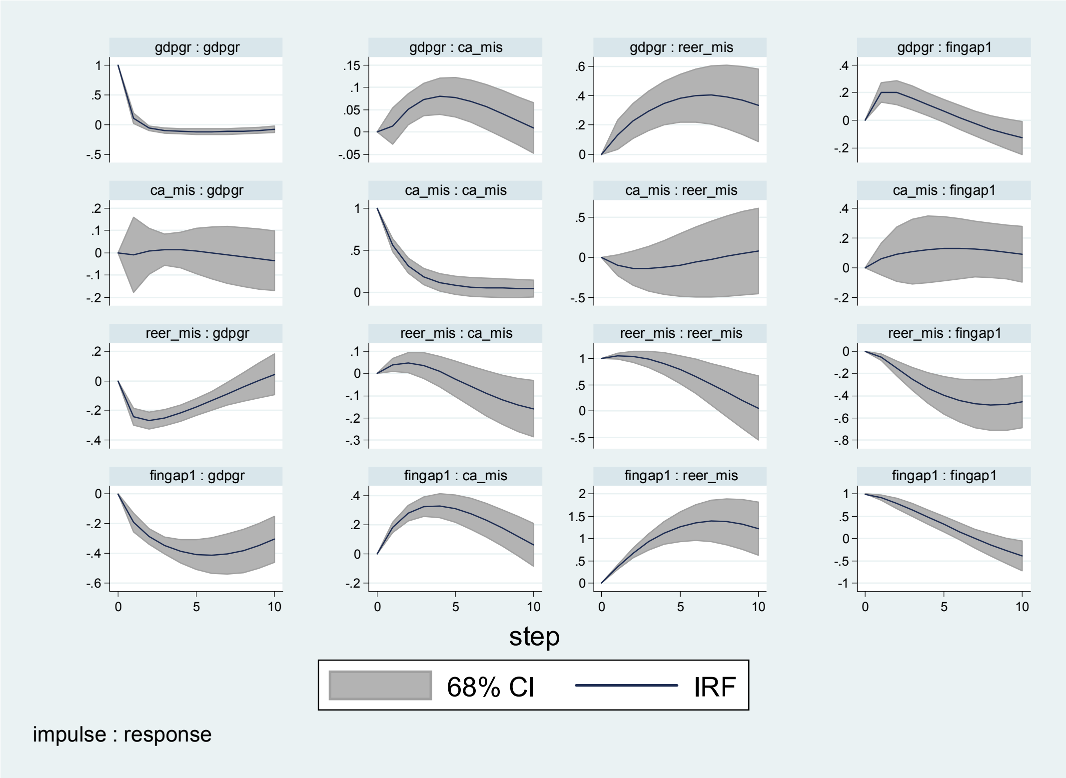


Figure 7a: IRFs by using partial pooling Bayesian panel VAR[64]

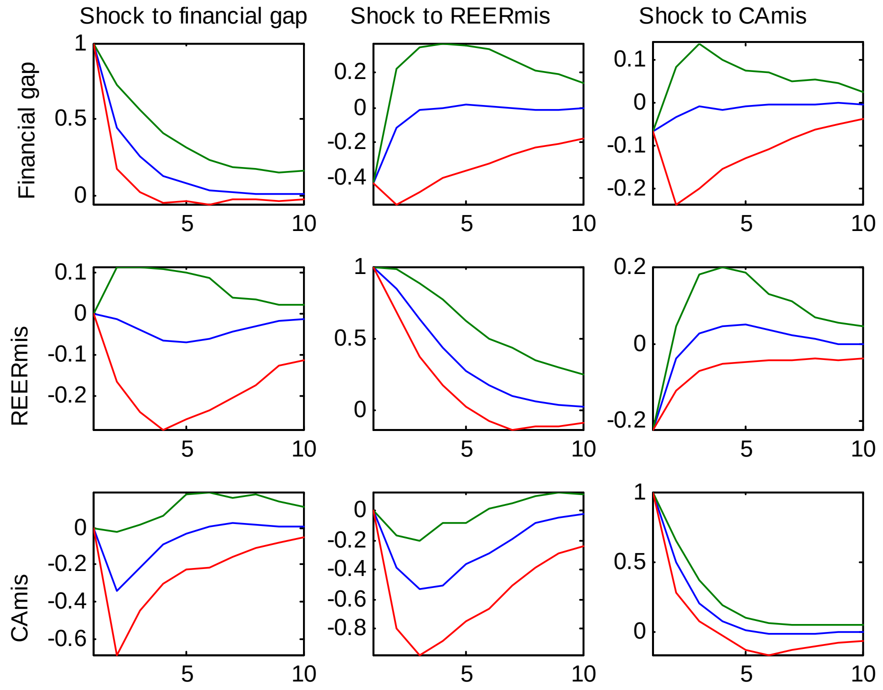
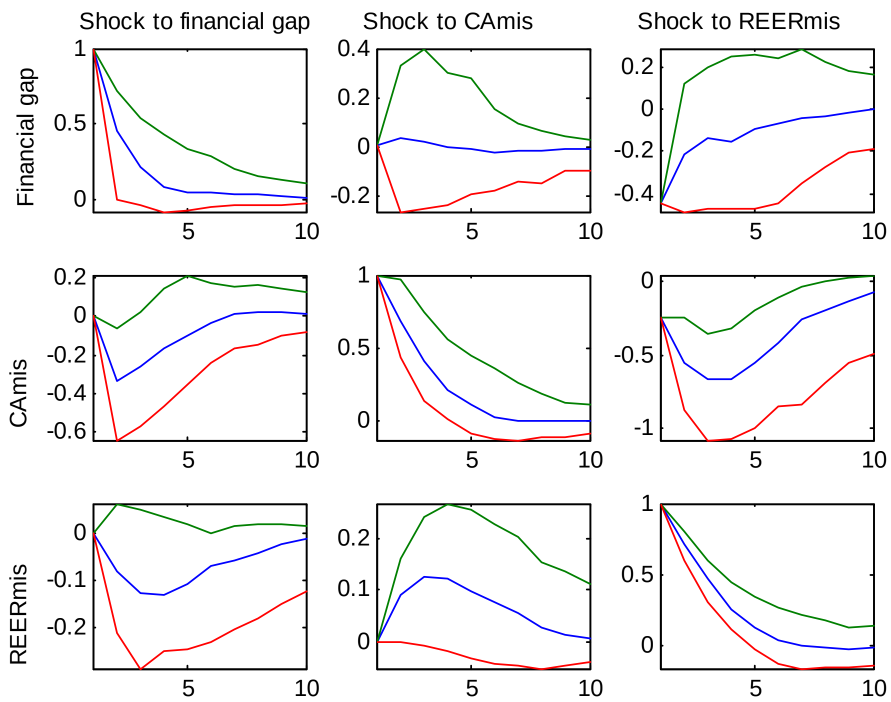


Figure 7b: alternative specification #1: financial gap; CA; REER



[64] Shocks are on columns and responses are to x-axis. For instance a financial gap shock of 1% to REERmis is in the second row first column.

