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# Who did it? A European Detective Story

## Was it Real, Financial, Monetary and/or Institutional: Tracking Growth in the Euro Area with an Atheoretical Tool

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## ABSTRACT

During the past thirty years, euro area countries have undergone significant changes and experienced diverse shocks. We aim to investigate which variables have consistently supported growth in this tumultuous period. The paper unfolds in three parts. First, we assemble a set of 35 real, financial, monetary and institutional variables for all euro area countries covering the period between 1990Q1 and 2016Q4. Second, using the Weighted-Average Least Squares (WALS) method, as well as other techniques, we gather clues about which variables to select. Third, we quantify the impact of various determinants of growth in the short and long runs. Our main finding is the positive and robust role of institutional reforms on long-term growth for all countries in the sample. An improvement in competitiveness matters for growth in the overall euro area in the long run as well as a decline in sovereign and systemic stress. The debt over GDP negatively influences growth for the periphery, but only in the short run. Property and equity prices have a significant impact only in the short run, whereas the loans to NFCs positively affect the core euro area. An increase in global GDP also supports growth.

*Keywords:* euro area, GDP growth, monetary policy, fiscal policy, institutional integration, financial crisis, systemic stress, and synchronization.

*JEL codes:* C23, E40, F33, F43.

## Non-technical summary

Euro area countries have undergone significant changes and diverse shocks over the past 30 years. We aim to investigate which factors have consistently supported growth over this tumultuous period. The paper unfolds in three parts. First, we assemble a set of 35 real, financial, monetary, and institutional variables for all euro area countries over the whole sample period. Second, to examine which factors are among the strongest/most relevant to explain GDP growth during these three decades, we deploy several econometric techniques/frameworks and statistical methods. Third, we apply some additional econometric techniques to disentangle short- and long-term effects, identify spillovers, and alert us to possible endogeneity issues.

In the first part of the paper, we collect a set of variables which have bearing on growth. This search is not trivial, and, in future extensions of our approach, more variables can be added. We start by including a set of real variables which are normally found in the literature to matter for growth, i.e. fiscal variables and REER, as a proxy for price competitiveness. Monetary policy is taken into account by using shadow rates, which allow us to include both standard and unconventional monetary policy actions. Next, we look at some financial cycles in credit, house prices and equity prices, and their co-movements with the business cycles. This is to disentangle the link between real and financial sides of the economy. Sovereign and systemic (mainly financial) stress indices are also added to control for crisis periods and global factors. The global linkages and spillovers are further investigated by including world GDP. Finally, we make use of the index of EU Institutional Integration (EURII). We believe that this might have been impactful in the past few decades, contributing to increases in trade, investments, capital and labour mobility, and innovation, and thus helping the overall convergence within members. The impact, however, might have been asymmetrical across countries.

In the second part, we must decide which variables to retain. Thus, we test for the relevance of each regressor in explaining GDP growth over the short and long term. Two statistical methodologies are employed in order to establish some comparisons. The first one is the Weighted-Average Least Squares (WALS), which incorporates possible model uncertainty as well as uncertainty about estimations. The second method makes use of the Bayesian Model Averaging (BMA) method as a further check. We find a very robust set of indicators which can play a role for growth, namely: debt over GDP, the Sovereign and systemic stress indices, REER growth, the EURII and the shadow rates. Among the cycles, we add the ones for house prices and loans to NFCs, and, lastly, one variable representative for synchronicity, i.e. between long-term rates and households' loans.

As for the third part of the paper, we perform some statistical tests to choose the correct estimators/setups for our panel. On the basis of these tests, we next apply, as a preferred setup, a panel error correction model, which deals with non-stationarity and cointegration. This also allows us to disentangle short- and long-run coefficients. Then, to correct for possible endogeneity problems as well as the presence of unobserved global factors, we look at a dynamic factor model in which we apply instrumental variables. In the last section, a simple panel VAR model for a sub-sample of our selected variables is provided, to look at possible interactions across determinants.

At the end of this detective story, it emerges that competitiveness and, above all, institutional integration at the EU level, has mattered for the member states in the long run. The latter factor played an important role especially for the periphery of the euro area. Credit to non-financial corporations could boost growth in some core euro area countries, where funds possibly have been more efficiently allocated. Over and above these findings, the paper as a whole can be considered an adaptable, atheoretical toolkit which can be expanded as more data for countries are collected.

## 1. INTRODUCTION AND MOTIVATION

Our aim is to provide an atheoretical tool to track fluctuations in euro area growth rates and differences among euro area country groups since 1990.[4] We focus on euro area countries for several reasons: they were bound by the process of European economic and monetary integration that started in the 1970s; they have experienced nominal convergence along the Maastricht convergence criteria since 1992; and they have shared a single currency and monetary policy as well as faced the same nominal exchange rate since 1999. Upon the launch of the euro, money markets and sovereign bond markets rapidly converged. Thus, several forces narrowed differences across euro area countries.

At the same time, euro area countries have also experienced diverse shocks. Since 1990, we have witnessed, among other phenomena: nominal exchange rate gyrations (1992-1993); the dot-com bubble burst (early 2000s); the so-called Great Moderation and a broad financial cycle spurred by globalization, financial innovation and securitization; financial turmoil starting in August 2007, a global financial crisis starting in September 2008 and followed by the Great Recession, which, in turn, exacerbated euro area imbalances and prompted the sovereign debt crisis in May 2010, with break-up risks acute until summer 2012 and the announcement of OMT; and, starting in 2013, a period of protracted low inflation with risks of deflation. Figure A provides a glimpse of this tumultuous period.

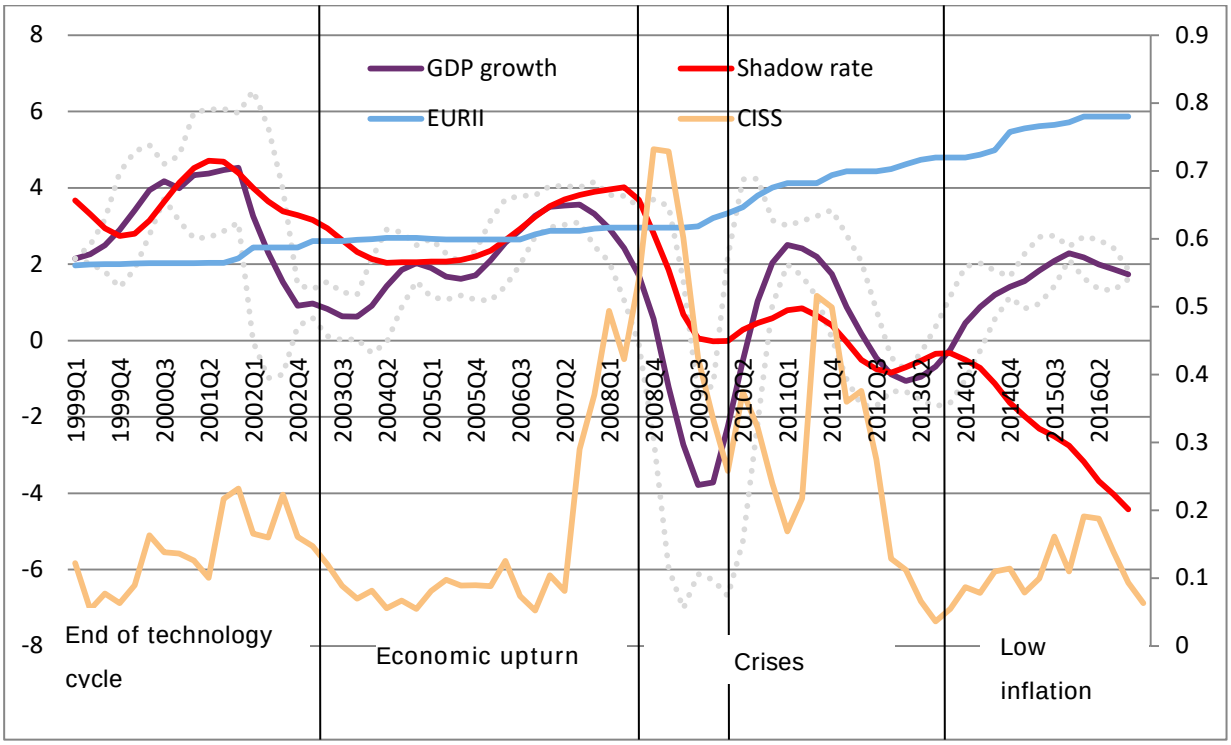
Responses to the crisis that started in 2007 are also relevant to the discussion. Since the start of the financial crisis, the European Central Bank (ECB) has implemented exceptional standard and non-standard monetary policies. Moreover, institutional reforms were introduced throughout the crisis, and we saw an enhanced pace of structural reforms. Hence, we now ask: what do we see in terms of the growth dynamic over the past three decades? Which factors played a role in stimulating growth or reducing it? Are these factors real, financial, monetary and/or institutional? Finally, how do the factors interact? For now, ours is a detective story told in broad brush strokes.

We make use of several techniques to select the factors which may have influenced growth based on the events above, such as the Weighted-Average Least Squares (WALS) and the Bayesian Model Averaging (BMA). Diagnostic tools are implemented to choose the correct estimators and setups. Based on that selection, we firstly apply a heterogeneous panel Error Correction Model (ECM), which helps us to quantify the contributions of the selected variables on growth in the short- and long-run. Then we use a dynamic factor model with instrumental variables to correct for cross-sectional dependence and possible endogeneity, finding overall robust results. Lastly, we apply a panel VAR and country-by-country VARs for a subset of variables in order to shed light on the transmission channels and country-specific results.

The main outcomes highlight the important positive role of institutional reforms for long-run growth overall, and particularly for the periphery countries. Furthermore, this is a robust result across specifications and setups. If we split the European institutional integration into its main components, we can see a significant positive role for financial and political integration in the long run. However, financial integration seems to have beneficial effects only for the core, unlike political integration, which positively influences only the periphery.

[4] We look at two main sub-groups, defined in a very simple way as euro area "core" (BE, DE, FI, FR, LU, NL) and "periphery" (ES, IT, PT).

**Figure A: Growth rates and growth factors for euro area**




Note: These are data for the aggregate EA19. For GDP growth, we take 4q moving average and +-2 standard deviations. The vertical lines represent the dot-com bubble and the end of the tech-cycle, the start of the global financial crisis, and the sovereign debt crisis and the start of the recovery/low inflation period. The areas are selected following Hartmann & Smets (2018). EURII is the European Index of Regional Institutional Integration and CISS is the Composite Indicator of Systemic Stress.[5]

An improvement in competitiveness matters in sustaining long-run growth in the euro area, as does a decline in sovereign and systemic stress. The first effect is also rather persistent over time. A decrease in systemic stress matters even more for growth. The debt over GDP negatively influences growth for the periphery, but only in the short run. The equity price cycle positively affects GDP growth only pre-crisis and in the short run, whereas the loans to NFCs had a positive impact, especially for Germany, in a longer perspective.

The paper is organised as follows. Section 2 provides some stylised facts and Section 3 a literature review. There, we describe diverse studies investigating the dynamics of growth and determinants of real convergence. Section 4 describes our set of data. Several authors have also investigated business cycles and financial cycles across European countries: we bring these into our framework. A feature of this paper is that we are the first to include an index of institutional integration as well as a composite index of systemic stress. In Section 5, we describe the selection of variables for our analysis by using different techniques. Section 6 presents the econometric diagnostics. Section 7 shows the main results for the panel error correction model and provides various robustness checks, Section 8 includes a dynamic factor models to correct for

[5] CISS is an indicator which uses information from equity, bonds, exchange rate volatilities, banks and payments systems and weights more when the stress has been found in several markets at the same time.

endogeneity and cross-sectional dependence and Section 9 offers a panel VAR analysis and country-by-country VARs. Section 10 concludes.

## 2. STYLISED FACTS

We start with some stylised facts about GDP growth rates and growth volatilities across the euro area, over the last three decades. We focus on the founders of the euro area, but for reasons explained below, we have to narrow down the data panel to 9 euro area countries for the period 1990Q1-2016Q4. The countries included are: Belgium, Germany, Spain, Finland, France, Italy, Luxembourg, the Netherlands and Portugal. This selection reflects the fact that, in order to guarantee consistency and high-quality data, we rely on the database from the European System of Central Banks Working Group on Economic Modelling (ESCB WGEM) team on real and financial cycles, based on ECB, BIS and national data sources. The data for the other euro area countries are either not yet included in this database – e.g., Austria and Ireland -- or have very short spans (e.g., for Greece and new member states).

Euro area countries have indeed experienced different growth rates across the sample period (1990-2016). This is clearly shown for the entire euro area in the previous figure and the nine countries in Figure B.6 Growth rates are heterogeneous across countries but also differ along various phases, i.e. until 1999 (launch of the euro), before the Global Financial Crisis (GFC) in 2008 and before/after the sovereign debt crisis in the second half of 2010.

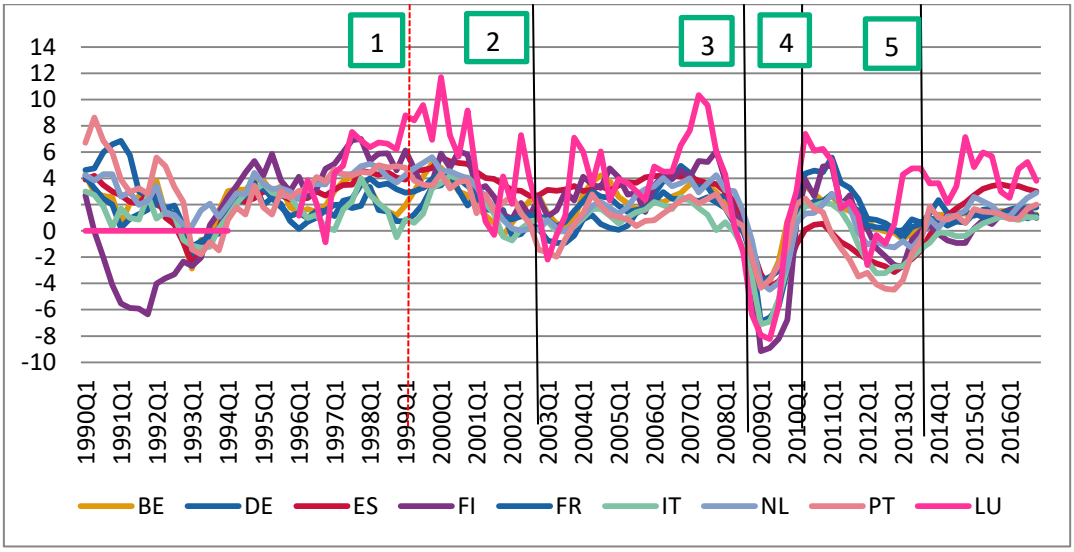
The core countries had high growth rates before the launch of the euro. This is especially true for Finland in the 90s. The country changed trade partners and most of its industrial policies after the collapse of the USSR. From the mid-2000s, Germany has experienced the most rapid increase in GDP, thanks to diverse structural reforms. Later on, the euro area core recovered faster and then stabilised at around 2%. Luxembourg, by contrast, is an outlier, having a more volatile and generally higher GDP growth over the period.

