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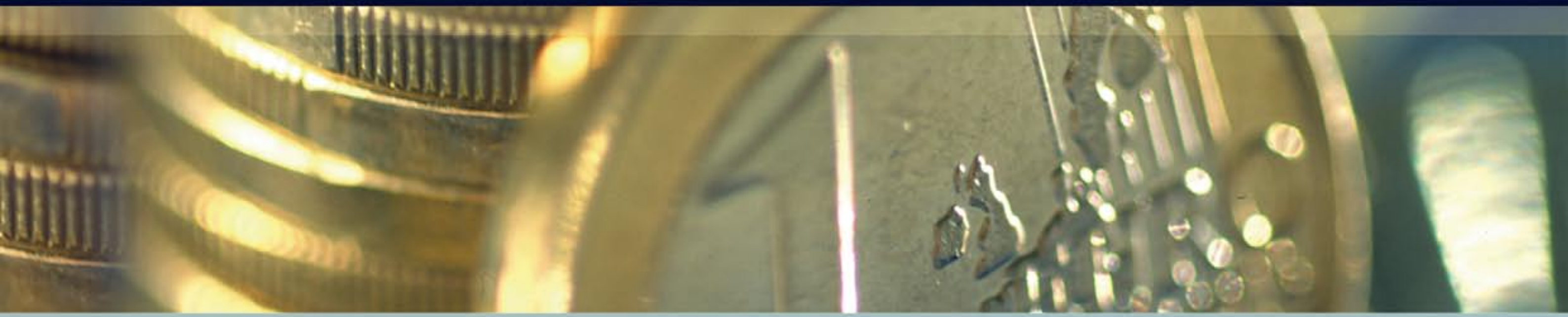

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Measuring Euro Area Monetary Policy Transmission in a Structural Dynamic Factor Model

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Abstract

We study the effects of a common monetary policy in the euro area by means of a Structural Dynamic Factor model estimated on a large panel of euro area quarterly series. While we estimate a flat response of prices to a monetary policy shock, which we explain as aggregation of country-specific heterogeneous responses, we find no relevant asymmetries between countries in terms of output reaction. However, for both Spain and Italy, we find asymmetries in consumption, investment, and unemployment. The introduction of the single currency in 1999 helps reducing asymmetries in price responses but not in consumption and investment.

JEL Classification: C32, E41, E52

Keywords: Structural Dynamic Factor Model, European Monetary Union, Monetary Policy Transmission, Asymmetric Effects.

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1 Introduction

The primary objective of the European Central Bank (ECB) is to maintain price stability within the euro area, and without prejudice to this, to contribute to a sustainable, and non-inflationary growth.[1] Although the objectives of the ECB are defined in terms of euro area aggregates, analyzing how each single country reacts to ECB decisions is a topic with relevant policy implications. This is particularly true in light of the recent global financial crisis to which euro area authorities had to respond with an unprecedented, and unconventional, mix of expansionary policies.

What are the effects of such policies on the euro area and on its members? Is there any asymmetric effect? What happened after the introduction of a single currency?

To address these issues, in this paper we estimate a Structural Dynamic Factor model à la Forni et al. (2009) on a large panel of euro area quarterly series. The goal is to evaluate the effects of the common monetary policy in the euro area both at the aggregate and at the national level.

The transmission mechanism of monetary policy in the euro area has been widely investigated in the literature by means of Structural VAR (SVAR) models, both at the aggregate level (Monticelli and Tristani, 1999; Peersman and Smets, 2003) and at the country level (Mojon and Peersman, 2003; Peersman, 2004). Albeit some exceptions (Clements et al., 2001; Rafiq and Mallick, 2008), the bulk of the literature employing SVAR models has reached a substantial consensus on excluding asymmetric effects of monetary policy across Member States.

In contrast to the SVAR literature, Boivin et al. (2009), by means of a Factor Augmented VAR model (FAVAR) à la Bernanke et al. (2005), find evidence of important heterogeneity in the effect of monetary shocks across countries before the launch of the Euro. Nonetheless, they also show that the creation of the Euro has contributed to shaping a greater homogeneity of the transmission mechanism across countries.