Figure 8: IRFs by using partial pooling Bayesian panel VAR - output gap -

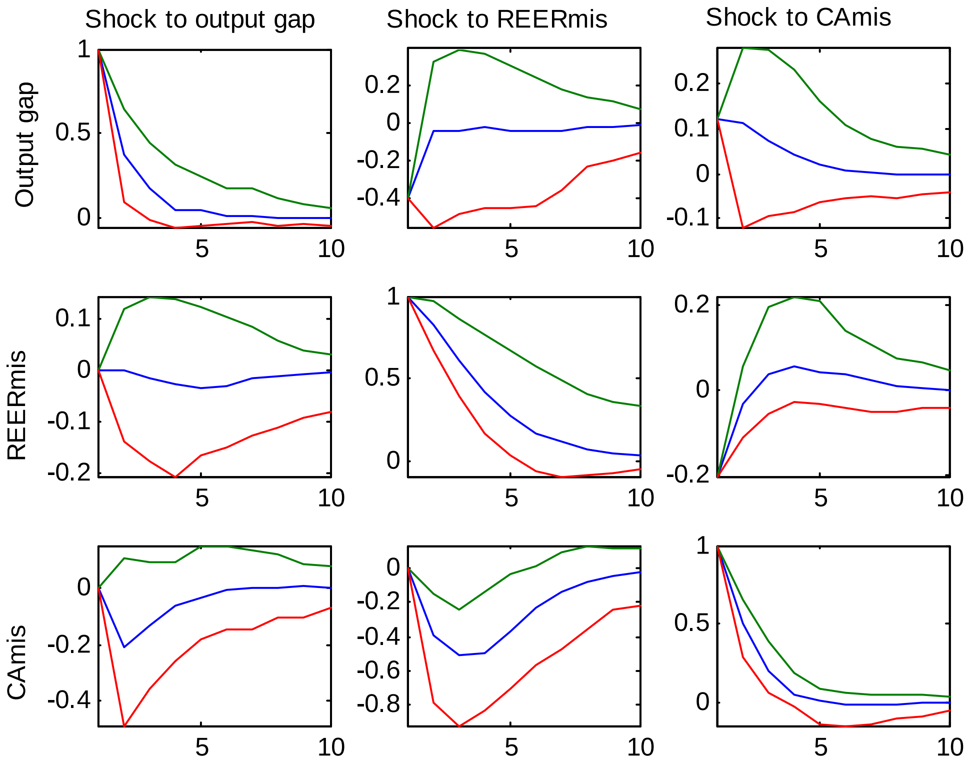


Figure 9: IRFs by using partial pooling Bayesian panel VAR - pca as financial gap -

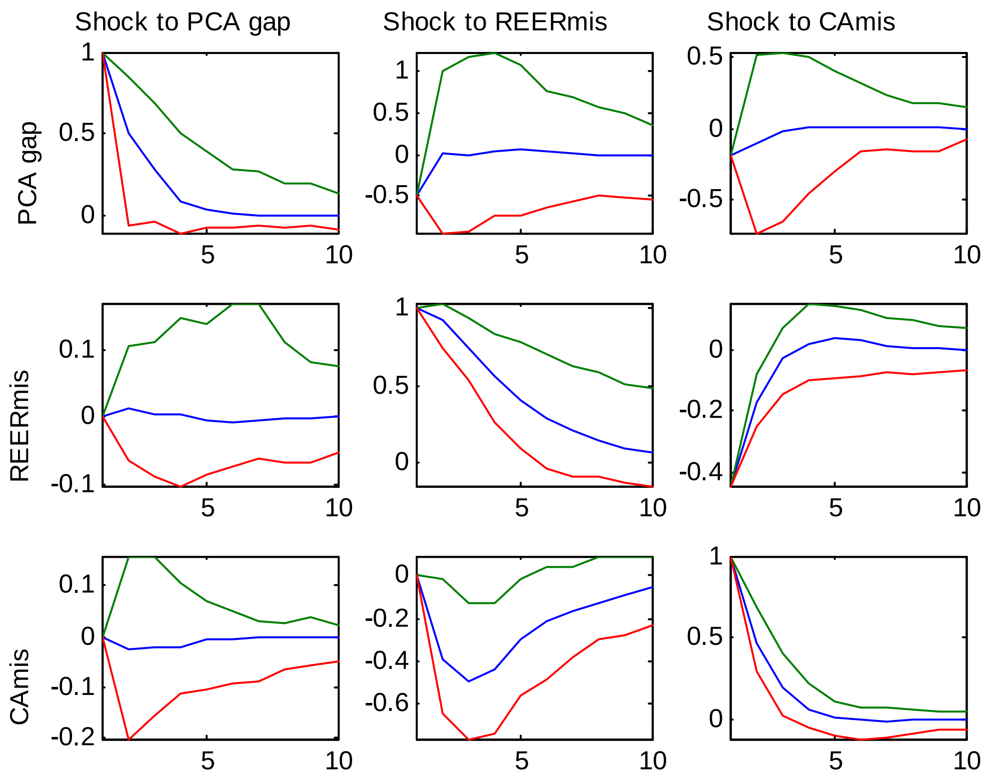


Figure 10a: IRFs by using partial pooling Bayesian panel VAR - euro area only with financial gap-

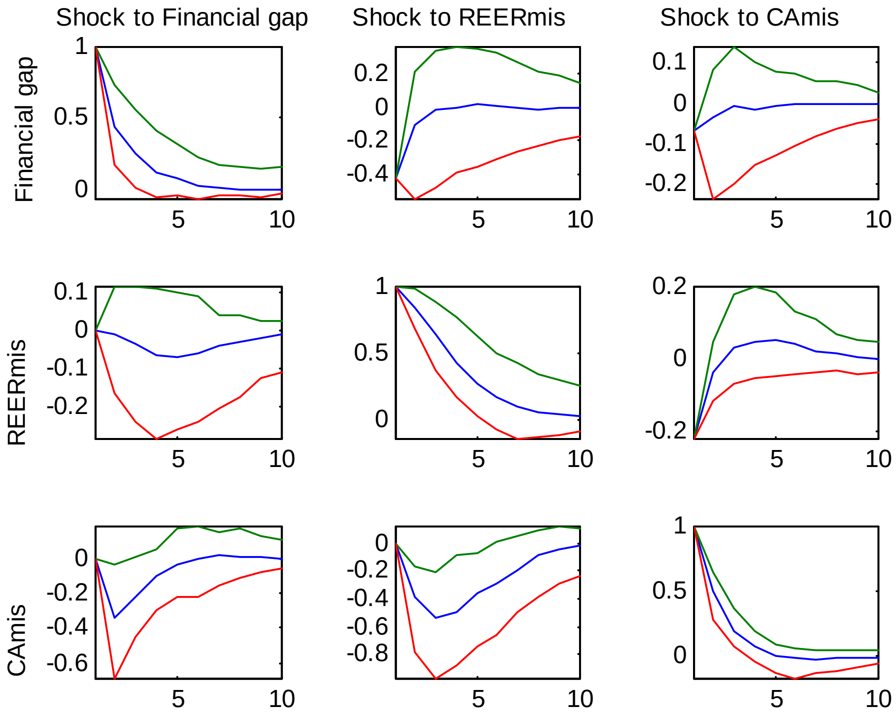


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Figure 10b: IRFs by using partial pooling Bayesian panel VAR - euro area only with output gap -