Within the periphery group, Italy has had a stagnating GDP growth since the beginning of the 1990s and posted the weakest recovery after the GFC and sovereign crisis (Papadia, 2017). Spain, contrariwise, had a boom period lasting a decade, from the mid-1990s to the mid-2000s, fuelled by reforms and an increase in the magnitude of the credit cycle (Comunale, 2019). Overall, the drop in growth for the periphery was less substantial during 2008-2009, but it was longer lasting. Only after 2014 can we see a further increasing growth trend for the periphery as well. Therefore, we expect differences in the changes of growth rates and in their volatilities over time.

Indeed, we show such differences in Table A, dividing the sample into different periods. Not only did the growth rates themselves perform differently, but we can see also heterogeneity in the second moments across member states in different time periods (Table A). Growth volatilities are on average between 2 and 7 percent, with two clear outliers: Finland and Luxembourg. But the main differences can be seen by focusing on the key sub-periods identified, i.e. before and after the introduction of the euro, and before and after the two main dips (the GFC, and the sovereign debt crisis).

[6] We can see the average growth rates and the confidence bands for EA19 in Figure A.

**Figure B: Growth rates of euro area countries**[7]




Note: These are the real growth rates compared to the same quarter of previous year. The vertical lines are for 1) the introduction of the euro (dashed red line is when Figure A starts), 2) the dot-com bubble and the end of the tech-cycle, 3) the start of the global financial crisis, 4) the sovereign debt crisis, and 5) the start of the recovery/low inflation period.

This finding allows us to illustrate and further stress the underlying asymmetries within the euro area performances in the past decades. Finland and Luxembourg experienced the highest volatilities especially before the introduction of the euro, and this is in line with the findings shown in Figure A and during the GFC. In the latter case, Germany as well has a very volatile GDP growth. France, Spain, the Netherlands and Belgium seem more stable in the decades under consideration. The largest volatilities are therefore found if we include the GFC (2008Q3-2013Q4), as expected. There is an overall decrease in volatility between pre-crisis years and the period after the sovereign debt crisis in all the members (in red in Table A). This is additional evidence of the importance of tracking and investigating the heterogeneity in growths within member states and across time periods.

**Table A: Volatilities of euro area countries over time**

| | Time periods | EA19 | BE | DE | ES | FI | FR | IT | LU | NL | PT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Full sample | 1990Q1-2016Q4 | 3.5 | 2.7 | 5.0 | 5.6 | 13.0 | 2.2 | 4.2 | 14.4 | 4.1 | 6.7 |
| Before euro | **1990Q1-1998Q4** | **0.5** | **2.5** | **4.0** | **2.8** | **17.6** | **1.7** | **1.9** | **6.4** | **1.6** | **5.4** |
| Economic upturn | 1999Q1-2007Q2 | 1.3 | 1.7 | 2.7 | 0.6 | 2.1 | 1.1 | 1.6 | 10.5 | 2.9 | 2.7 |
| During the crises | 2008Q3-2013Q4 | 5.6 | 3.6 | 11.9 | 2.0 | 16.7 | 3.4 | 7.1 | 20.6 | 4.1 | 5.2 |
| Low inflation and recovery | 2014Q1-2016Q4 | 0.1 | 0.0 | 0.1 | 1.0 | 0.8 | 0.1 | 0.3 | 2.1 | 0.6 | 0.2 |

Note: the volatility is here defined as the standard deviation (squared). The EA19 is the aggregate of 19 member states, which includes new member states, and the data start in 1996Q1 (source: OECD).

[7] Luxembourg is an outlier. We also performed our baselines without it, as a robustness check.

What might explain such large variations and differences? To sum up our aims, we analyse these heterogeneities across country groups and time periods, both in the short and long run, and assemble an atheoretical toolkit that is flexible and adaptable (and can be built upon as more data for all countries are collected).

## 3. LITERATURE REVIEW

Our study is at the intersection of a rich literature on growth models and the determinants of real convergence. An initial group of studies follows the Solow exogenous growth model (Solow (1956)). The Solow model postulates that if preferences and institutional features are the same across countries, a high expected return on investment in capital-scarce countries encourages capital to flow to the less endowed countries. The latter then grow at a faster pace, thus slowly converging towards the level of income of the capital-rich countries. This is often referred to as unconditional convergence, and is evidenced by the catching-up phenomenon (β-convergence).

In the case of European countries, the empirical evidence for β-convergence is mixed. Barro and Sala-i-Martin (1992) find evidence support catching-up for a sample of European countries, although the speed is low and the path uneven. The limits of this approach lie, amongst others, in the requirement of identical preferences and institutions across countries. There is also no reflection on economic policies (Diaz del Hoyo et al. (2017)). Alcidi et al. (2018) show a "tale of two speeds": with overall income convergence over last 15 years, but with large diverging internal patterns.

Another group of studies endogenises technological change through increased returns to production factors or by generating innovation in its own right. Uzawa (1963) and Lucas (1988) include investment in human capital. Romer (1986), for his part, recognizes that countries may become more prosperous if they allocate more resources to innovation. Borsi and Metiu (2013) use a neoclassical growth model augmented by endogenous technological progress, and find no evidence of overall real GDP per capita convergence for the EU27 in the period 1970-2010. They do, however, identify "convergence clubs", or clusters (see also Comunale et al. (2019) for a more recent study). The endogenous growth models permit policymakers to implement growth-enhancing strategies to target TFP, education, innovation and technological progress, thereby boosting economic growth and facilitating convergence (see Diaz del Hoyo et al. (2017) for a survey).

A third group of studies explains cross-country differences in per capita growth with differences between institutions and governance (see North (1990) and North and Thomas (1973)). Countries with strong institutions encouraging innovation will experience higher factor accumulation, more efficient resource allocation, and more stable long-term growth (Easterly and Levine 1997). Barro (1996) finds a non-linear relationship between growth, on the one hand, and democracy and political freedom, on the other. Political instability, corruption, red tape, and an inefficient judicial system are shown to be detrimental to growth (see Hall and Jones (1999); Mauro (1995), and Aixala and Fabro (2008)). There is a positive correlation with a country's initial level of income and good initial governance (Han, Khan and Zhuang (2014)).

To sum up, the spectrum of variables affecting growth is very broad and predictions are wide. We include several of the above variables in our exercise.

## 4. DATA DESCRIPTION

In order to explain GDP growth in the euro area in both the short and the long run, we include several i) real, ii) financial, iii) monetary and iv) institutional variables, various sub-samples of countries and across time. This section describes them in detail, while a summary table can be found in the Appendix, for convenience. As already explained in Section 2, our data covers a panel of 9 euro area countries for the period 1990Q1-2016Q4, for max 972 observations. [8]

### 4.1. Real variables

The real GDP growth data for the countries – as well as the real and financial cycles – come from the database of the above-mentioned Working Group on Econometric Modelling of the European System of Central Banks (ESCB WGEM) team (see ECB (2018). The real GDP growth series are extended by using IMF IFS data (which are interpolated by using cubic spline).

In the set of real variables, we include fiscal variables, such as (seasonally adjusted) fiscal deficit and debt over GDP, and a proxy for price competitiveness represented by the growth rate of the REER vis-à-vis 41 partners and deflated by CPI. All these series are from Eurostat. Next, we make use of global GDP growth in the robustness checks, to look at possible global/spillover effects on growth in the euro area countries. These data are from IMF-IFS, in million nominal USD. The rates of growth are taken year-on-year in percentage. We consider 42 countries, including other advanced economies and emerging markets.[9]

Lastly, we included the real GDP (YER), i.e. business cycle. We did this in order to complete the set of the cyclical components, that is, to have a real counterpart for the financial cycles.[10] The cycle was computed, as we did for the financial cycles in Section 4.2, by using the band-pass filter á la Christiano and Fitzgerald (2003), with 8-80 quarters as lower-upper bounds.

### 4.2 Financial variables

For the financial variables, we use several measures of the financial cycle based on credit, house prices and equity prices. They overlap, of course, but are not identical. The cycles are based on data from real total credit to private non-financial sector (TCN), real credit to non-financial corporations (LNF), real credit to households (LHH), property prices (RPP), equity price indices (EQP), and nominal long-term rates (LTN). The equity price indices and the nominal long-term rates are from ECB Statistical Data Warehouse (SDW) while the other data are from BIS and extended by using national sources. The cycles were computed by using the band-pass filter á la Christiano and Fitzgerald (2003), with 8-80 quarters as lower-upper bounds. We follow the previous studies by Drehmann et al. (2012) and Aikman et al. (2015) and use a so-called band-pass filter to extract the cycles.

We also make use of a new set of within-country synchronicity indices between real and financial cycles from Comunale (2019). These new measures provide us with proxies of macro-financial co-movements, capturing whether positive and negative cyclical phases coincide, i.e. they can be either both positive or both negative, regardless of their amplitudes (see Mink et al. (2012) for the cross-country analysis). We look at all

[8] The data for the cycles and the synchronicity measures are not publicly available but they can be replicated by using the series and filters as explained in this section and in ECB (2018).
[9] The 9 euro area countries are included. This makes our variable rather suitable to account for possible spillover effects.
[10] Indeed, this variable is never picked by the statistical methods when the dynamics is included, and we do not have business cycles in any of the results.

the country-pairs from the cycles described above.[11] The indices of synchronicity have been added to the possible set of regressors following recent evidence of their link to macro-financial characteristics of EU countries (see ECB (2018)). A high synchronicity between real and financial cycles (or among financial cycles) can be related to some structural characteristics of a country (from homeownership or Loan-to-Value ratios to current account misalignments and financial openness) and signal an upcoming recession (Comunale, 2019).[12]

In the context of sovereign and systemic (mainly financial) stress, we also include indicators taking these aspects into consideration, which are especially important for the last 10 years of data. We have the country-specific Composite Indicator of Sovereign Stress (SOVCISS)[13] and the common Composite Indicator of Systemic Stress (CISS), as computed by Holló et al. (2012). Both are taken from ECB SDW. The SOVCISS is at monthly frequency and averaged into quarterly. The CISS is at daily frequency and we make use of the quarterly averages. The SOVCISS combines the short- and long-end yield curve information including spreads, volatilities and bid-ask spreads to come out with an index for stress in sovereign bond markets. CISS, for its part, is an indicator which uses information from equity, bonds, exchange rate volatilities, banks and payments systems, and weights more when stress has been found in several markets at the same time.

### 4.3 Monetary variables

For the monetary factor, with the ECB policy rate constrained by the zero lower bound (ZLB) over a significant portion of the sample period under investigation, we use shadow interest rates of Wu and Xia (2016) to capture both conventional and unconventional monetary policy actions. [14] These series by Wu and Xia (2016) are augmented by EONIA rates for the periods before 2004 from ECB SDW and pre-1992 country-specific short-term interest rates from national sources. The proposal of having a shadow rate has intuitive appeal because when it is positive it equals the actual short-term rate, but the shadow rate is free to evolve to negative levels after the actual short-term rate becomes constrained by the ZLB. A lower shadow rate captures a further use of unconventional monetary policy measures. We decided to apply the specific Wu and Xia (2016) shadow rate because it has been widely used in the literature and is constantly updated. Moreover, if we use a simple VAR with GDP and inflation adding several different shadow rates, the results of the transmissions are very similar. [15]

### 4.4 Institutional variables

We also include a European Index of Regional Institutional Integration (EURII), which maps developments in European integration for 6 euro area founding members on the basis of a monthly dataset from Dorrucci et

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[11] Each index results in a value of either 1 or -1, where 1 means that the cycles are perfectly synchronized at time t and, therefore, they have the same sign (either positive or negative). A value of -1 indicates instead that the cycles have opposite signs.

[12] As explained in detail in Comunale (2019), among the different credit cycles and between the house price cycle and the real cycle, there is a relatively high level of synchronicity. Credit and GDP fluctuations seem to be less synchronized, mostly because credit volumes tend to lag the real cycle by several quarters. The high rates of private homeownership tend to be associated with larger cycles in GDP, credit, and house prices. Higher Loan-To-Value ratios, seen as a proxy of borrowing constraints, and a higher percentage of flexible-rate mortgages, could also indicate that a country is more sensitive to shocks and possibly increase pro-cyclicality and increase cycle volatility. Finally, the pro-cyclicality of the credit and housing market to the GDP cycle can be linked to the fluctuation in current accounts and their misalignments with respect to the theoretical norm value. Some synchronicity measures and, above all, the credit cycles, may also be considered for signaling future recessions.

[13] See Garcia-de-Andoain and Kremer (2017) for more details.

[14] The Wu and Xia (2016) shadow rates are based on an analytical representation for bond prices in a multifactor shadow rate term structure model (SRTSM). The minimum rate is set as 25 basis points. Among its advantages, we can see that it is easy to compare with normal rates, it can be applied directly to discrete-time data and it is not based on simulated methods. Moreover, the approximation is free of any numerical error associated with simulation methods and numerical integration. However, the shadow rates depend on: the specification of the shadow/ZLB model and the data and method used for estimation.

[15] Results based on the shadow rates series described in Comunale and Striaukas (2017). The results are available on request. There are other shadow rates or methods used in the literature to capture the unconventional monetary policy phase. All have pros and cons, however, and there is no consensus on the best among them (see Comunale and Striaukas, (2017).

al. (2015), extended to include 2016. The data are taken at quarterly frequency by averaging the monthly series. Common across all the countries and time-varying, this index represents a novelty in this type of study.[16] The EURII index captures the path of institutional integration in Europe since the launch of the EU in 1958. We define two overarching periods. The first is the "Common Market Era", from 1958 until 1993. During this overarching period, integration advanced along different stages (Balassa (1961). They were: a free trade area and customs union, the gradual build-up of the European internal market, some degree of coordination of, for instance, exchange rate policies or monetary policies, and a number of institutions, laws, and decision-making processes which can be defined – though to different degrees – as supranational in nature (e.g., the EU Parliament and Court of Justice). The second overarching period is the "Union Era", which starts after 1993. This era has four main components, namely, the economic union, the fiscal union, the financial union and the political union.[17]

Conceptually, the Union Era became the center of the European debate at the end of 2012 with the Four Presidents' Report and in 2015 with the Five Presidents' Report. These reports underscore the need to complement the monetary union with the four other unions. A maximum score of 50 is assigned to each of these eras, with the index starting at 0 on 1 January 1958 (when the Treaty of Rome entered into force) and then making progress up to the current cumulated value of slightly above 76 as of 1 January 2015. The gap between 100 – i.e., the maximum total score that would be assigned in the index if all objectives of the Common Market and Union Eras were fully accomplished – and the current total score gives an indication of the distance still to be covered until a 'new perceived steady state' is achieved in the process of integration. The EURII index exhibits a discontinuity in the integration process that was implied by the start of stage two of the EMU in 1994. That is when the nature of institutional integration profoundly changed in the EU/euro area. In our sample, we start from the period just before stage two of the EMU in 1994 (i.e. we start our sample in 1990) until the last quarter of 2016.