Following the approach by Forni and Gambetti (2010a) for analyzing United States' monetary policy, we choose to use a Structural Dynamic Factor model for analyzing euro area monetary policy. Our approach has some advantages with respect to the SVAR literature. First, the use of a large number of variables, including both euro area aggregates and national variables, allows us to analyze the effect of a monetary policy shock in a unified and coherent framework. Second, as shown by Forni and Lippi (2001), large macroeconomic databases usually admit a factor representation. Third, contrary to SVAR models, it is extremely unlikely that we run into the *non-fundamentalness* prob-

[1] "Without prejudice to the objective of price stability, the European System of Central Banks (ESCB) shall support the general economic policies in the Community with a view to contributing to the achievement of the objectives of the Community as laid down in Article 2". (Maastricht Treaty article 105.1)

lem (Forni et al., 2009; Forni and Lippi, 2010; Alessi et al., 2011), meaning that large information sets should help to correctly recover the space spanned by the structural shocks.

Also when compared to FAVAR, Structural Dynamic Factor models have some advantages. First, we can *test* for the number of common shocks driving the economy, without any a priori belief on the existence of a common interest rate factor. Second, we can impose identification restrictions directly on the impulse response of the observed variables to the shocks without the need of interpreting principal components.

In particular, although our work is clearly closely related to the one by Boivin et al. (2009), it represents a methodological improvement with respect to their work. We are indeed able to respond to the critiques made by Uhlig (2009) in a discussion to the paper by Boivin et al. (2009). Precisely, he provides challenging results on three basic assumptions: the claimed existence of a comovement among the selected macroeconomic time series, the correct identification of monetary policy shocks and of their effects, and the informative content of data with respect to the evolution of monetary transmission after the the Euro introduction. Uhlig (2009) shows that, first, the comovements found by Boivin et al. (2009) are simply the product of the autocorrelation in the data, i.e. the data used are non-stationary. Second, the monetary policy shock is not correctly identified, as one can infer from some puzzling responses. Third, Boivin et al. (2009) do not perform a proper evaluation of the uncertainty in the impact of the Euro on monetary transmission across countries.

In this paper we address the whole set of critiques. First, we use *heavy* data transformations, i.e. second differences of prices and first differences of interest rates and quarter-on-quarter (instead of year-on-year) growth rates and we use state-of-the-art consistent tests to determine the number of euro area common shocks. Second, we adopt an identification strategy that is standard, and commonly accepted by the econometric literature, i.e. a recursive scheme. Last, we report error bands for the post-Euro responses. In this way, not only we are able to confirm a wide share of Boivin et al. (2009) results without suffering of their drawbacks, e.g. either *removing* or *explaining* some observed puzzles, but also we add new empirical evidence on euro area monetary transmission

Other related papers are by Eickmeier (2009) and McCallum and Smets (2009). However, while Eickmeier (2009) establishes stylized facts on comovements and homogeneity of individual euro area countries' output and price developments in the past two decades, McCallum and Smets (2009) focus on the impact of monetary policy on real wages. Hence, both papers have a different focus.

The analysis is carried out on a panel of 237 quarterly series from 1983:Q1 to 2008:Q4 comprising both euro area aggregates, main macroeconomic variables for single member states, and key indicators for the United Kingdom, the United States, and Japan. We find that the euro area business cycle can be well characterized by four structural sources of fluctuations, and we identify one of them as a monetary policy shock by means of a standard recursive identification scheme.

A first set of results is obtained when estimating our model over the whole sample 1983:Q1-2007:Q4, which we consider as our *baseline specification*. We have five main findings. First, monetary policy shocks influence euro area real activity, while they have a negligible effect on prices, thus suggesting that the European Central Bank drives prices stabilization by means of its *systematic* reaction to economic shocks. Second, we estimate a flat response of prices to a monetary policy shock, a result that we can explain by showing that, while the reaction of most euro area countries is either negative or not significant, there is a strong positive reaction of Italian, Portuguese, and Greek prices. Third, with the exception of Greece, which is totally asynchronized with respect to the common business cycle, there are no asymmetries within European countries in terms of output reaction. However, fourth, we find relevant asymmetries in terms of consumption and investment for both Spain and Italy. This heterogeneity stems from an asymmetric reaction of long term yields for which we observe a wider reaction in Italy and Spain. We reconcile these two results by showing that after a monetary policy shock, the Italian and Spanish real exchange rate first rise on impact, but then depreciate, hence dampening the decline of output. Fifth, we provide evidence of strong asymmetries with respect to unemployment for Italy (asynchronized response) and for Spain (magnified response).