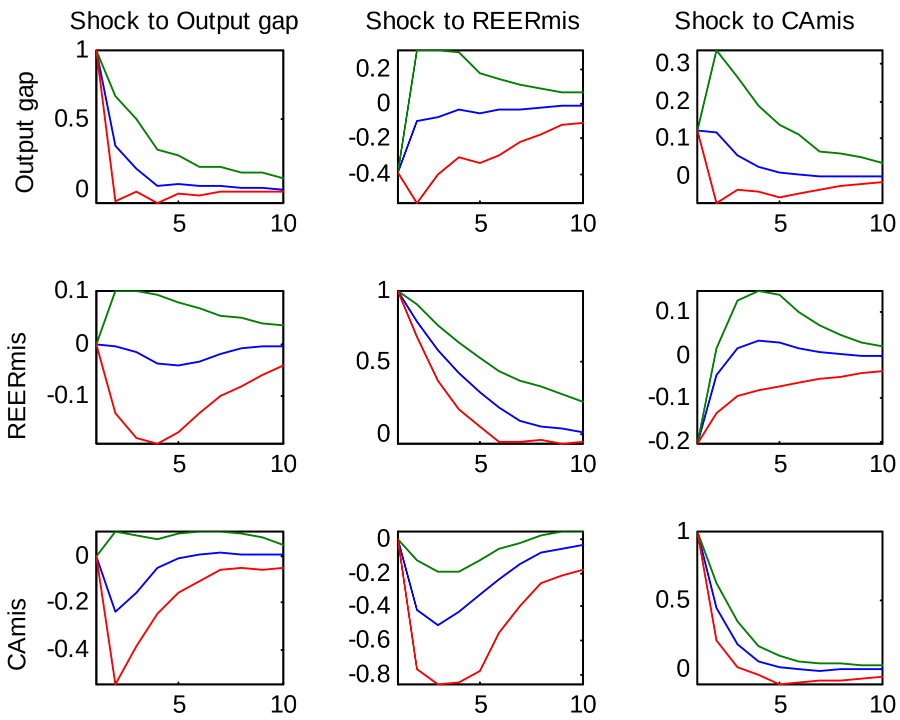
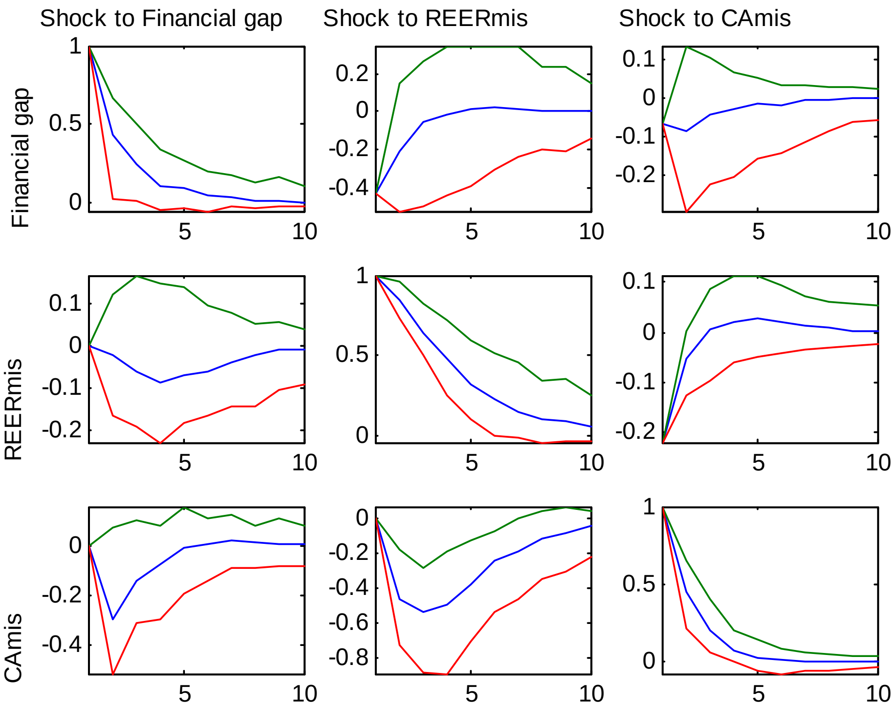
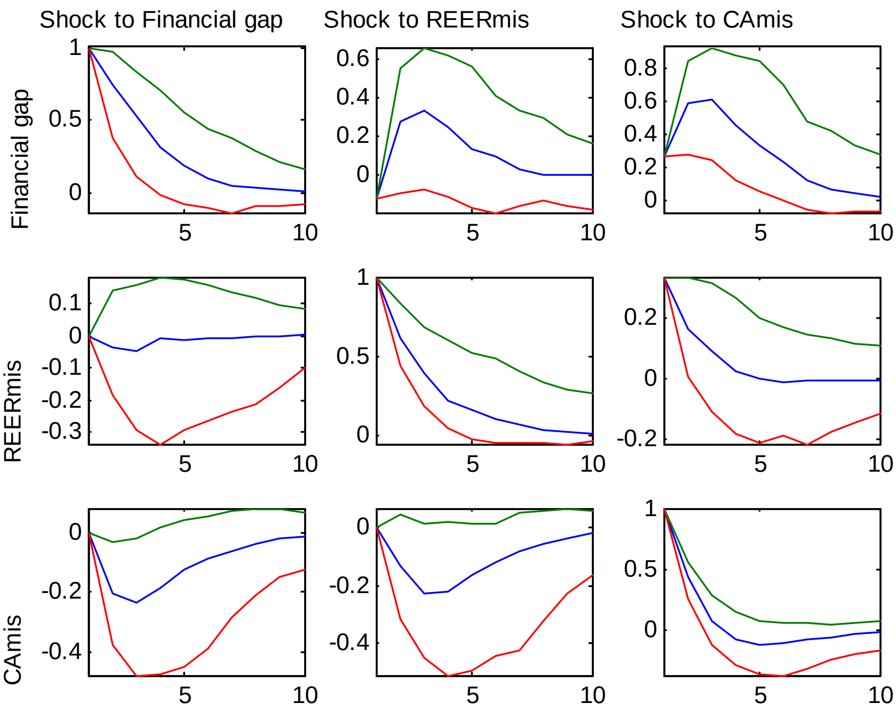