Summing up, we have been able to round up about 35 variables in total, thus far, including 21 synchronicity indices. More variables might be added in the future.

## 5. SELECTION OF VARIABLES

We now need to understand the relevance of each regressor in potentially affecting GDP growth. Significantly, we do not claim any causality: highly correlated variables do not guarantee causation, i.e. high correlation may be caused by a similar set of shocks. Our main contribution is to provide an atheoretical setup looking at the "usual suspects" in the policy debate, but rather "unusual" in the academic literature, as possible factors driving fluctuations and differences in growth rates among euro area countries since 1990. We do not rely here on established theoretical models on growth, but, at the same time, we want to avoid spurious selections of variables. The selection is thus made in a statistical way, via model averaging algorithms for linear models. These methods combine information taken from parameters of each possible model using a weighted average of conditional estimates, i.e. they incorporate model uncertainty as well as uncertainty about estimations, selecting the best setup available in the set. As in all estimation procedures

[16] An illustrative chart with the subcomponents of the EURII index is provided in the Appendix (A.3.).
[17] A check by using these four components separately is also provided.

with model averaging algorithms, we look at a linear regression model, as in equation (1), also elaborated on in Magnus et al. (2010). This is reported below in a panel setup:

$$Y_{it} = \beta_1 X_{1,it} + \beta_2 X_{2,it} + \varepsilon_{it} \quad (1)$$

In this setup, $X_{1,it}$ are our "focus" variables (for which we might have a reference model) and $X_{2,it}$ is a (n x k) matrix of "auxiliary" variables. A different model arises whenever a different subset of $X_{2,it}$ is set equal to zero, and, in general, there are $2^k$ models to consider. In order to select the best one(s), the model averaging estimation proceeds in two steps: 1) we estimate the parameters, conditional upon a selected model; and then 2) we compute the estimator as a weighted average of these conditional estimators.

We apply as a preferred method the Weighted-Average Least Squares (WALS) proposed by Magnus et al. (2010) and reviewed by Magnus and De Luca (2016). WALS is a flexible approach that has proven quite efficient for the selection of GDP growth factors. The WALS approach also reduces the computational burden compared with other methods (see below), especially when we include synchronicity indices.[18] It combines frequentist, i.e. (constrained) least squares, estimations with only the weights taken as Bayesian. One key advantage is that the priors are here neutral, so the method relies on a transparent definition of prior ignorance.

Thereafter, and only as a robustness check, we apply the Bayesian Model Averaging (BMA) method, which relies fully on Bayesian weights and estimates and has been widely used in the growth literature (see Sala-i-Martin et al., 2004 and Masanjala and Papageorgiou, 2008). In the BMA, informative priors need to be specified. An additional reason to apply BMA exclusively as a check is that, in so doing, we avoid combining frequentist approaches with pure Bayesian ones.

As in Magnus et al. (2010), we consider a rough guideline for "robustness" of a regressor to be whether it has a Posterior Inclusion Probability (PIP) value of 0.5 (Raftery, 1995) in the BMA, corresponding approximately with an absolute t-ratio of abs(t)=1 (Masanjala and Papageorgiou, 2008), for instance, in WALS.[19] We decided, however, to be more restrictive. In the case of WALS, only t-values greater than 1.5 in absolute terms are included in our study. For BMA, only regressors for which the PIP is close to one (minimum of 0.8) are selected and then added. If the PIP is exactly equal to one, the regressor needs to be included by probability one.

The PIP and the t-values are available in the Appendix in Table A.2 and A.3 for WALS and BMA respectively. In dark green, we show the variables picked using our more restrictive selection; in light green, we can see the results if we apply the criteria from the literature. The final selection of the variables for the baseline, i.e. the ones that should be included for both methods, is in Table A.4.

Starting with WALS (Table A.2 in the Appendix), the regressors to be included (i.e. if t-values are greater than 1.5 in absolute terms), together with the lagged value of the dependent variable (GDP growth) are:

[18] We make use of the codes in Stata by De Luca and Magnus (2011). An application of WALS for growth equation can be found, for instance, in Magnus et al. (2010) or in Owoundi (2016).
[19] Diverse caveats apply. Both WALS and BMA apply in a context of static linear regressions models and they do not take into account the possible heterogeneity across units and short- and long-term effects separately. Moreover, stationarity in the data is not required. The presence of the above-mentioned factors may well be crucial in our analysis. In our view, this is in any case a worthwhile initial screening check.

CISS, SOVCISS, REER growth, debt over GDP, the shadow rates, the EURII, the cycles of equity and house prices, credit to NFCs (and the one on total credit), and the synchronicity between long-term rates and credit to households as well as credit to NFCs. If we do not include the lagged GDP growth, we find that other synchronicity indices could be also one of the factors to take into account. Among the cycles, the business cycle seems to capture what was given by the lagged GDP growth in the previous specification.

If we apply the BMA (Table A.3) and then compute the PIP, including among the regressors the lag of GDP growth, it is clear that debt, CISS, REER growth and the institutional index EURII should be included, together with the equity price cycle. Given that these Bayesian techniques are designed for static panels, we applied the BMA also without any lag of the dependent variable. In this case, debt over GDP, REER growth, both CISS and SOVCISS, shadow rates and the institutional index should be included in the model. Among the cycles, the real one captures what the lagged GDP growth had previously added; moreover, credit to NFCs and house prices may play a role. Finally, we added the synchronicity indices, but only between the real GDP cycle and financial cycles. We exclude synchronicity between financial measures at this stage because of the computational burden of the BMA technique. If, however, we include only the synchronicity indices between long term rates and loans to households and between long term rates and loans to NFCs, which are the only ones that were important in the WALS case, they turn out to be not crucial for growth using the BMA. The only index that seems to matter is the one between real GDP and equity prices, but only if the lagged value of real GDP is not included.

Summing up, by means of what overlaps in the WALS and the BMA techniques (Table A.4 in the Appendix), we find a set of robust factors which need to be added as regressors. One finding is that, by using either of these techniques, the fiscal deficit should not be included and only some specific financial cycles. The selected variables are therefore: debt over GDP, CISS and SOVCISS, REER growth, the EURII and shadow rates. Among the cycles, we will add the ones for house prices and loan to NFCs and, lastly, one variable representative for synchronicity, i.e. the one between long- term rates and loans to households. This is our baseline setup. Our alternative baseline excludes the synchronicity measure, which is not captured in BMA.

## 6. ECONOMETRIC DIAGNOSTICS AND SETUP

Given the above selection of growth factors, we need to test for cross-sectional dependence (CSD), non-stationarity and also cointegration. The sequence of the tests is crucial. For instance, without checking for the presence of CSD, we cannot choose the correct test for non-stationarity and for cointegration.

Given that, our panel experiences the first problem, i.e. cross-sectional dependence.[20] Therefore, in order to properly test for the presence of unit roots, we use a second-generation test by Pesaran (2003). Our dynamic panel cannot reject non-stationarity for some of the series or even fully accept the null of non-stationarity for all the series in some cases (CISS index, cycles, shadow rates and institutional index). [21]

[20] We applied the test in Pesaran (2004). The results for our baselines strongly reject independence: Pesaran's test of cross-sectional independence = 17.695, Pr = 0.0000 (with synchronicity index) and Pesaran's test of cross-sectional independence = 17.903, Pr = 0.0000 (without).

[21] The null hypothesis assumes that all series are non-stationary. This t-test is also based on Augmented Dickey-Fuller statistics such as IPS (2003), but it is augmented with the cross-section averages of lagged levels and first-differences of the individual series (CADF statistics). More details on the tests can be found in the Appendix (A.5). The cycles are normally stationary series, as they are deviation from a trend. However, when the test is conducted correcting the series for the presence of cross-sectional dependence, we no longer find stationarity. The test is performed in a panel sense and the high cross-sectional dependence found in our panel needs to be taken into account.

For the test of cointegration among the selected variables, we apply an error-correction-based panel cointegration test, i.e. the Westerlund (2007) test. This approach is effective in the case of panel data with cross-sectional dependence. One drawback is that we cannot check for our full baseline, given the limitation to 6 regressors. However, by using the cycles one by one, we do reject the null hypothesis of no-cointegration for at least one of the cross-sectional units. The same applies for the baseline without cycles or synchronicity indices.[22]

As for the third step, we perform some statistical tests to choose the correct estimators/setups for our panel. On the basis of these findings, we apply as a preferred setup a panel error correction model (PECM), which deals with non-stationarity and cointegration and allows us to disentangle short- and long-run coefficients. Then, to correct for possible endogeneity problems and the presence of unobserved global factors, we look at a dynamic factor model with Instrumental Variables. In the last section, a simple panel VAR model for a sub-sample of our selected variables is provided to examine possible interactions across determinants as well. The results are presented also in this sequence: Section 7 will describe the outcomes for PECM, Section 8 for the dynamic factor model and Section 9 will look deeper into the main findings emerging from the VARs.

Hence, first, we reparametrize our setup from an Autoregressive Distributed Lag (ARDL) form (Equation (2)) into a panel error correction model (PECM), as shown in equation (3).[23] Another reason for the choice of the PECM is that this framework allows us to study both the short-term and the long-term influence of the factors we selected to explain growth. We believe that the differences between the short and long run are crucial for possible factors affecting growth. Here we do not claim causality, but also the simple correlations (calculated in an econometrically sound way with a PECM, which would be not the case with the WALS results for the dynamic setup) need to be looked at in a short- vs. long-run perspective. Especially for growth, we do care about the short run, of course, but the long run is our main concern. For the PECM setup, the estimators we can use are three, namely the Mean Group (MG), the Pooled Mean Group (PMG) and the Dynamic Fixed Effects (DFE). The MG estimator is the only one that gives heterogeneous coefficients in both the short- and long-run analysis, and we decided to use it to keep the information coming from the heterogeneity of our sample.[24]

$$GDPG_{i,t} = \beta_{1i} GDPG_{i,t-1} + \beta_{2i} X_{i,t} + \beta_{3i} X_{i,t-1} + \varepsilon_{i,t} \quad (2)$$

$$\Delta GDPG_{i,t} = \phi_i \left( GDPG_{i,t-1} - \theta'_{0i} - \theta'_{1i} X_{i,t-1} \right) + \delta^{'*}_{11i} \Delta X_{i,t} + \mu_i + \varepsilon_{i,t} \quad (3)$$

The coefficients $\phi$ and $(\phi \cdot \theta)$ capture the long-run effects, while the coefficient $\delta$ corresponds to the impact of the variables in the short run. The X is the vector of the variables taken into account. Based on

[22] For the baseline without any cycle or synchronicity index, we always reject the null of non-cointegration at 5%. Details of the tests' results are available upon request.
[23] The number of lags has been selected based on the Schwarz's Bayesian information criterion (SBIC). This method has proven to give more accurate outcomes for quarterly data series also in case of small samples for VARs and Vector ECMs (Ivanov and Kilian, 2005). We implemented this criterion country by country. Only for some countries would the SBIC criterion have chosen 2 lags. We applied in our setups only one lag for the overall panel to keep a higher degree of freedom. The number of regressors with both one and two lags in the ECM is also too high to be estimated by the Mean Group. If we use only the second lag, the results are robust with respect to our baseline in Table 1.
[24] The results with the DFE are also available upon request. The estimated coefficients are very robust with respect to the ones estimated by applying the MG.

these results in Section 4, the list for the baseline vector of factors is provided and includes: debt over GDP, CISS and SOVCISS, REER growth, the EURII and shadow rates together with the cycles for equity prices, house prices and loan to NFCs and synchronicity between real GDP and equity prices.

Second, to correct the cross-sectional dependence and a possible endogeneity problem in this dynamic panel setup, we apply the framework developed by Chudik and Pesaran (2015) and further implemented and extended in Ditzen (2018). This is a dynamic factor model (DFM IV) with cross-sectional averages for correcting the cross-sectional dependence and instrumental variables for the key regressors to deal with endogeneity.[25] The estimator is a mean group-type which tries to keep as much heterogeneity in the coefficients as possible (CCEMG-IV). In equation (4), we can see a representation of a dynamic factor model (Pesaran and Tosetti, 2011):

$$y_{i,t} = \alpha_i + \delta_i' \boldsymbol{d}_t + \beta_i' \boldsymbol{x}_{it} + \gamma_i' \boldsymbol{f}_t + e_{it} \quad (4)$$

where $\boldsymbol{d}_t = (d_{1t}, \dots, d_{nt})$ is the vector of observed common variables,[26] $\boldsymbol{x}_{it}$ is the vector of observed individual ones and $\boldsymbol{f}_t$ is a vector of *m* unobserved common factors which will represent the cross-sectional averages (i.e. spillovers) and other common factors.

Third, in the last checks, we also provide a simple panel VAR model such as the following in equation (5) in order to look at our results with an endogenous structure (see Canova and Ciccarelli, 2013). This is not meant to add any causality but only to take into account the possible endogeneity among our variables of interest.

$$Y_{i,t} = A_{0i}(t) + A_i(l) Y_{i,t-1} + u_{i,t} \quad (5)$$

where $Y_{i,t}$ is the vector of our variables described in the preferred identification scheme (see Section 6.3). We compact into $A_{0i}(t)$ all the deterministic components of the data (constants, seasonal dummies and deterministic polynomial in time), if present. $A_i(l)$ are polynomials in the lag operators and $u_{i,t}$ are the identically and independently distributed errors. Lags of all endogenous variables of all units enter the model for *i*, i.e. we allow for "dynamic interdependencies".[27]

Summing up, we will now show whether the selected set of variables – as well as the econometric approach chosen – play a role in explaining GDP growth in the euro area countries at different horizons, and determine if we can find any robustness results, using all the reported techniques.

[25] The instruments are model-selected lags of our variables.
[26] These are variables which are common across countries (see EURII) and are included explicitly.
[27] When the global GDP growth is included, a VARX model is also applied, with the new variable taken as exogenous.

# 7. RESULTS WITH PECM

## 7.1 Main results with PECM

A comparison between the two PECM baselines – one with and the other without the synchronicity between real GDP and equity prices – can be found in Table 1.[28] We also look at two sub-groups, defined in a very simple way as euro area "core" (BE, DE, FI, FR, LU, NL) and "periphery" (ES, IT, PT) and whether the difference in the coefficients is significantly non-zero (Table 2). We show hereafter only our preferred estimator, which, to the greatest extent possible, retains the heterogeneity in the samples, i.e. the Mean Group estimator (as a simple average of cross-sectional coefficients). The results of using a homogeneous estimator, i.e. the dynamic fixed effect, are available upon request.