We then investigate the effects of Euro's introduction on monetary transmission. Concerning the period after 1999 we have three additional results. First, the price reaction is stronger than the one observed before 1999. Second, the Greek economy partially synchronizes with the euro area business cycle. Third, notwithstanding convergence in the responses of both long-term yields, and exchange rates, we do not have clear evidence pointing towards homogeneity of consumption and investment reaction, a result obtained also by Reichlin (2009) by means of a Large Bayesian VAR model.

The paper is structured as follows. In section 2 we review the econometric methodology. In section 3 we describe the data used and the criteria for determining the number of factors. In section 4 we present the results obtained with the baseline specification. In section 5 we perform subsample analysis thus trying to highlight the effects of the Euro, while in section 6 we briefly address the impact of financial crisis. In section 7 we conclude.

2 Structural Dynamic Factor model

2.1 The general model

The factor model we consider here is firstly introduced by Forni et al. (2009). In fact, this is a restricted version of a more general factor model previously introduced by Forni et al. (2000) and Forni and Lippi (2001).

Structural Dynamic Factor models are based on the idea that fluctuations in the economy are due to a few structural shocks affecting all variables, and on several idiosyncratic shocks influencing only one or just a few variables. In this paper, we consider the few structural shocks as the sources of business cycle fluctuations affecting the whole euro area (monetary policy or oil shocks for example), while we interpret the idiosyncratic shocks as country specific economic shocks having only marginal effects on the rest of the European countries. Formally, we define $\mathbf{x}_t$ as the vector containing all our observable variables after being demeaned and reduced to stationarity. Each variable x_{it} can then be written as the sum of two mutually orthogonal unobservable components: the common component χ_{it} and the idiosyncratic component ξ_{it}, i.e.

$$x_{it} = \chi_{it} + \xi_{it}, \qquad i = 1, \ldots, n \text{ and } t = 1, \ldots, T,$$

where n is the number of variables observed and T is the sample length. Equivalently, in vector notation, we have

$$\mathbf{x}_t = \boldsymbol{\chi}_t + \boldsymbol{\xi}_t, \qquad t = 1, \ldots, T. \tag{1}$$

The common component is driven by a finite number $q \leq n$ of structural macroeconomic shocks, or dynamic factors, $\mathbf{u}_t$:

$$\boldsymbol{\chi}_t = \mathbf{B}(L)\mathbf{u}_t = \sum_{h=0}^{s} \mathbf{B}_h \mathbf{u}_{t-h}, \qquad t = 1, \ldots, T, \tag{2}$$

where L is the lag operator, $\mathbf{B}_h$ are $n \times q$ matrices and s is maximum allowed lag length, which, in principle, could be also infinite. We make the assumptions that: (i) $\mathbf{u}_t$ is an orthonormal white noise process; (ii) the shocks are orthogonal to the idiosyncratic components at any lead and lag, i.e. $\mathrm{E}[u_{it}\xi_{js}] = 0$ for any $i, j = 1, \ldots, n$ and any $t, s = 1, \ldots, T$; (iii) the idiosyncratic components can be mildly cross sectionally correlated, i.e. there exists a real number κ such that $\mathrm{E}[\xi_{it}\xi_{js}] \leq \kappa$ for any $i \neq j$ and for any t, s, while no assumption is made regarding their univariate serial correlation.