Figure 11: IRFs by using partially pooling Bayesian panel VAR - 3 subgroups with financial gap -

(a) Core countries



(b) Periphery countries



(c) CEE new member states

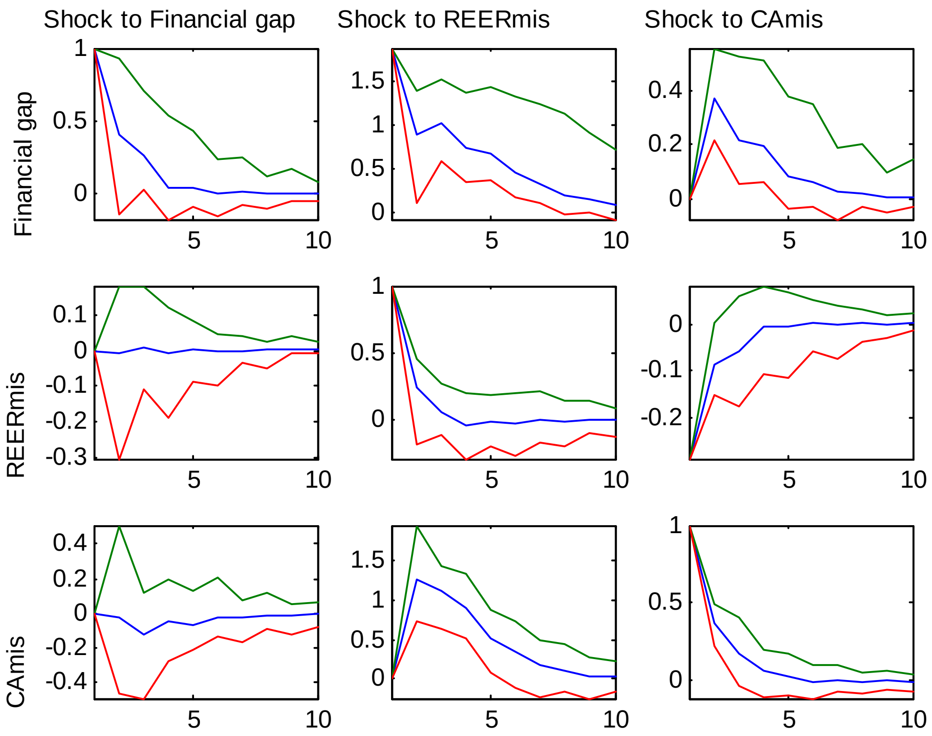
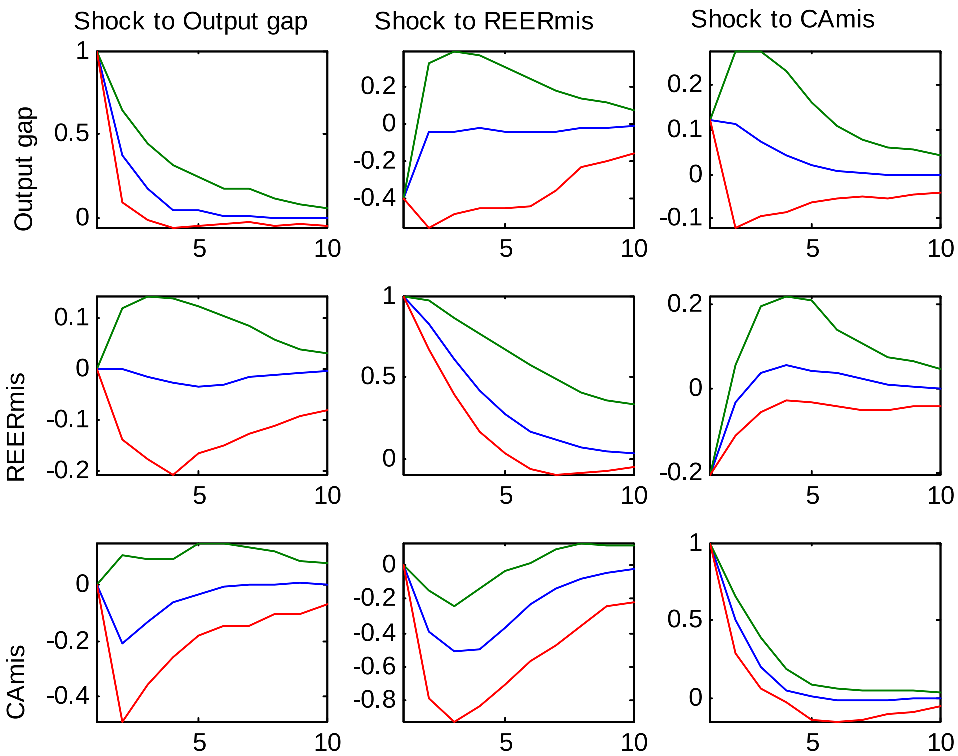
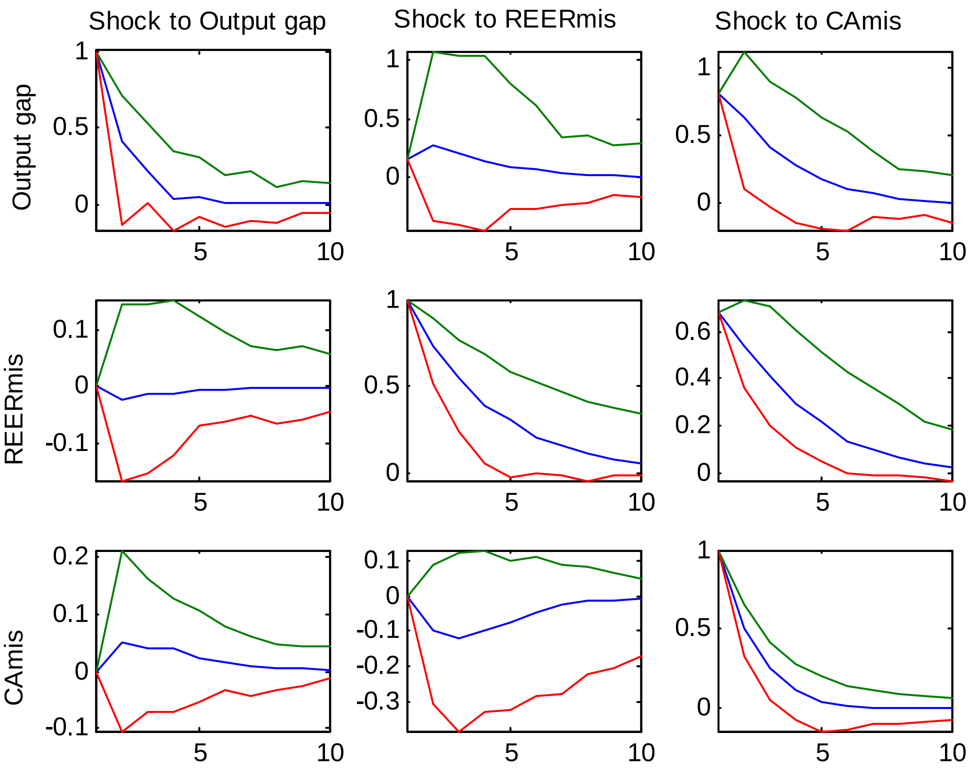