[Insert Tables 1-2 around here]

In the long run, an improvement in competitiveness matters for growth as well as a decline in sovereign and systemic stress.[29] By assembling our broad set of data and controlling for some econometric issues, we are in line with the previous literature. For example, Gala and Lucinda (2006)[30] and Rodrik (2008)[31] both indicate that a real depreciation, i.e. increase in competitiveness, is associated with higher GDP growth. Comunale (2017a) finds that the REER misalignments associated with foreign capital inflows in the EU were a further cause of declining GDP, in a long-run perspective, while they played no role in the short run. Indeed, situations of protracted or recurrent REER misalignments have been associated with lower economic growth mostly over the medium and long run in the literature (Edwards 2000). Notably, as reported in Berg and Miao (2010), the REER is not a policy instrument, but mainly a result of policy actions and externalities. Thus, funding the appropriate, more productive sectors can increase competitiveness and then long-run growth (Comunale, 2017a).

The debt over GDP negatively influences growth for the periphery only in the short run (and this drives the same results for the entire sample). This is in line with the general empirical literature on the relationship between public debt and economic growth, which is far from conclusive on this issue (Panizza and Presbitero, 2013, 2014 and Mika and Zumer, 2017). A similar conclusion can be found in Kempa and Khan (2017), who showed that debt shocks do not make a significant impact on the growth dynamics across the euro zone. For their part, Gómez-Puig and Sosvilla-Rivero (2016) stress the variability of the impact, depending on the specific euro area countries examined and the specific time span considered.

The equity price cycle is positively associated with GDP growth just pre-crisis, when some countries experienced a substantial increase in the magnitude of the positive side of the cycle. This affected growth only in the very short run, and it did not have a persistent effect on the overall performance. The loans to NFCs, instead, could have had a positive role for growth in the long run, and especially for the core countries. For the periphery, we do not see any significant impact of these loans on GDP growth. This result may depend on how the funding has been used in the different economies, i.e. for more-productive or less-productive sectors. As

[28] We report only the heterogeneous coefficients, i.e. our preferred choice. A check with homogeneous ones is available upon request.
[29] An increase in REER and REER growth means a decrease in competitiveness and vice versa.
[30] This paper studies the link between REER and growth by using a dynamic panel data analysis with GMM techniques, for 58 countries in the period 1960-1999.
[31] Rodrik (2008) estimate the results for a panel of 184 countries in the period 1950-2004.

reported in Hassan et al. (2017), differences in the efficiency of fund allocations could have mattered. In Italy, for example, credit is allocated less efficiently than in France and Germany.

The only index that passes the WALS test is the one between long-term rates and loans to households. This is highly heterogeneous across EU members, being higher in Finland and Portugal (80% of the times these cycles are synchronized) and much lower in Germany, the Netherlands, Spain and Italy (less than 60%).[32] This index can be interpreted as a proxy for the link between long-term interest rates and financial conditions, in the spirit of Hördahl et al. (2016), without introducing an additional interest rate into the setup.

The monetary policy stance is proxied by the short-term rates until the ZLB, and then by the shadow rates.[33] There was a strong co-movement between EONIA (in levels) and GDP growth interrupted at the crisis in 2008Q3 (Figure 1).[34] Afterwards, when the ZLB has been reached, a lower shadow rate signals a further use of unconventional monetary policy measures. In our PECM for the time full sample, the coefficient for the rates is positive and significant in the long run, while positive but not significant in the short run. As expected, the sign is always positive, because monetary policy is set endogenously: when GDP rises, interest rates are set to go up, and, if GDP declines, the rates are set to decrease. In fact, in the early part of the sample/chart below, GDP leads interest rates. Stagnation after the Great Recession accounts for the monetary policy stance taken to react to the situation. From the time of the sovereign debt crisis, the transmission mechanism broke down, and monetary policy has been accommodating (to increasing degrees). In 2013, there is a decoupling of the shadow rate from GDP growth, and the shadow rate captures the unconventional monetary policy.

[Insert Figure 1 around here]

Then we look at the differences with the pre-crisis periods, comparing the whole sample with data up to 2010Q1 (the European sovereign debt crisis).[35] In this case, we did not split the samples into core and periphery because we have too few observations. The main outcomes stress the important positive role for long-run growth of institutional integration reforms also before the sovereign debt crisis. Instead, in the short run, in contrast, we see a negative impact only prior to the crisis.[36]

[Insert Table 3 around here]

An interesting narrative emerges from the different EURII components (financial and political integration) and the difference between core and periphery.[37] For the full euro area sample, we can see a big and significant positive role for financial and political integration, while economic and fiscal integration are less directly impactful/effective in boosting growth. In the short run, we do not see any positive outcomes coming from the components, and even the political integration seems to affect growth negatively in the very short run. Looking instead at the sub-sample of core and periphery, the latter result holds, but it is important to bear in mind that, in the short run, the opposite sign obtains for economic integration. While it is strongly positive for the periphery, it turns negative for the core. In the short run, we can also see a positive effect of fiscal integration on periphery countries, which, however, does not translate into any long-run effects. For the

[32] The financial cycles are generally also longer than business cycles. For more detail, see ECB (2018).
[33] We use pre-1992 country-specific short-term interest rates and then EONIA.
[34] In Table 3, we report the results up to 2010Q1, only in this case the coefficient for the short-term/shadow rates is negative in the short run.
[35] The results for the data until 2008Q3 are available upon request. In a nutshell, the factors seem to matter mostly only in the short run, and equity prices and competitiveness are key. The sample from 2010Q2 to 2016Q4 also lacks a degree of freedom in the time series to perform an error correction model in a proper way, so we compare the pre-crisis rather with the entire sample.
[36] A second sub-sampling exercise has been performed looking only at the post-euro introduction (from 1999q1). However, the results coincide with the baseline, because we do not have enough observations in the periods before the introduction of the euro. Adding a dummy variable equal to 1 from 1999q1 yields the same outcomes. Results are available upon request.
[37] The main findings from the other factors are confirmed in this specification.

long run, instead, a deeper financial integration seems to have beneficial effects on the core, while such integration is not significant in the periphery. The opposite holds for political integration, as an increase in the latter boosts long-run growth only for the core members of the euro area (see also Comunale and Mongelli (2019) for the complete set of results coming from the EURII components and country sub-samples).

#### 7.1.1. Contributions analysis

We thus calculated the contributions of each of the factors in determining changes in the growth rates during the years before 2010, and from 2010 to 2016. These two periods were chosen to expose possible differences between the contribution before and after the sovereign debt crisis, and in order to obtain a clearer idea of the respective magnitudes. We did so by using the long-run coefficients (group-specific coefficients as in Table 2) multiplied by the difference in the factors in the considered period. The results for the two periods -- before 2010, and then from 2010 to 2016 -- are provided in the Appendix (A.1 and A.2 respectively).

The institutional factor is again the main one associated with higher GDP growth. The contribution is bigger in magnitude in the first period, given the major advancement in EMU design between the 1990s to the 2000s; however, the positive contribution for increase in GDP growth is clearly evident also after the sovereign debt crisis. For Spain, Italy and Portugal, both before and after 2010, the magnitude of the contribution of EURII to growth is bigger compared to the core countries by 6pp before the GFC, and by around 3pp afterwards.

Ultimately, as for the other factors, in the period 2010-2016, we also see a decrease in the CISS, which captures systemic stress, and this has had a positive influence on growth. To a lesser extent, we see in 2016 a positive contribution to growth of a decrease in the sovereign stress indicator. We can see an increase in the important positive role of price competitiveness between 2010 and 2016. The role of cycles is mostly negative, but small in relative terms. Lastly, the impact of the short-term interest rates could be somehow counterintuitive. This is because the coefficients are positive for the whole period, and it is only after the ZLB that a more accommodative monetary policy means a decrease in the shadow rate.

### 7.2. Robustness checks for ECM

We run a simpler setup with only debt over GDP, sovereign CISS, institutional index, interest rates and looking at the differences between a general measure of real and financial cycle from total credit. Then, in order to delve more deeply into the fiscal side of growth, which we expect to be crucial after the sovereign debt crisis, we add the fiscal deficit. The positive and significant role for the institutional index is here confirmed in almost all the checks. This yields a highly robust factor that helps growth in a more long-run perspective. The interest rate again positively affects growth, and an increase of debt-to-GDP ratio negatively affects growth mostly in the long run – and, in some cases, curbs it in the short run as well. The fiscal deficit does not play a clear role regarding influencing growth in the short run, while we find a significant negative effect only in some cases in the long run. Lastly, as expected, the real cycle plays a major role in driving the GDP growth in the short run, but, in the long run, the impact is not robust across specification.

Next, we perform the baseline estimations for the sample without Luxembourg, which experienced a higher volatility of growth rates than the other member states and has some series limited in its time dimension (see stylized facts). The positive impact of European institutional reforms in the long run is confirmed, as is competitiveness (REER growth) and short-term interest rates. The only significant difference

is in the role of the property price cycle for growth in the short run, which is more substantial if we drop Luxembourg from the sample.[38]

Having checked for the presence of cross-sectional dependence (CSD) in our panel, we add, as a further determinant, a measure of global GDP growth.[39] This is, econometrically, in order to "purify" our panel – this addition should take out a part of the common factor and therefore substantially reduce the (strong part of) cross-sectional dependence.[40] Economically, this variable is useful to check for a possible transmission of an increase in global GDP to European growth. The main result is once again robust: the institutional index is crucial in the long run. Moreover, the global GDP growth seems to positively affect euro area GDP growth in the short run.

Then we applied a different way to split the sample, based not on level of debt or sovereign stress (core vs. periphery) but rather on low vs. high volatilities of growth in the whole period (see Table A). The first group is composed of Belgium, Germany, France, Italy and the Netherlands. The high growth volatility group includes the other four countries, namely: Spain, Finland, Luxembourg and Portugal. The results are in the Appendix (Table A.6). With this alternative way of dividing the sample, the coefficients for the institutional index and REER growth are very similar and extremely robust, in comparison with the baseline for the entire sample (Table 1). When we compared core vs. periphery (Table 2), they mattered more for the latter group of countries. This means that institutional reforms at the EU level and competitiveness may be more substantial factors in affecting growth for countries with higher debt or who are more affected by the sovereign crisis. SOVCISS, the country-specific index of stress in sovereign bond markets, has a negative impact on growth in the short-run when growth volatility is high. However, it negatively impacts growth in the long run for countries with lower volatilities in GDP growth.

Lastly, as a further check, we also run the regression from the WALS methodology directly. This comes with some important caveats on the estimator. It does not take into account the problems we encounter in our panel: the presence of unit roots, cointegration, cross-sectional dependence and heterogeneity. Moreover, it does not disentangle between short- and long-run effects. In any case, the main outcomes are once again confirmed, including the important positive role played by the EURII, even if the latter is smaller in magnitude when using WALS compared with other methods.[41]

## 8. THE DYNAMIC FACTOR MODEL WITH INSTRUMENTAL VARIABLES

One possible critique of our baseline framework is that is does not fully deal with cross-sectional dependence, even if, in Section 7.2, we tried to proxy for possible common effects, and some of our regressors may be endogenous. We will deal with endogeneity by using a panel VAR and country-specific VARs in the next sub-section. However, given that our paper is atheoretical in spirit, it is hard to define and properly identify structural shocks. Moreover, the high number of possible regressors, together with new indicators like the EURII, makes a more refined (panel) VAR exercise, i.e. with sign and zero restrictions in the

[38] The outcomes for the sample without Luxembourg are available upon request.
[39] We also check for the importance of global GDP growth with WALS, and this method confirmed that the variable could indeed be included.
[40] This approach is similar to the one in Comunale (2017a). This method is inspired by Solberger (2011), which only adds an omitted variable, constant in the cross-section, forcing exogenous common factor dependence; simply demeaning the dependent variable would be unsatisfactory.
[41] Details and the full set of coefficients are available upon request.

short and long run, a task which may require a paper of its own. Given these caveats, we aim to resolve these issues here, i.e. cross-sectional dependence and endogeneity in a dynamic panel setup, by using the framework developed by Chudik, and Pesaran (2015) and further implemented and extended in Ditzen (2018). This framework is indeed targeted to fix the abovementioned problems in this heterogeneous unbalanced panel. At the same time, it is important to bear in mind that this setup does not disentangle the effects in the short and long run, which would require a larger N.

What we apply here is a dynamic common-correlated effect setup (the averages across countries of all the regressors are included as independent variables) with mean group estimator (all the country-specific coefficients are taken into account separately and then averaged) and instrumental variables for the key regressors (CCEMG-IV). The main results are found in Table A.7 (in the Appendix), with the regressors taken in lags and 2 lags as instruments for both regressors and cross-sectional averages. The institutional integration is still positive and significant in this framework, too, if all the regressors are considered as endogenous. This result is broadly robust to checks with different sets of endogenous (and then instrumented) variables and lags.[42] The debt over GDP and the REER growth are negative and significant in our preferred setup (Table A.7.), and, in general, only if lags to regressors are applied. This confirms our findings regarding the importance of competitiveness for growth; thus, when REER decreases, i.e. competitiveness improves, GDP growth goes up. In this setup, we also find a negative role played by the stock of debt, which was not completely clear in other specifications. We do not find any effect of the financial cycles on growth.

## 9. A VAR EXERCISE

As an initial further check, as explained in the section above, we provide a VAR (see Section 5) identified by a simple Cholesky scheme. This is not meant to add any causality, but only to take into account the possible endogeneity among our variables of interest.[43] We have 10 main determinants overall: debt over GDP, CISS and SOVCISS, REER growth, the EURII and shadow rates together with the cycles for equity prices, house prices and loan to NFCs and synchronicity between real GDP and equity prices.

For the VAR, firstly, we identify shocks for the GDP growth and for 6 out of 10 determinants. In the first setup, these are: the EURII, SOVCISS,[44] REER growth, the shadow rates and one of the financial cycles (loans to NFCs).[45] In step one, we identify shocks as in equation (6), ranking the variables from the most exogenous variable to the most endogenous at time t.

$$Y_t = (\text{short term } i_t, \text{loans to NFC}_t\,,\ \text{sovciss}_t\,, \text{eurii}_t,\ \text{reer growth}_t\,,\ \text{GDP growth}_t)' \qquad (6)$$

We have the short-term interest rates as we start with a monetary policy action, which can have a direct impact on contemporaneous variables. The rates affect loans to NFCs, as the boom/bust cycle in the credit

[42] The code does not run if we increase the number of regressors further, i.e. if we include, for example, the synchronicity indices.
[43] The high number of possible regressors together with new indicators, like the EURII, makes a more refined (panel) VAR exercise, i.e. with sign and zero restrictions in the short and long run, a task which may require a paper of its own.
[44] This is mainly because SOVCISS is country-specific and possibly more relevant for both core and periphery. Including both CISS and SOVCISS could also cause multicollinearity issues. We also use CISS in a further check, resulting important from the Error Correction Model analysis. We keep the structure limited to 6 variables, because of data limitation and we decide to use SOVCISS to proxy also for fiscal and debt issues related to the sovereign debt crisis.
[45] This is because this cycle is the only one significant in our baseline setup with the Error Correction Model.

market has also been influenced by interest rates and the further accommodation of unconventional measures to deal with the possibility of credit crunch. Ordering financial variables as last does not alter the main outcomes of our VAR exercise. There is no consensus on the identification of shocks using financial variables in such VARs. The "traditional literature" orders financial variables as the most endogenous, since for instance asset prices are "fast-moving", while real variables are more "slow-moving" (see Paul (2017), among others). Thus, a financial shock is not likely to have an immediate impact on real variables. This may be different in cases of extreme shocks, such as those that caused the Great Recession, when financial constraint becomes binding immediately. Hence, economic agents adopt a wait-and-see stance rather quickly, the more so when we are dealing with quarterly data. Moreover, it would be a rather strong assumption to let a shock in real GDP having a contemporaneous impact on financial variables, since real GDP is published with a substantial lag (something like 6 weeks or so). If a GDP shock can contemporaneously cause a financial change, this could be seen as assuming perfect foresight. Hence, ideally, one would try to identify two-way instantaneous causality, but this requires non-trivial identification schemes.

The interest rates can play a role in the SOVCISS, i.e. the sovereign stress indicator, which can be influenced by financial variables too. Hence, the REER growth, as in Comunale (2017a), can affect GDP growth and it can be influenced by financial flows, as in the Dutch Disease literature. Moreover, stress and sovereign debt can also affect competitiveness negatively, as shown in Checherita-Westphal and Rother (2010).[46] The last variable is GDP growth. This in t+1 will then influence the interest rate as in a sort of Taylor Rule. As we include the EURI I as a common factor for the euro area as in equation (6), we expect this variable to have a positive impact in the long run, as previously shown by the panel ECM. In the ordering in Cholesky, this goes after a change in the SOVCISS indicator of sovereign stress, as it could respond to a change in it.[47] The competitiveness could be then affected also by a change in the EURI I via its impact on exchange rates.

We will only comment on the impulse responses to each shock for GDP growth, which is the main goal of this paper; the full set is shown for completeness. If we do not add an EU integration factor in the long run, the effects on growth are non-significant in most of the cases. This is another reason why it is important to include such reforms in an analysis of growth. The horizon is set then at 5 years (20 quarters), to look at the medium-long horizon.

### 9.1. A panel VAR

As a first simple check, we provide a panel VAR (see Section 5) identified by a Cholesky scheme and estimated by using a GMM-style estimator as in Albrigo and Love (2015).[48] The results for the baseline are shown in Figure 2.

[Insert Figure 2 around here]

[46] The channels through which government debt has been found to have an impact on the economic growth rate are: (i) private saving; (ii) public investment; (iii) total factor productivity (TFP) and (iv) sovereign long-term nominal and real interest rates. From a policy perspective, the results in Checherita-Westphal, and Rother (2010) provide additional arguments for debt reduction to support longer-term economic growth prospects.
[47] The IRFs of growth by using only debt over GDP without SOVCISS are not significant for any of the variables. However, the path is comparable with the other specifications and sensitivity analyses.
[48] We are aware that in this case the coefficients are homogeneous; the results, however, seem to be robust to the ones with heterogeneous estimators in the previous sections. The confidence bands are set at 68%, up and we consider one-unit shocks.

As expected, the impact of REER on growth is negative, i.e. an increase in competitiveness is indeed a boost for growth in the euro area, and it has a very persistent effect over time – in line with the outcomes in Comunale (2017a). An increase in sovereign stress can bring a decrement in growth. Monetary policy, including both standard and non-standard measures, affects growth contemporaneously in the baseline. As expected, the effect at impact is indeed negative, becoming insignificant or very small and positive after 1 year and a half.[49]

We made a further sensitivity check, having instead interest rates reacting to change in GDP growth at time t and with GDP growth as the most exogenous variable. Monetary policy is set endogenously: when GDP rises, interest is set to go up. The rate indeed reacts positively at a change in growth, and institutional changes still have a positive impact.

The EU integration index EURII in the baseline setup at equation (6) has a negative impact on growth only in the very short run, while, in the long run, it is always positive and significant. This is consistent with our results in the panel ECM section (see Table 1), where we see a significant positive coefficient for EURII in the long run. The short-term effect may be larger; however, it is not persistent and transitions quickly (after 1 year) to a positive sign in the medium-long run. The cumulative responses over 5 years (20 quarters) signal that these are negative for the first 2 years, and then turn to slightly positive territories.[50]

We also provide a sensitivity analysis for the specification with EURII in which the order of variables in Cholesky starts with excessive credit, and then monetary policy, sovereign stress and institutional changes react. The results are robust: institutional changes always matter in the long run and support GDP growth. If we start from SOVCISS instead, in case we want to start the process from the sovereign debt weakness perspective, the results are confirmed once again and institutional reforms do matter.[51] Lastly, the EURII index is relatively slow moving, so one potential specification is to rank it last in the ordering (see Appendix, Figure A.3). The results for EU integration are once again confirmed.

Next, like for the panel ECM, we add as a further determinant a measure of global GDP growth.[52] Our measure of world GDP growth is the average growth of the countries weighted by trade (it is country-specific), as found in the GVAR literature and applied, for instance, in Comunale (2017). At the same time, we can look at a foreign/global push factor, which may affect growth in our countries of interest and can correct some cross-sectional dependence. This variable is first taken as exogenous, with the claim that single euro area countries count for only a minor part of global GDP,[53] after which we use it as an endogenous variable. In the latter case, global GDP growth is, among the variables, the most exogenous one in the identification. In these checks, the results are very robust with respect to the previous ones in Table 4. In the latter robustness check, it is worth noting that an increase in global GDP could yield medium-long run positive effects in euro area member states. One of the possible channels is via an increase in domestic demand for European products and services.

[49] The effect is negligible in the cases of other setups without the EURII institutional index and CISS.
[50] Complete charts for all the robustness checks are available on request. This outcome is very robust.
[51] The results for the complete set of sensitivity checks are available on request.
[52] This variable can also be seen as a very simple proxy for the global real cycle.
[53] Therefore, we have a panel VARX model.

### 9.2. Country-by-country VAR

Ultimately, we want to account for the heterogeneity and all the country-specific information we have from each of the 9 countries, and we apply our VAR identification (as in equation (6)) on a country-by-country basis.[54] The complete set of results is available upon request.

The lags in this case are country-specific and automatically selected by SBIC criteria. The lags are one or two depending on the considered country (see footnote 16). We focus here first on the impact of a positive shock in institutional EU reforms on GDP growth. In the cases of Germany, Italy, the Netherlands and France, the impact is negative in the short run, after which it becomes positive starting at around 3 years from the impact, lasting for 2-3 years. For Belgium and Luxembourg, we see almost no effect of EURII changes on GDP growth.[55] For Finland, the response of growth to a positive shock in EU institution reforms is only positive in the short run; it turns mainly negative in the medium run and insignificant after 2 years from the shock. Interestingly, in Spain and Portugal, we see no negative impact in the short run of the institutional EU index, and the long-run positive impact is larger in magnitude and much more persistent over time. Overall, in the countries that we call "periphery", the impact of EU institutional changes is positive – and it is so especially in the medium-long run.

A further important factor, which is robust in affecting growth over our specifications, is REER growth, i.e. the competitiveness component. Consequently, we look at the country-specific impulse responses of growth to a shock in REER. A positive shock in REER means an increase in this rate and thus a decrease in competitiveness, and we expect a negative sign in the impulse responses. The response of growth behaves exactly like this in the medium-long run in the cases of Italy and Spain, and in the short run for Luxembourg and Portugal. Only in the Netherlands is the effect basically the opposite, while for the other countries it is not significant. Summing up, in a country-specific setup, the impact of competitiveness is less than clear-cut.

Next, we look at the impact of a positive shock to SOVCISS or to loans to NFCs on growth in each euro area member state. The former is expected to be negative overall, since SOVCISS is a measure of sovereign stress. Indeed, SOVCISS has a large and persistent negative effect on growth in the periphery. This is also true for the Netherlands, and in the short run in Finland and Luxembourg. An increase in loans to NFCs could help growth if the resources were better allocated to more productive sectors and industries; otherwise, it might even hamper growth (Hassan et al., 2017). As for a shock in loans to NFCs, this has a very positive impact in the short and long runs only in the case of Germany, while for France, Italy, Spain, and, surprisingly, in the Netherlands and Finland, the impact is both highly negative and persistent.

Lastly, global GDP growth has a positive impact for most of the countries under study (the exceptions are Spain and the Netherlands); however, the timing seems to vary across countries. For Germany, an increase in global GDP growth has a significant effect up to 1 year, while for Belgium, France, Italy, Portugal and Finland, the impact is in a more medium-run perspective.

[54] This has been done with the *caveat* that for each country we have a maximum of around 60 observations. We applied small-sample degrees-of-freedom adjustments. In doing so we do not use Bayesian techniques for this paper, mostly to avoid mixing frequentist approaches with Bayesians.
[55] It is only slightly positive in the very short run (up to 1 year from impact).

## 10. FINAL REMARKS

Over the past three decades, euro area countries have experienced profound economic, financial and institutional changes, plus diverse shocks. Growth has been highly volatile, and almost missing, in some countries over a tumultuous period. In this study, we have assembled a rich array of real, financial, monetary and institutional variables, seeking to identify those that played a heightened role in stimulating growth, or reducing it in the short versus long term and pre- versus post-financial crisis.

After excluding several variables with no bearing on growth, we apply a number of time series techniques for large panels of heterogeneous data. Our main findings are that institutional reforms support long-run growth for all countries, and, in particular, those in the periphery. This finding is robust across specifications and setups. If we split the European institutional integration into its main components, we can see a significant positive role for financial and political integration in the long run. However, the first seems to have beneficial effects for the core only, while the opposite holds for political integration, which positively influences the periphery only.

Additionally, we find that enhanced competitiveness matters for growth in the long run. A decline in systemic stress is also associated with growth. As expected, global growth supports euro area growth, generally in the medium run.

How about the public finance impact on growth? The debt over GDP negatively influences growth for the periphery, but only in the short run. This is less clear when using the dynamic factor model or VARs, and it is in line with the lack of consensus in the literature about the impact of public debt on economic growth. Surprisingly, the deficit plays no role. Instead, higher sovereign stress is associated with lower growth. And what about monetary policy? Prior to the zero lower bound, higher monetary policy rates are associated with growth. This relationship changes after the ZLB and when using the shadow rate; the latter captures exceptional standard and non-standard monetary policies. Finally, what about the financial cycle? The equity price cycle positively affects GDP growth only pre-crisis and only in the very short run, while loans to NFCs had a positive impact for the core euro area, and especially for Germany.

Importantly, our results must be considered as preliminary. Correlations and associations do not constitute causations. The evidence provided in the current paper requires corroboration by model-based analysis. We cover a period of intense flux in European economic, financial, monetary and institutional history. Some of the countries in the sample experienced switches in policy regimes. Thus, much remains to be done in future research. In the econometrics, a possible further contribution may include the use of a sign/zero restrictions (panel) VAR, or models that include changing parameters, stochastic volatility – or preferably, both. For the factors, the role of EU funds might also be taken into account. This possible determinant is not included here because of a (still) limited availability in its time-dimension. Similarly, we do not have enough data availability for the new euro area governance and the SSM. Overall, our proposed atheoretical toolkit has several important traits: it is flexible, adaptable, and can be built upon as more data for all countries are collected.

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**Annex: Tables and figures**

**Table 1: Baseline results with WALS and BMA selection**

| | WALS<br>Baseline with synchronicity | BMA<br>Baseline without synchronicity |
|---|---|---|
| | (1) | (2) |
| VARIABLES | | |
| short-run | | |
| ec | -0.501*** | -0.493*** |
| | (0.0521) | (0.0534) |
| D.EURII | 0.0585 | 0.0751 |
| | (0.141) | (0.140) |
| D.debt/GDP | -0.0691** | -0.0712** |
| | (0.0323) | (0.0280) |
| D.ciss | 0.0285 | 0.0328 |
| | (0.0206) | (0.0214) |
| D.sovciss | 0.0414*** | 0.0373*** |
| | (0.0116) | (0.00954) |
| D.reergr | 0.0884 | 0.0838 |
| | (0.0963) | (0.0968) |
| D.ST rates | 0.0575 | 0.0419 |
| | (0.163) | (0.193) |
| D.eqp_cycle | 0.0612 | 0.0595 |
| | (0.0463) | (0.0428) |
| D.rpp_cycle | 0.413* | 0.361 |
| | (0.226) | (0.222) |
| D.lnf_cycle | -0.108 | -0.111 |
| | (0.307) | (0.317) |
| D.ltn_lhh | 2.73e-05 | |
| | (0.000837) | |
| Constant | -0.137** | -0.147** |
| | (0.0662) | (0.0733) |
| long-run | | |
| EURII | 0.523*** | 0.528*** |
| | (0.121) | (0.135) |
| Debt/GDP | -0.0391 | -0.0249 |
| | (0.0810) | (0.0747) |
| ciss | -0.0703 | -0.0761 |
| | (0.0497) | (0.0507) |
| sovciss | -0.0378 | -0.0280 |
| | (0.0422) | (0.0467) |
| reergr | -0.509*** | -0.473*** |
| | (0.121) | (0.116) |
| ST rates | 1.098** | 1.092** |
| | (0.446) | (0.481) |
| eqp_cycle | -0.0114 | -0.0129 |
| | (0.0176) | (0.0190) |
| rpp_cycle | 0.160 | 0.103 |
| | (0.223) | (0.203) |
| lnf_cycle | 0.239* | 0.282* |
| | (0.133) | (0.145) |
| ltn_lhh | -0.00243 | |
| | (0.00196) | |
| Observations | 535 | 535 |

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

Note: Mean Group estimator has been applied here. The cycles are based on data from real GDP (YER), equity price indices (EQP), real total credit to private non-financial sector (TCN), real credit to non-financial corporations (LNF), real credit to households (LHH), property prices (RPP), nominal long-term rates (LTN). The synchronicities are based on cycle's pairs. EURII is the European Index of Regional Institutional Integration. CISS is the Composite Indicator of Systemic Stress, SOVCISS is the Composite Indicator of Sovereign Stress, REERGR refers to the growth rate in the Real Effective Exchange Rate and ST rates are the EONIA/shadow rates.