Figure 12: IRFs by using partially pooling Bayesian panel VAR - 3 subgroups with output gap -

(a) Core countries



(b) Periphery countries



(c) CEE new member states

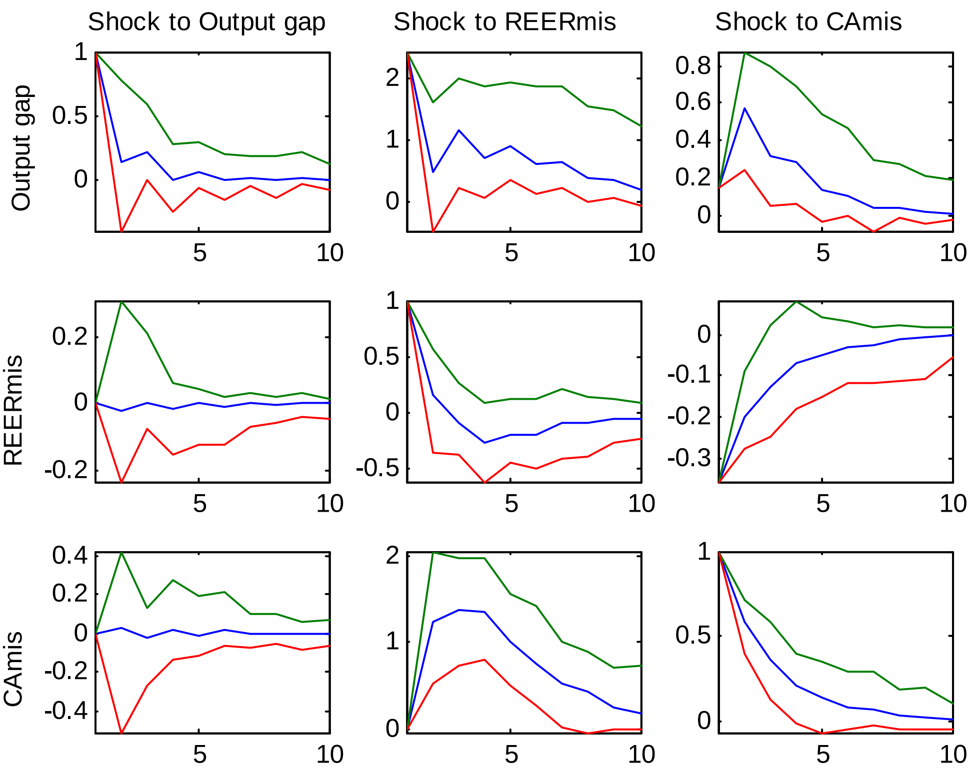


Figure 13a: IRFs by using partially pooling Bayesian panel VAR - Denmark, Sweden and UK -