**Table 2: Baseline results for core and periphery**

| | core | periphery | core | periphery |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| VARIABLES | Baseline with synchronicity | Baseline with synchronicity | Baseline without synchronicity | Baseline without synchronicity |
| short run | | | | |
| ec | -0.581*** | -0.341*** | -0.564*** | -0.352*** |
| | (0.0496) | (0.0341) | (0.0602) | (0.0356) |
| D.EURII | 0.0889 | -0.00235 | 0.108 | 0.00966 |
| | (0.216) | (0.0378) | (0.215) | (0.0231) |
| D.debt/GDP | -0.0770 | -0.0532* | -0.0787* | -0.0561** |
| | (0.0481) | (0.0274) | (0.0412) | (0.0268) |
| D.ciss | 0.0375 | 0.0107*** | 0.0449 | 0.00876*** |
| | (0.0311) | (0.00132) | (0.0318) | (0.00155) |
| D.sovciss | 0.0485*** | 0.0272*** | 0.0411*** | 0.0297*** |
| | (0.0171) | (0.00245) | (0.0144) | (0.00278) |
| D.reergr | 0.140 | -0.0152 | 0.130 | -0.00889 |
| | (0.134) | (0.116) | (0.137) | (0.112) |
| D.ST rates | 0.0677 | 0.0371 | 0.0283 | 0.0689 |
| | (0.244) | (0.146) | (0.284) | (0.207) |
| D.eqp_cycle | 0.0690 | 0.0455 | 0.0715 | 0.0355 |
| | (0.0699) | (0.0333) | (0.0648) | (0.0241) |
| D.rpp_cycle | 0.452 | 0.336 | 0.344 | 0.395* |
| | (0.334) | (0.231) | (0.329) | (0.229) |
| D.lnf_cycle | 0.0775 | -0.479 | 0.0589 | -0.452 |
| | (0.378) | (0.558) | (0.413) | (0.517) |
| D.ltn_lhh | 0.000356 | -0.000630 | | |
| | (0.00117) | (0.00112) | | |
| Constant | -0.145 | -0.123** | -0.155 | -0.133** |
| | (0.0998) | (0.0508) | (0.111) | (0.0569) |
| long run | | | | |
| EURII | 0.442*** | 0.684** | 0.428*** | 0.728** |
| | (0.115) | (0.300) | (0.126) | (0.333) |
| Debt/GDP | -0.0509 | -0.0155 | -0.0281 | -0.0184 |
| | (0.123) | (0.0488) | (0.114) | (0.0390) |
| ciss | -0.0619 | -0.0870*** | -0.0760 | -0.0763*** |
| | (0.0758) | (0.0254) | (0.0777) | (0.0237) |
| sovciss | -0.00382 | -0.106* | 0.0138 | -0.112* |
| | (0.0537) | (0.0588) | (0.0581) | (0.0631) |
| reergr | -0.431*** | -0.665*** | -0.385*** | -0.649*** |
| | (0.136) | (0.254) | (0.141) | (0.196) |
| ST rates | 1.072* | 1.150** | 1.042 | 1.192** |
| | (0.642) | (0.569) | (0.712) | (0.486) |

| | | | | |
|---|---|---|---|---|
| eqp_cycle | -0.00976 | -0.0147 | -0.00615 | -0.0265 |
| | (0.0219) | (0.0364) | (0.0242) | (0.0359) |
| rpp_cycle | 0.166 | 0.148 | 0.0867 | 0.135 |
| | (0.340) | (0.127) | (0.311) | (0.107) |
| lnf_cycle | 0.255** | 0.209 | 0.303** | 0.239 |
| | (0.112) | (0.384) | (0.131) | (0.405) |
| ltn_lhh | -0.00417* | 0.00104 | | |
| | (0.00222) | (0.00348) | | |
| Observations | 357 | 178 | 357 | 178 |

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: Mean Group estimator has been applied here. The cycles are based on data from real GDP (YER), equity price indices (EQP), real total credit to private non-financial sector (TCN), real credit to non-financial corporations (LNF), real credit to households (LHH), property prices (RPP), nominal long-term rates (LTN). The synchronicities are based on cycle's pairs. EURII is the European Index of Regional Institutional Integration. CISS is the Composite Indicator of Systemic Stress, SOVCISS is the Composite Indicator of Sovereign Stress, REERGR refers to the growth rate in the Real Effective Exchange Rate and ST rates are the EONIA/shadow rates.

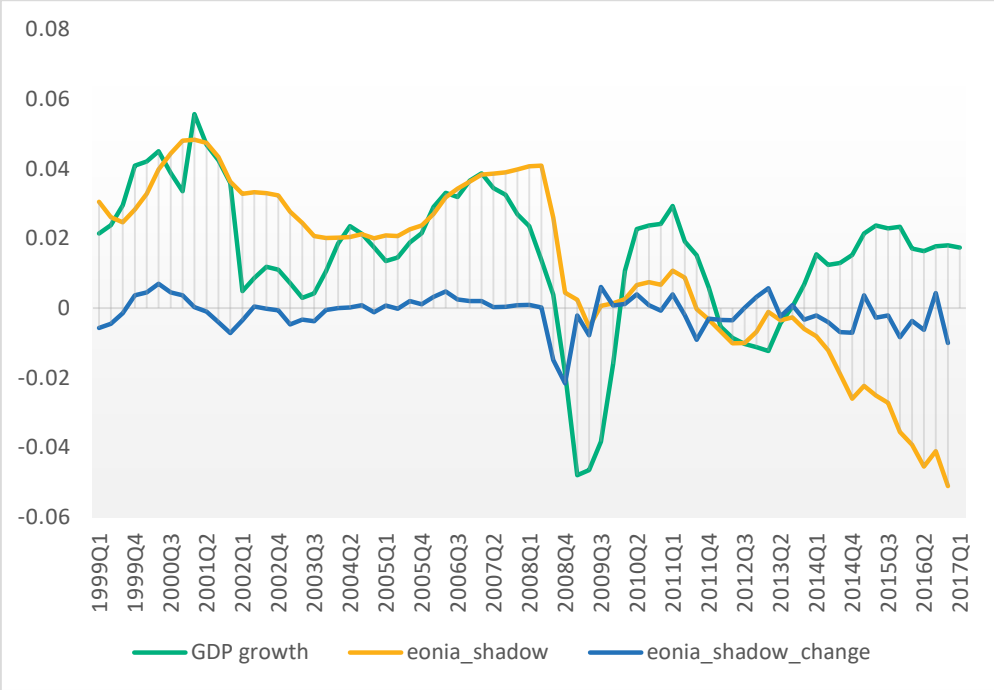
**Table 3: Baseline results with sub-samples: data until 2010q1**

| VARIABLES | (1) Baseline without synchronicity | (2) Baseline with synchronicity |
|---|---|---|
| short run | | |
| ec | -0.692*** | -0.628*** |
| | (0.0868) | (0.0740) |
| D.EURII | -0.763*** | -0.606*** |
| | (0.264) | (0.235) |
| D.debt/GDP | -0.249* | -0.236* |
| | (0.134) | (0.134) |
| D.ciss | 0.0217 | 0.0381* |
| | (0.0215) | (0.0205) |
| D.sovciss | 0.0220 | 0.0328* |
| | (0.0356) | (0.0194) |
| D.reergr | 0.203 | 0.155 |
| | (0.131) | (0.132) |
| D.ST rates | -0.804*** | -0.439* |
| | (0.213) | (0.234) |
| D.eqp_cycle | 0.308** | 0.119* |
| | (0.146) | (0.0615) |
| D.rpp_cycle | 0.219 | 0.864** |
| | (0.591) | (0.431) |
| D.lnf_cycle | -0.275 | -0.0613 |
| | (0.555) | (0.566) |
| D.ltn_lhh | 0.001 | |
| | (0.0009) | |
| Constant | -0.422*** | -0.381** |
| | (0.160) | (0.152) |
| long run | | |
| EURII | 0.983*** | 0.861*** |
| | (0.270) | (0.302) |
| Debt/GDP | 0.124 | 0.141 |
| | (0.115) | (0.162) |
| ciss | -0.0839 | -0.109 |
| | (0.0673) | (0.0668) |
| sovciss | 0.0920 | 0.0417 |
| | (0.0946) | (0.0474) |
| reergr | -0.658*** | -0.534*** |
| | (0.222) | (0.205) |
| ST rates | 2.184*** | 1.555*** |
| | (0.809) | (0.536) |
| eqp_cycle | 0.00745 | -0.0216 |
| | (0.0348) | (0.0422) |
| rpp_cycle | -0.226 | 0.0853 |
| | (0.527) | (0.289) |
| lnf_cycle | 0.334 | 0.602** |
| | (0.233) | (0.253) |
| ltn_lhh | -0.00688 | |
| | (0.00492) | |
| Observations | 333 | 333 |

Note: Mean Group estimator has been applied here. The cycles are based on data from real GDP (YER), equity price indices (EQP), real total credit to private non-financial sector (TCN), real credit to non-financial corporations (LNF), real credit to households (LHH), property prices (RPP), nominal long-term rates (LTN). The synchronicities are based on cycle's pairs.

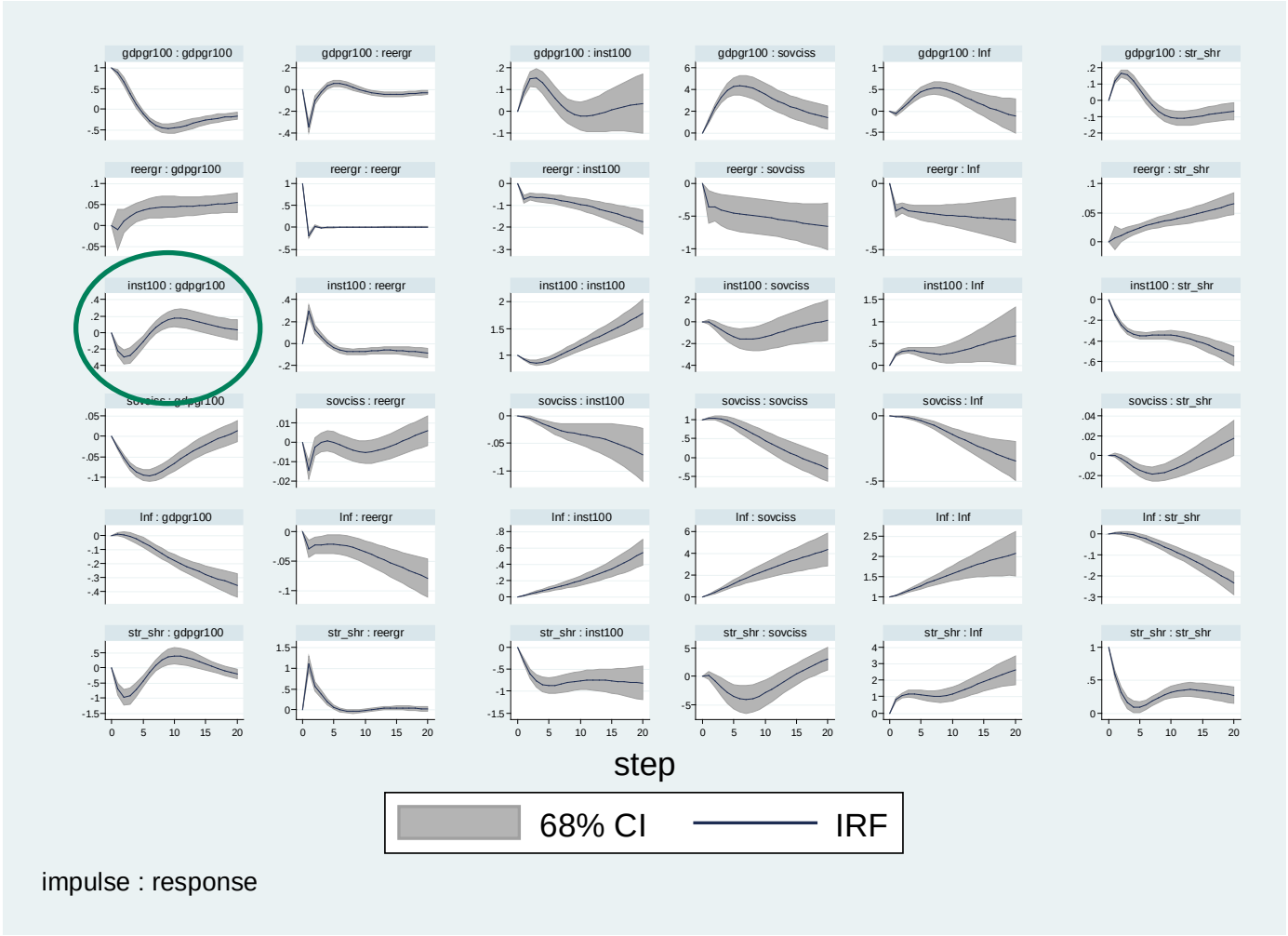
EURII is the European Index of Regional Institutional Integration. CISS is the Composite Indicator of Systemic Stress, SOVCISS is the Composite Indicator of Sovereign Stress, REERGR refers to the growth rate in the Real Effective Exchange Rate and ST rates are the EONIA/shadow rates.

**Figure 1: GDP growth and EONIA/shadow rates (level and change) for the aggregate euro area between 1999 and 2017**




Source: ECB SDW and Wu and Xia (2016)

**Figure 2: Impulse responses in a simple panel VAR**




Note: GDPGR100 is real GDP growth rate. REERGR refers to the growth rate in the Real Effective Exchange Rate. INST100 is the European Index of Regional Institutional Integration (EURII). SOVCISS is the Composite Indicator of Sovereign Stress. The cycles are based on data from real credit to non-financial corporations (LNF), STR_SHR are the EONIA/shadow rates. The blue circle refers to the impulse responses of GDP growth to a shock in the EURII; this is highlighted as is the key results of this paper.