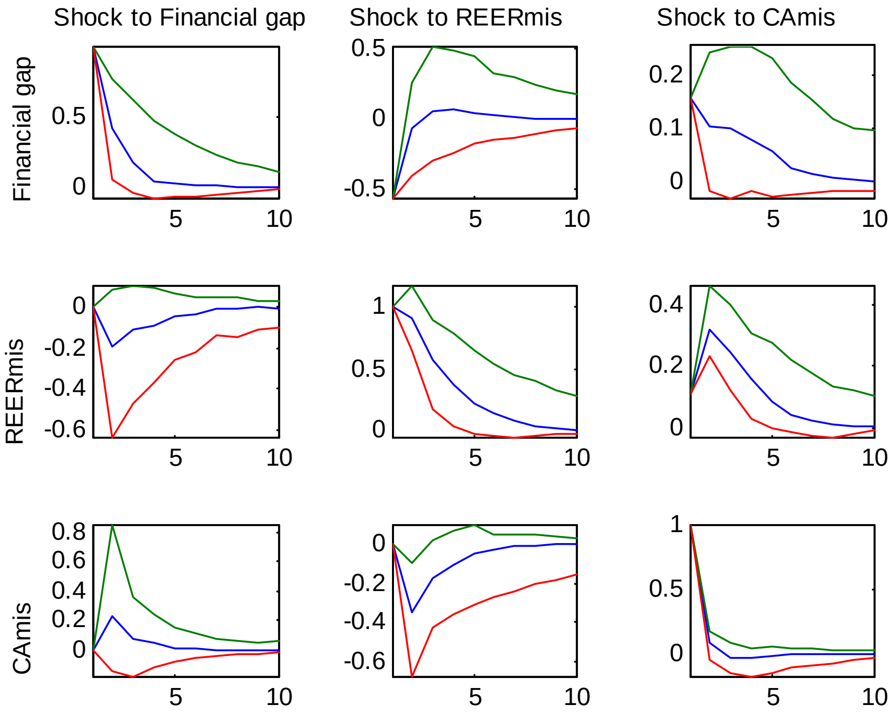


Figure 13b: IRFs by using partial pooling Bayesian panel VAR - euro area core -

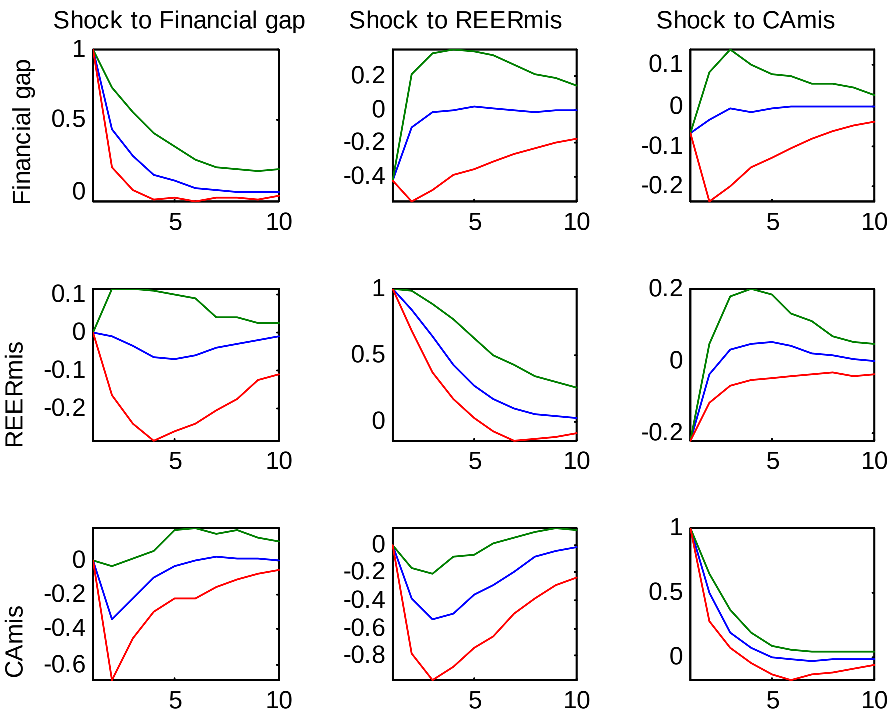
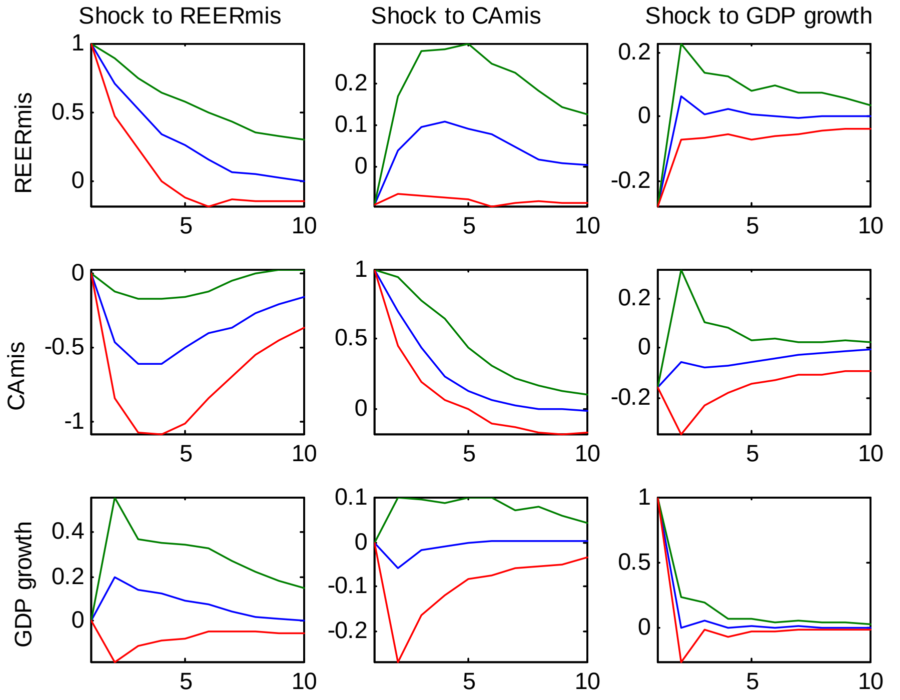
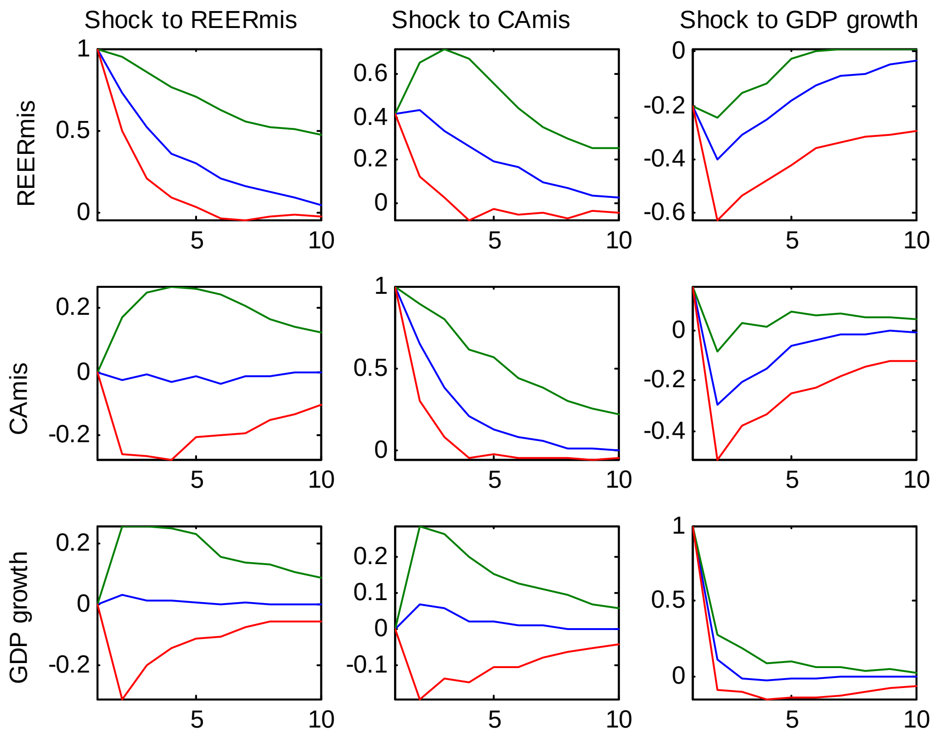


Figure 14: IRFs by using partial pooling Bayesian panel VAR - GDP growth -

(a) Euro area core countries



(b) Periphery countries



(c) CEE new member states

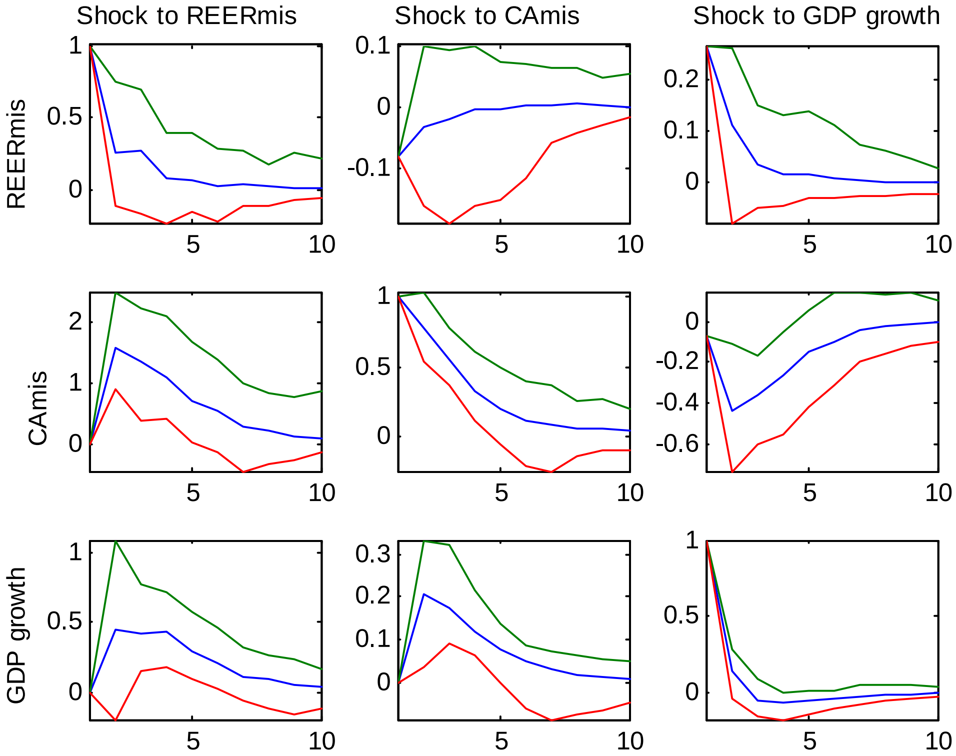


Table 2: Dynamic factor model - EU27

	EU27			EU27			EU27		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	ca_mis	reer_mis	pca2	ca_mis	reer_mis	pca2	ca_mis	reer_mis	pca2
ca_mis (-1)	0.201***	-0.146	0.00505	0.177***	-0.160	0.0288	0.124**	-0.177	-0.00967
	(0.0663)	(0.207)	(0.0242)	(0.0658)	(0.231)	(0.0241)	(0.0619)	(0.260)	(0.0383)
reer_mis	0.0100			0.0201			-0.00760		
	(0.0290)			(0.0297)			(0.0266)		
reer_mis (-1)		0.437***	-0.0144		0.441***	-0.0363***		0.404***	-0.0672***
		(0.0505)	(0.0118)		(0.0559)	(0.00805)		(0.0564)	(0.0144)
pca	0.227**	-0.966							
	(0.0962)	(0.748)							
pca (-1)			-0.0869*						
			(0.0494)						
fingap1							0.0415	-0.560*	
							(0.0433)	(0.318)	
fingap1 (-1)									0.396***
									(0.0594)
outputgap				0.113*	-0.373				
				(0.0586)	(0.350)				
outputgap (-1)						0.0298			
						(0.0470)			
UCFs	**0.795*** **	**0.600*** **	**0.968*** **	**0.783*** **	**0.651*** **	**1.034*** **	**0.818*** **	**0.785*** **	**0.980*** **
	(0.126)	**(0.177)**	**(0.117)**	**(0.124)**	**(0.216)**	**(0.114)**	**(0.132)**	**(0.262)**	**(0.121)**
Constant	1.625***	2.412	-0.817***	1.619***	2.359	0.0860	4.018***	12.20***	-1.569***
	(0.476)	(1.522)	(0.104)	(0.460)	(1.469)	(0.0935)	(0.766)	(4.432)	(0.227)
Observations	486	486	486	486	486	486	486	486	486
Number of co	27	27	27	27	27	27	27	27	27

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: UCFs are Unobserved Common Factors.

Table 3: Dynamic factor model - sub-groups

	EA Core			Periphery			CEECs			CEECs		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
VARIABLES	ca_mis	reer_mis	fingap1	ca_mis	reer_mis	fingap1	ca_mis	reer_mis	fingap1	ca_mis	reer_mis	pca2
ca_mis (-1)	0.341**	0.110	-0.0938*	-0.0331	-0.0345	-0.0882	0.0566	-0.328*	-0.0230	0.112	-0.342**	-0.0305
	(0.156)	(0.324)	(0.0484)	(0.0787)	(0.0474)	(0.0803)	(0.0682)	(0.170)	(0.0710)	(0.0761)	(0.155)	(0.0342)
reer_mis	0.0645*			-0.0556			-0.0202			-0.0262		
	(0.0357)			(0.0500)			(0.0344)			(0.0365)		
reer_mis (-1)		0.475***	0.0125		0.237	-0.0842***		0.177*	-0.0263*		0.242**	0.0271***
		(0.0844)	(0.0282)		(0.151)	(0.0287)		(0.102)	(0.0141)		(0.0986)	(0.0102)
fingap1	0.191	-0.871**		-0.00704	-0.0837		0.0894***	-0.177				
	(0.159)	(0.368)		(0.113)	(0.134)		(0.0285)	(0.141)				
fingap1 (-1)			0.0414			0.431***			0.435***			
			(0.0525)			(0.103)			(0.0753)			
pca										0.328***	-0.0735	
										(0.104)	(0.261)	
pca (-1)												0.0300
												(0.0430)
UCFs	**0.841****	**0.837**	**0.959*****	**0.815*****	**0.702*****	**0.845*****	**0.760*****	**0.641*****	**1.031*****	**0.809*****	**0.579*****	**1.019*****
	(0.371)	**(0.533)**	**(0.152)**	**(0.146)**	**(0.139)**	**(0.162)**	**(0.0918)**	**(0.181)**	**(0.168)**	**(0.0915)**	**(0.148)**	**(0.164)**
Constant	-0.847	8.167	3.539***	6.210***	-2.189	-1.777***	3.428***	24.77***	-1.495***	3.366***	-1.903	-1.515***
	(0.891)	(8.094)	(0.604)	(1.025)	(1.757)	(0.610)	(0.674)	(5.053)	(0.345)	(0.735)	(3.190)	(0.272)
Observations	108	108	108	126	126	126	198	198	198	198	198	198
Number of co	6	6	6	7	7	7	11	11	11	11	11	11

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: UCFs are Unobserved Common Factors.