**Appendix:**

**A.1. Data description and sources**

| Variable | Description | Unit | Source |
|---|---|---|---|
| **dependent variable:** | | | |
| gdpgr | real GDP growth | y-o-y growth rate in % | ESCB WGEM team, IMF IFS |
| **regressors:** | | | |
| **cycles:** | | | |
| eqp_cycle | cycle of equity price indices | Deviation from the trend (by using CF filter) | ESCB WGEM team, ECB SDW |
| ltn_cycle | cycle of nominal long-term rates | | ESCB WGEM team, ECB SDW |
| yer_ cycle | business cycle, from real GDP | | ESCB WGEM team, ECB SDW |
| lhh_cycle | cycle of real credit to households | | ESCB WGEM team, BIS and national sources |
| lnf_cycle | cycle of real credit to non-financial corporations | | ESCB WGEM team, BIS and national sources |
| rpp_cycle | cycle of property prices | | ESCB WGEM team, BIS and national sources |
| tcn_cycle | cycle of real total credit to private non-financial sector | | ESCB WGEM team, BIS and national sources |
| **synchronicity measures:** | | | |
| ltn_lhh | synchronisation of the cycle of nominal long-term rates and of real credit to households | Either 1 (synchronised) or -1 (not) | Comunale (2019) |
| all the cycles combinations | cycles pairs (dummy equal 1 when same sign) | | Comunale (2019) |
| **real variables:** | | | |
| Fiscal deficit | seasonally adjusted fiscal deficit: it refers to the public balance between government revenue and expenditure, a deficit when negative. | To GDP ratio in % | Eurostat |
| Debt/GDP | total government debt over GDP (quarterly) | To GDP ratio in % | Eurostat |
| reergr | country-specific growth rate of the REER vis-à-vis 41 partners and deflated by CPI | y-o-y growth rate in % | Eurostat |
| **monetary factors:** | | | |
| eonia_shadow | monthly data --> averaged to quarterly<br>From 2004Q4 shadow rates from Wu and Xia (2016) for EA only. When ZLB not binding=EONIA | In b.p. | Eonia (ECB SDW)<br>Shadow rates (Wu and Xia, updated) |
| ST rates | pre-1992 country-specific short term interest rates, then EONIA and shadow rates | | short-term rates from LIFT report |
| **institutional factors:** | | | |
| EURII | European Index of Regional Institutional Integration | From 0 (no integration) to 100 (complete integration) | Dorrucci et al. (2015) updated |
| **sovereign and systemic stress:** | | | |

| | | | |
|---|---|---|---|
| ciss | composite Indicator of Systemic Stress - Daily data --> averaged to quarterly | From 0 (min) to 1 (max systemic stress) | ECB SDW |
| sovciss | composite Indicator of Sovereign Stress (SovCISS) | From 0 (min) to 1 (max systemic stress) | ECB SDW |

### A.2. Selection of variables: WALS

| | (t-value) | (t-value) |
|---|---|---|
| L.GDP growth | 20.45 | |
| Fiscal deficit | -0.91 | 0.79 |
| Debt/GDP | -3.73 | -6.64 |
| REER growth | -5.52 | -5.32 |
| ciss | -5.49 | -2.39 |
| sovciss | -1.99 | -3.83 |
| ST rates | 2.11 | 7.34 |
| EURII institutional index | 2.33 | 8.15 |
| eqp_cycle | 1.66 | 1.30 |
| ltn_cycle | -0.59 | -1.05 |
| yer_cycle | 0.31 | 3.62 |
| lhh_cycle | 0.88 | -0.83 |
| lnf_cycle | -2.04 | -4.33 |
| rpp_cycle | 2.23 | 3.82 |
| tcn_cycle | -1.19 | -2.18 |
| **Synchronicities** | | |
| eqp_ltn | 0.69 | 0.85 |
| eqp_yer | -1.02 | -3.69 |
| eqp_lhh | 0.61 | 0.86 |
| eqp_lnf | -0.39 | 0.53 |
| eqp_rpp | 0.58 | -0.7 |
| eqp_tcn | 0.96 | 1.21 |
| ltn_yer | 0.69 | 0.97 |
| ltn_lhh | -1.76 | -1.02 |
| ltn_lnf | 1.62 | -0.02 |
| ltn_rpp | -0.13 | -0.86 |
| ltn_tcn | 0.15 | 1.42 |
| yer_lhh | 0.31 | -0.03 |
| yer_lnf | -0.19 | 0.73 |
| yer_rpp | -0.19 | 0.7 |
| yer_tcn | -1.44 | -1.61 |
| lhh_lnf | -0.53 | 0.01 |
| lhh_rpp | 0.3 | 0.72 |
| lhh_tcn | -0.39 | -1.91 |
| lnf_rpp | 1.39 | 0.27 |
| lnf_tcn | 0.47 | 0.78 |
| rpp_tcn | 0.89 | 1.65 |

Note: the more restrictive inclusion rule is: abs(t-value)>1.5 (dark green), and it is the one we use here. In the literature is normally as abs(t)>1 (light green). The first column of each method includes the lag of the dependent variable (L.GDP growth). L. GDP growth is the first lag of GDP growth, fiscal deficit is defined as the public balance between government revenue and expenditure, a budget deficit when negative. It is in percentage GDP and so is total government debt (Debt/GDP). REER growth refers to the growth rate in the Real Effective Exchange Rate. CISS is the Composite Indicator of Systemic Stress, SOVCISS is the Composite Indicator of Sovereign Stress and ST rates are the EONIA/shadow rates. EURII is the European Index of Regional Institutional Integration. The cycles are based on data from equity price indices (EQP),

nominal long-term rates (LTN), real GDP (YER), real credit to households (LHH), real credit to non-financial corporations (LNF), property prices (RPP), real total credit to private non-financial sector (TCN),. The synchronicities are based on cycle's pairs. ,

### A.3. Selection of variables: BMA

| | pip | pip | pip | pip | pip | pip | pip |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| L.GDP growth | 1.0 | | 1.0 | | 1.0 | 1.0 | |
| Fiscal deficit | 0.1 | 0.1 | 0.1 | 0.7 | 0.1 | 0.1 | 0.1 |
| Debt/GDP | 0.9 | 1.0 | 0.8 | 1.0 | 0.8 | 0.9 | 1.0 |
| REER growth | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| ciss | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| sovciss | 0.2 | 1.0 | 0.3 | 1.0 | 0.3 | 0.2 | 1.0 |
| ST rates | 0.1 | 1.0 | 0.3 | 1.0 | 0.3 | 0.1 | 1.0 |
| EURII institutional index | 0.1 | 1.0 | 0.1 | 1.0 | 0.1 | 0.1 | 1.0 |
| eqp_cycle | 0.8 | 0.1 | | | | 0.8 | 0.1 |
| ltn_cycle | 0.1 | 0.2 | | | | 0.1 | 0.2 |
| yer_cycle | 0.1 | 1.0 | | | | 0.1 | 1.0 |
| lhh_cycle | 0.1 | 0.1 | | | | 0.1 | 0.1 |
| lnf_cycle | 0.1 | 1.0 | | | | 0.1 | 1.0 |
| rpp_cycle | 0.2 | 1.0 | | | | 0.2 | 1.0 |
| tcn_cycle | 0.1 | 0.1 | | | | 0.1 | 0.1 |
| **Synchronicities** | | | | | | | |
| eqp_yer | | | 0.1 | 1.0 | | | |
| ltn_yer | | | 0.1 | 0.1 | | | |
| yer_lhh | | | 0.1 | 0.1 | | | |
| yer_lnf | | | 0.0 | 0.6 | | | |
| yer_rpp | | | 0.0 | 0.1 | | | |
| yer_tcn | | | 0.0 | 0.1 | | | |
| ltn_lhh | | | | | 0.1 | 0.1 | 0.0 |
| ltn_lnf | | | | | 0.1 | 0.1 | 0.1 |

Note: If the posterior inclusion probability (pip) is exactly equal to one, the regressor needs to be included by probability one (dark green). A less restrictive rule of ours takes pip>0.8 (as in the literature). The columns from (1) to (2) represent different variables inclusions for cycles and synchronicities. This is because the BMA method does not allow a large number of variables to work. The first column of each method includes the lag of the dependent variable (L.GDP growth). L. GDP growth is the first lag of GDP growth, fiscal deficit is defined as the public balance between government revenue and expenditure, a budget deficit when negative. It is in percentage GDP and so is total government debt (Debt/GDP). REER growth refers to the growth rate in the Real Effective Exchange Rate. CISS is the Composite Indicator of Systemic Stress, SOVCISS is the Composite Indicator of Sovereign Stress and ST rates are the EONIA/shadow rates. EURII is the European Index of Regional Institutional Integration. The cycles are based on data from equity price indices (EQP), nominal long-term rates (LTN), real GDP (YER), real credit to households (LHH), real credit to non-financial corporations (LNF), property prices (RPP), real total credit to private non-financial sector (TCN),. The synchronicities are based on cycle's pairs. ,

### A.4. Comparison and selection of baseline

| | BMA | | WALS | |
|---|---|---|---|---|
| | pip | pip | (t-value) | (t-value) |
| L.GDP growth | 1.0 | | 20.45 | |
| Fiscal deficit | 0.1 | 0.1 | -0.91 | 0.79 |
| Debt/GDP | 0.9 | 1.0 | -3.73 | -6.64 |
| REER growth | 1.0 | 1.0 | -5.52 | -5.32 |
| ciss | 1.0 | 1.0 | -5.49 | -2.39 |
| sovciss | 0.2 | 1.0 | -1.99 | -3.83 |
| ST rates | 0.1 | 1.0 | 2.11 | 7.34 |
| EURII institutional index | 0.1 | 1.0 | 2.33 | 8.15 |
| **Synchronicities** | | | | |
| eqp_cycle | 0.8 | 0.1 | 1.66 | 1.30 |
| ltn_cycle | 0.1 | 0.2 | -0.59 | -1.05 |
| yer_cycle | 0.1 | 1.0 | 0.31 | 3.62 |
| lhh_cycle | 0.1 | 0.1 | 0.88 | -0.83 |
| lnf_cycle | 0.1 | 1.0 | -2.04 | -4.33 |
| rpp_cycle | 0.2 | 1.0 | 2.23 | 3.82 |
| tcn_cycle | 0.1 | 0.1 | -1.19 | -2.18 |
| ltn_lhh | 0.1 | 0.0 | -1.76 | -1.02 |
| ltn_lnf | 0.1 | 0.1 | 1.62 | -0.02 |

Note: The first column of each method includes the lag of the dependent variable (L.GDP growth). . L. GDP growth is the first lag of GDP growth, fiscal deficit is defined as the public balance between government revenue and expenditure, a budget deficit when negative. It is in percentage GDP and so is total government debt (Debt/GDP). REER growth refers to the growth rate in the Real Effective Exchange Rate. CISS is the Composite Indicator of Systemic Stress, SOVCISS is the Composite Indicator of Sovereign Stress and ST rates are the EONIA/shadow rates. EURII is the European Index of Regional Institutional Integration. The cycles are based on data from equity price indices (EQP), nominal long-term rates (LTN), real GDP (YER), real credit to households (LHH), real credit to non-financial corporations (LNF), property prices (RPP), real total credit to private non-financial sector (TCN),. The synchronicities are based on cycle's pairs. ,

### A.5. Unit root test in case of CSD - CIPS/CADF 2nd generation test

| Variables | Z[t-bar] | P-value |
|---|---|---|
| **GDP growth (+1 lag)** | -6.011 | 0.000 |
| **EURII institutional index*** | 14.667 | 1.000 |
| **Debt/GDP*** | -0.771 | 0.220 |
| **CISS*** | 14.473 | 1.000 |
| **SOVCISS** | -3.378 | 0.000 |
| **REER growth** | -14.538 | 0.000 |
| **ST rates and shadow rates*** | 0.898 | 0.815 |
| **Equity prices cycle*** | 1.367 | 0.914 |
| **House prices cycle*** | -0.573 | 0.283 |
| **Credit to NFCs cycle*** | 2.738 | 0.997 |
| **Synchronicity credit HH and rates*** | -7.883 | 0.000 |

Note: Null hypothesis assumes that all series are non-stationary, the alternative is that some series are stationary. 1 lag has been imposed for the dependent variable. 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)[56]. *means non-stationarity for all series (cannot reject the null or we do accept the null). EURII is the European Index of Regional Institutional Integration. CISS is the Composite Indicator of Systemic Stress, SOVCISS is the Composite Indicator of Sovereign Stress, REERGR refers to the growth rate in the Real Effective Exchange Rate and ST rates are the EONIA/shadow rates.

[56]The command in Stata is called *-pescadf-* and it has been built by Piotr Lewandowski, Warsaw School of Economics, Institute for Structural Research. The results for the tests for GDP growth are in line with Comunale (2017a).

**A.6 Low vs. high volatility of growth**

| VARIABLES | (1) Low volatility | (2) High volatility |
|---|---|---|
| Short-run | | |
| ec | -0.492*** | -0.512*** |
| | (0.0572) | (0.104) |
| D.EURII | -0.0217 | 0.159 |
| | (0.0490) | (0.331) |
| D.debt/GDP | -0.0512 | -0.0915** |
| | (0.0499) | (0.0426) |
| D.ciss | 0.00226 | 0.0614 |
| | (0.0171) | (0.0375) |
| D.sovciss | 0.0269** | 0.0595*** |
| | (0.0115) | (0.0197) |
| D.reergr | 0.0549 | 0.130 |
| | (0.0399) | (0.228) |
| D.ST rates | 0.0435 | 0.0750 |
| | (0.275) | (0.180) |
| D.eqp_cycle | 0.111** | -0.000887 |
| | (0.0497) | (0.0802) |
| D.rpp_cycle | 0.276 | 0.584 |
| | (0.296) | (0.379) |
| D.lnf_cycle | -0.236 | 0.0518 |
| | (0.573) | (0.0323) |
| D.ltn_lhh | 0.000636 | -0.000734 |
| | (0.000946) | (0.00154) |
| Constant | -0.146 | -0.126** |
| | (0.117) | (0.0567) |
| Long-run | | |
| EURII | 0.524*** | 0.522** |
| | (0.120) | (0.253) |
| Debt/GDP | -0.0849 | 0.0181 |
| | (0.128) | (0.0994) |
| ciss | 0.00635 | -0.166*** |
| | (0.0565) | (0.0631) |
| sovciss | -0.0735* | 0.00697 |
| | (0.0391) | (0.0832) |
| reergr | -0.538*** | -0.473*** |
| | (0.187) | (0.170) |
| ST rates | 1.555** | 0.527** |
| | (0.755) | (0.216) |
| eqp_cycle | -0.0225 | 0.00249 |
| | (0.0222) | (0.0305) |
| rpp_cycle | 0.229 | 0.0743 |
| | (0.395) | (0.181) |
| lnf_cycle | 0.178 | 0.317 |
| | (0.146) | (0.258) |
| ltn_lhh | -0.00372 | -0.000825 |
| | (0.00301) | (0.00252) |
| Observations | 295 | 240 |

Note: Mean Group estimator has been applied. “ec” is the error correction term.The cycles are based on data from real GDP (YER), equity price indices (EQP), real total credit to private non-financial sector (TCN), real credit to non-financial corporations (LNF), real credit to households (LHH), property prices (RPP), nominal long-term rates (LTN). The synchronicities are based on cycle’s pairs. EURII is the European Index of Regional Institutional Integration. CISS is the Composite Indicator of Systemic Stress, SOVCISS is the Composite Indicator of Sovereign Stress, REERGR refers to the growth rate in the Real Effective Exchange Rate and ST rates are the EONIA/shadow rates.

**Table A.7. Heterogeneous dynamic factor model with IV and corrections for cross-sectional dependence**

| | (1) |
|---|---|
| VARIABLES | GDP growth |
| | |
| L.GDP growth | -0.238 |
| | (0.207) |
| L.debt/GDP | -0.274* |
| | (0.147) |
| L.EURII | 0.906* |
| | (0.492) |
| L.sovciss | -0.0178 |
| | (0.165) |
| L.reergr | -0.574* |
| | (0.310) |
| L.eqp_cycle | -0.215 |
| | (0.157) |
| L.rpp_cycle | -0.266 |
| | (0.196) |
| L.lnf_cycle | -0.0950 |
| | (0.365) |
| Constant | -0.386 |
| | (0.251) |
| | |
| Observations | 517 |
| Number of groups | 9 |

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: CCEMG-IV estimator has been applied. CISS and short-term rates are zero and omitted in the outcomes. All the Cross Sectional Averaged Variables are included with 2 lags and used as implicit controls. To be consistent, 2 lags as instruments to the other regressors are applied. The cycles are based on data from real GDP (YER), equity price indices (EQP), real total credit to private non-financial sector (TCN), real credit to non-financial corporations (LNF), real credit to households (LHH), property prices (RPP), nominal long-term rates (LTN). The synchronicities are based on cycle’s pairs. EURII is the European Index of Regional Institutional Integration. CISS is the Composite Indicator of Systemic Stress, SOVCISS is the Composite Indicator of Sovereign Stress, REERGR refers to the growth rate in the Real Effective Exchange Rate and ST rates are the EONIA/shadow rates.

**Figure A.1. Contributions until 2010**

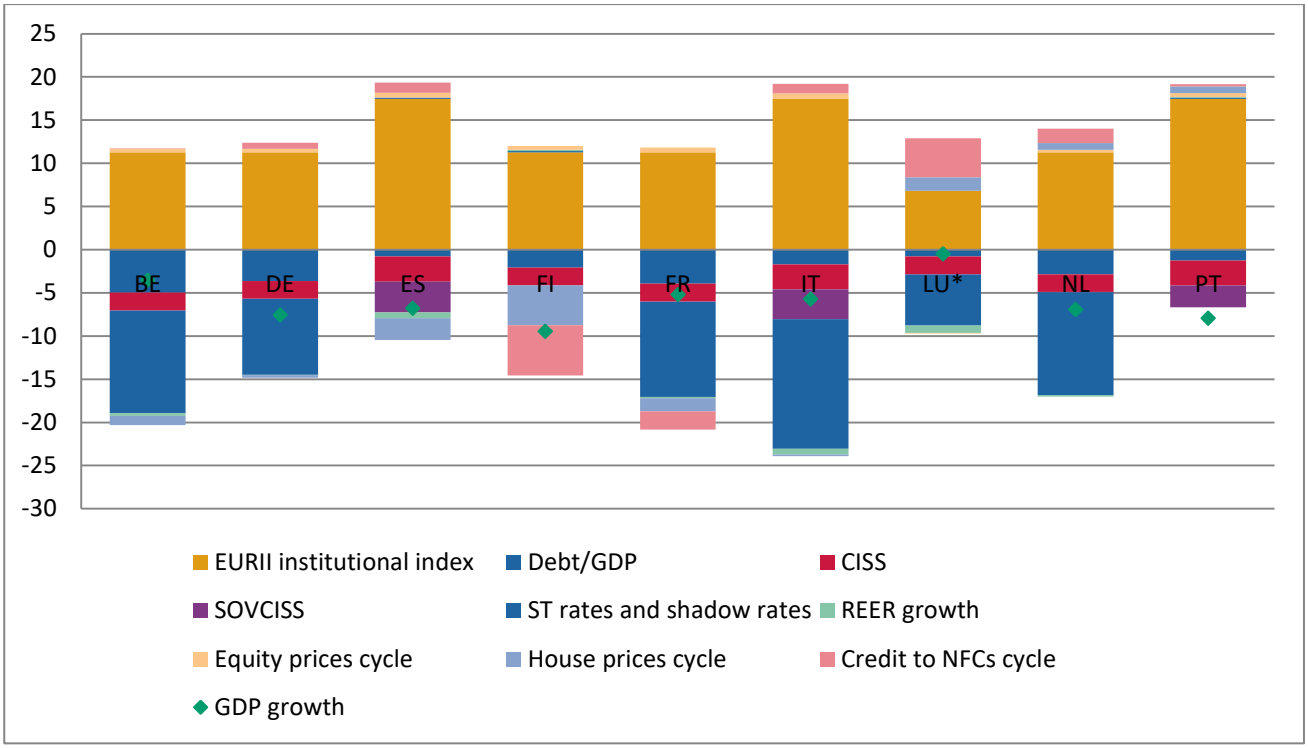
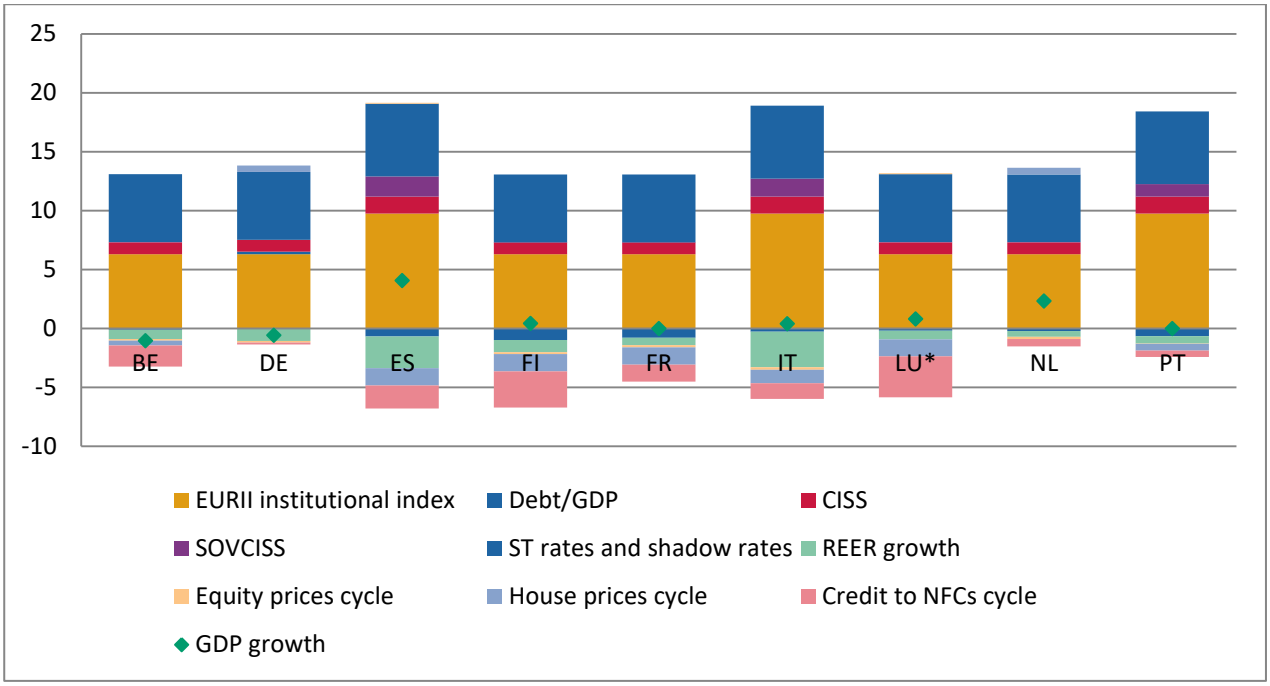
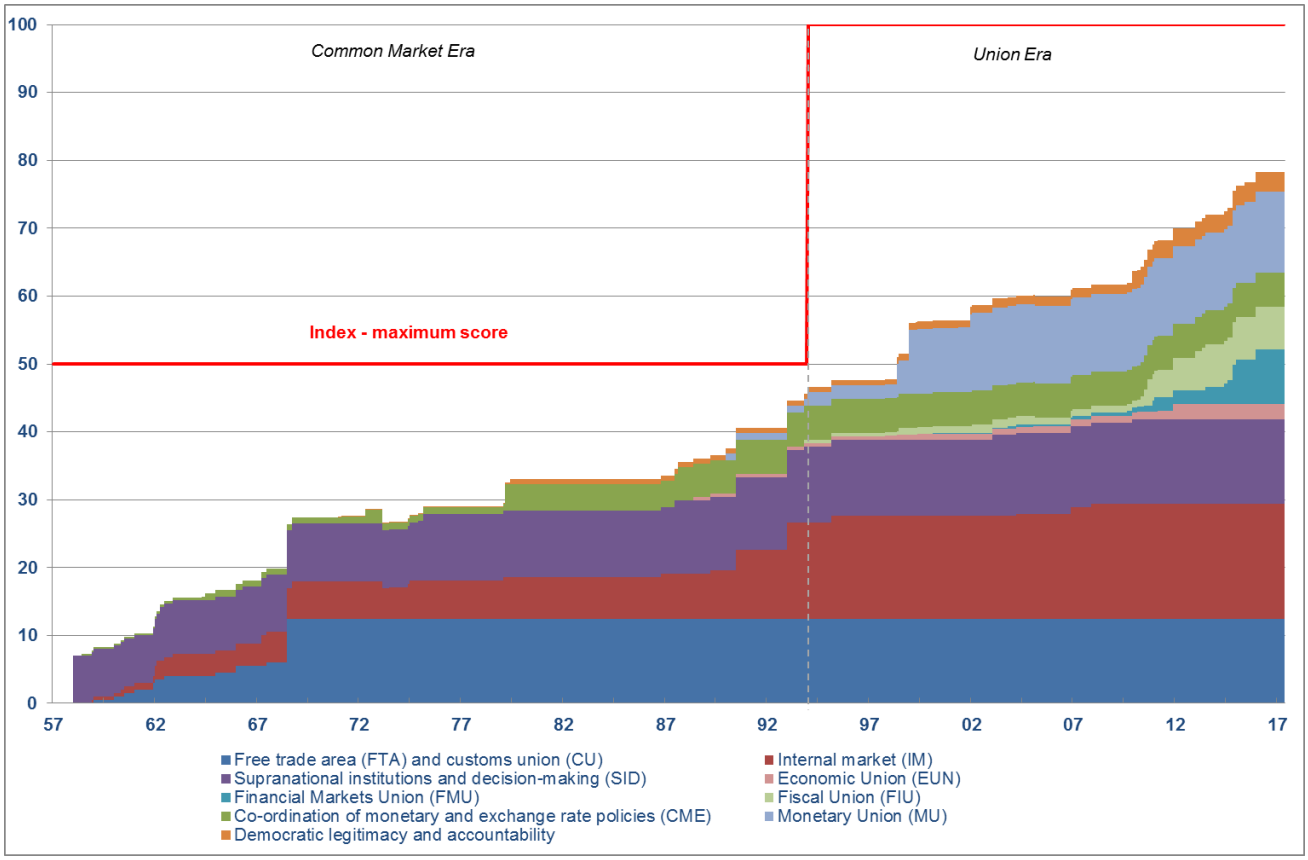



**Figure A.2. Contributions from 2010 to 2016**



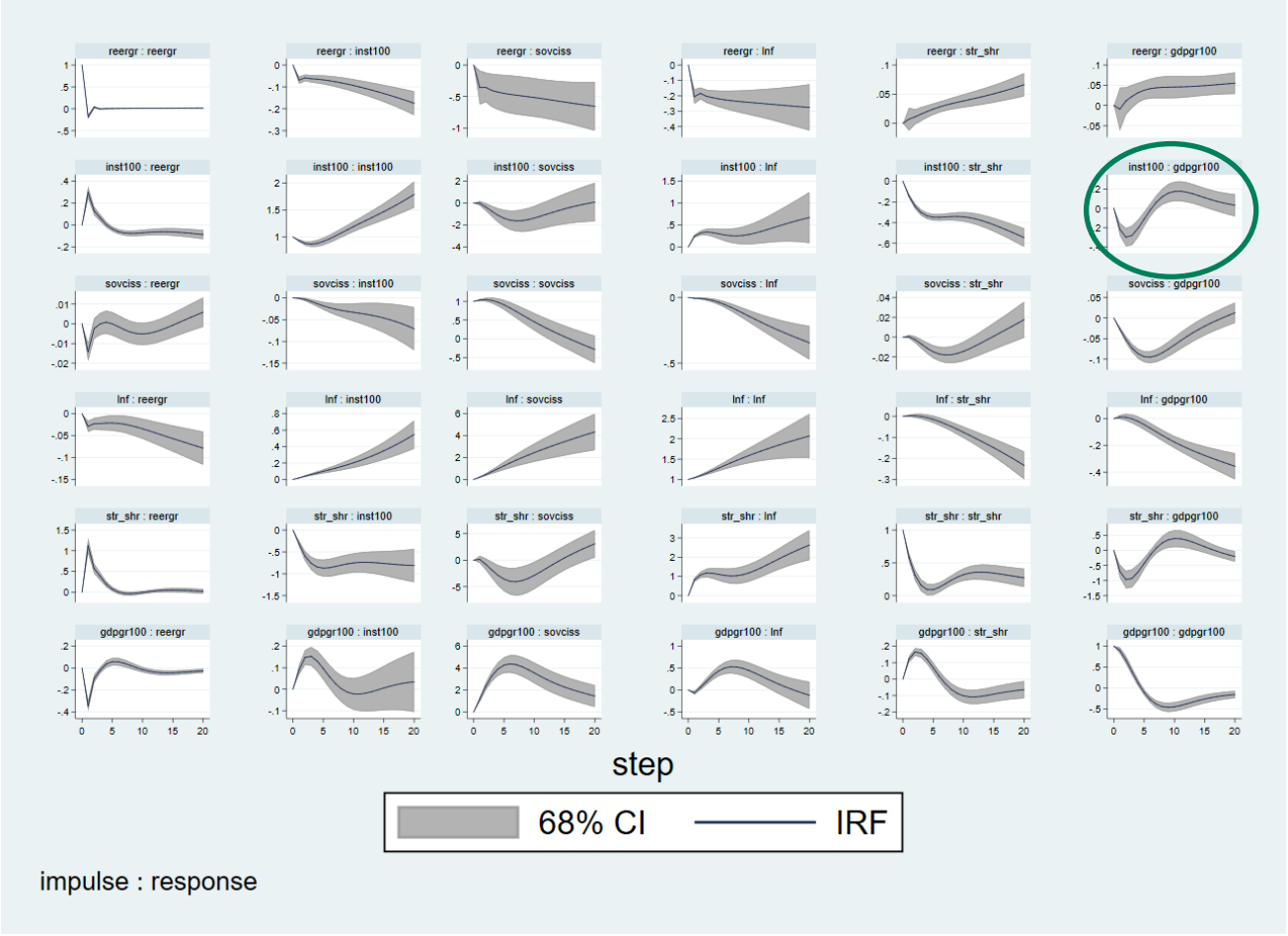

Note: The data for Luxembourg (LU*) are only from 1996Q1. The cycles are based on data from real GDP (YER), equity price indices (EQP), real total credit to private non-financial sector (TCN), real credit to non-financial corporations (LNF), real credit to households (LHH), property prices (RPP), nominal long-term rates (LTN). The synchronicities are based on cycle's pairs. EURII is the European Index of Regional Institutional Integration. CISS is the Composite Indicator of Systemic Stress, SOVCISS is the Composite Indicator of Sovereign Stress, REER growth refers to the growth rate in the Real Effective Exchange Rate and ST rates are the EONIA/shadow rates.

**Figure A.3. The EURII index**




Source: authors' updated series from Dorrucci et al. (2015).

**Figure A.4. Panel VAR with EURII ordered last**




Note: GDPGR100 is real GDP growth rate. REERGR refers to the growth rate in the Real Effective Exchange Rate. INST100 is the European Index of Regional Institutional Integration (EURII). SOVCISS is the Composite Indicator of Sovereign Stress. The cycles are based on data from real credit to non-financial corporations (LNF), STR_SHR are the EONIA/shadow rates. The blue circle refers to the impulse responses of GDP growth to a shock in the EURII; this is highlighted as is the key results of this paper.