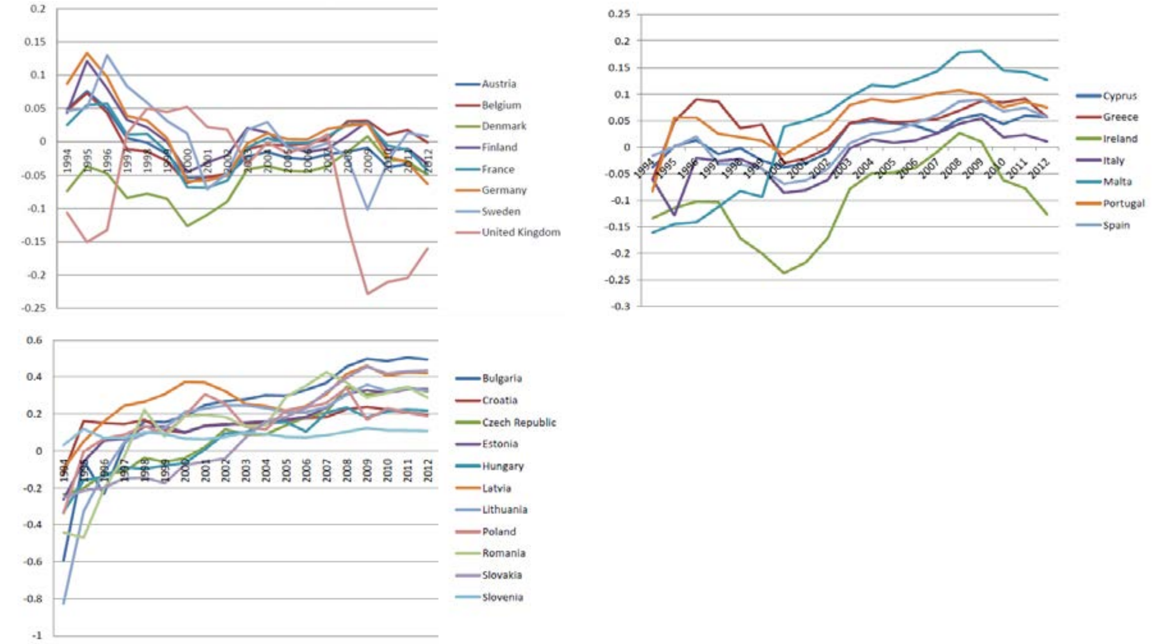
7 Data description

Variables in the panel VAR setup

variables	Sources	Description	Data coverage
CA_mis	Comunale (2016)	= CA underlying – CA norm	1994-2014
REER_mis	Comunale (2017)	= actual REER – equilibrium REER	1994-2012
Fingap1	Comunale (2015c)	Real GDP, HP filtered with lambda 100,000	1994-2014
dd_index_f	Comunale (2015c)	Domestic demand HP filtered with lambda 100,000	1994-2014 (for some countries 1995-2014; Greece from 2000)
dc_index_f	Comunale (2015c)	Credit to the private sector/GDP HP filtered with lambda 100,000	1994-2014 (for some countries 1995-2014; Lithuania from 2005 and Romania from 1996)
pca	Comunale (2015c)	Principal Component Analysis on output gap, credit to the private sector/GDP growth and domestic demand growth, just first component	1995-2013 (for some countries 1995-2014; Greece from 2001; Bulgaria and Ireland from 1996; Lithuania from 2005; Romania from 1997 and Slovenia from 1996)
Outputgap	Comunale (2015c)	Real GDP, HP filtered with lambda 1,600	1994-2014
wgdpgr	IMF WEO	Real world GDP growth	1994-2014
GDP_growth	IMF IFS	Real GDP growth (as percentage change with respect to the previous year)	1994-2012

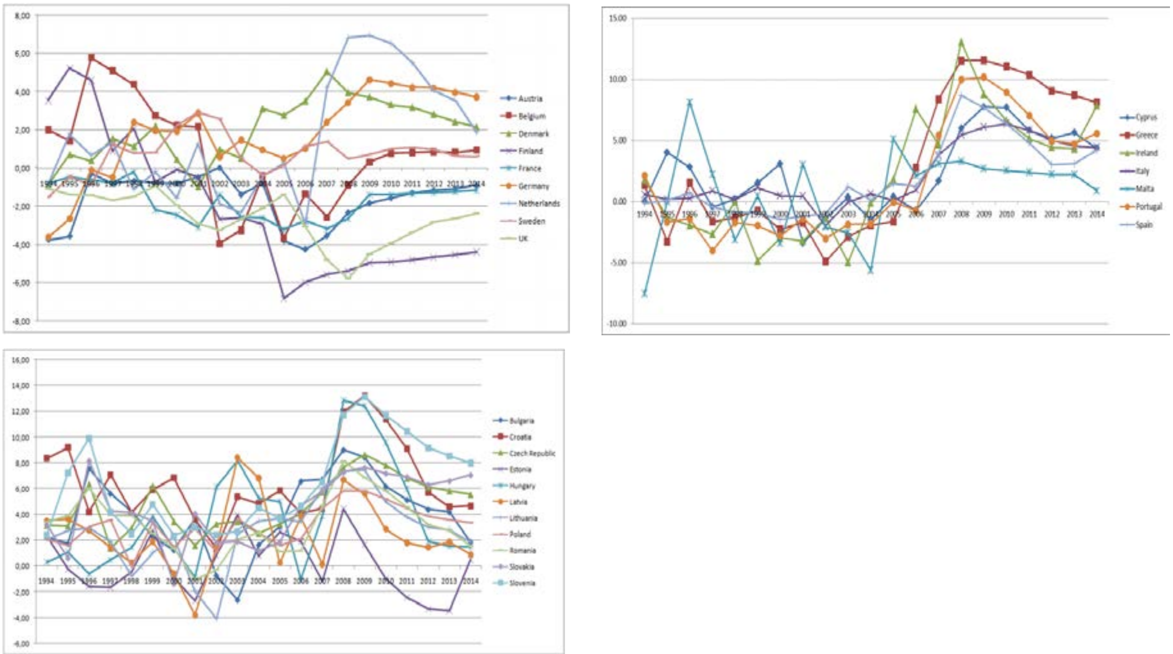
8 Appendix

Figure A: REER misalignments



Source: Comunale (2017)

Figure B: CA misalignments



Source: Comunale (2016)

Acknowledgements

The conclusions expressed in the paper are those of the author and do not necessarily represent the o¢ cial views of the Bank of Lithuania or the European Central Bank.

I am very thankful to Fabio Canova, Karsten Staehr, Robert Vermeulen, Mihnea Constantinescu, Matthias Weber, to the seminar participants at the ECB (Working Group on Econometric Modelling), at Paris School of Business, at the Bank of Lithuania, at the CEFER Research Seminar, to the anonymous referees of the Competitiveness Research Network and of the ECB Working Paper Series for suggestions and comments. I would like to thank Alistair Dieppe for the discussion on the Bayesian panel VAR setup and results. I acknowledge the very kind help by Francesca Loria for the code on partial pooling. I thank Paulina Katilovskytė for the assistance in collecting the data and Francesca D'Urzo, Giulia Felice, Anh Dinh Minh Nguyen for proofreading.

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ISSN 1725-2806 (pdf) DOI 10.2866/30584 (pdf)
ISBN 978-92-899-2748-2 (pdf) EU catalogue No QB-AR-17-038-EN-N (pdf)