In this paper, we are interested in the impulse response functions of macroeconomic variables $\mathbf{x}_t$ to a monetary policy shock, which we assume to be common to all euro area variables, i.e. is an element of $\mathbf{u}_t$. Impulse responese are defined as $\mathbf{B}^{mp}(L) = \sum_{h=0}^{s} \mathbf{B}_h^{mp} L^h$, where the superscript mp indicates the column corresponding to the monetary shock.

Although in practice we observe only n macroeconomic variables, in order to be able to identify the factor structure also in presence of mild correlation across the idiosyncratic components, the model and its assumptions have to be formulated for an infinite panel of time series (Forni et al., 2000). This is the motivation for requiring a *large* cross section of time series in order to disentangle the common and idiosyncratic components of (1). More specifically, after denoting as $\lambda^j(\theta)$ the j-th largest eigenvalue of the spectral density matrix of $\mathbf{x}_t$ computed at a generic frequency $\theta \in [-\pi, \pi]$, we make two additional assumptions for n going to infinity: (iv) $\lambda^q(\theta)$ goes to infinity almost everywhere in $\theta \in [-\pi, \pi]$, and (v) $\lambda^{q+1}(\theta)$ stays uniformly bounded. Forni and Lippi (2001) prove that if assumptions (i) to (v) hold then: (a) $\mathbf{x}_t$ admits a representation such as (1) and (2); (b) the decomposition into common and idiosyncratic components is unique, meaning that the number of factors q and the common and idiosyncratic components are uniquely identified, thus a representation with a different number of shocks is not possible; (c) the *viceversa* also holds, that is a representation with q factors has a spectral density with just its q largest eigenvalues diverging as n goes to infinity. The assumptions we make imply that the matrices $\mathbf{B}_h$ have full rank q, meaning that each common shock affects each element of the dataset under consideration, i.e. the shocks $\mathbf{u}_t$ are pervasive.

Typically, in empirical macroeconomic applications, given the strong comovements across data, we find $q << n$. In this case we say that the data at hand *admit* a factor representation without the need of an *a priori hypothesis* of a factor structure.

Finally, if we introduce the additional assumption that the space generated by the common components has finite dimension, i.e. $s < \infty$, Forni et al. (2009) prove that we can write (2) as

$$\begin{aligned} \boldsymbol{\chi}_t &= \boldsymbol{\Lambda}\mathbf{f}_t, \quad \text{where} \\ \mathbf{A}(L)\mathbf{f}_t &= \boldsymbol{\epsilon}_t \quad \text{and} \\ \boldsymbol{\epsilon}_t &= \mathbf{H}\mathbf{u}_t, \qquad t = 1, \dots, T. \end{aligned} \tag{3}$$

$\mathbf{f}_t$ is an r-dimensional vector of, so called, static common factors, r is a finite integer independent of n and such that $q \le r \le n$, $\boldsymbol{\Lambda}$ is a $n \times r$ matrix, $\mathbf{A}(L) = \sum_{k=1}^p \mathbf{A}_k L^k$ where is a filter of finite lag p and $\mathbf{A}_k$ are $r \times r$ matrices, and finally $\mathbf{H}$ is a $r \times q$ matrix (see Forni and Gambetti, 2010a, for an iterpretation of r and $\mathbf{f}_t$). Identification of r and of the common and idiosyncratic components is still possible if we add the assumption that, as n goes to infinity, the r largest eigenvalue of the covariance matrix of $\mathbf{x}_t$ diverges, while the $r+1$-th largest eigenvalue stays bounded. Notice that model 3 is a development of the model proposed by Stock and Watson (2002) and it is a static representation of a dynamic factor model.

From (3) we get the impulse response functions as:

$$\mathbf{B}(L) = \boldsymbol{\Lambda} \left(\mathbf{I}_r - \sum_{k=1}^{p} \mathbf{A}_k L^k \right)^{-1} \mathbf{H}. \tag{4}$$

The impulse response function of the i-th variable to the j-th shock is then the (i, j)-th entry of (4). Being $n >> q$ we have a large variety (n is large) of impulse responses just by identifying the few (q is small) dynamic factors.

2.2 Identification

Although the common component is uniquely identified, the impulse response functions in (4) and the corresponding structural shocks are not. Indeed, if $\mathbf{R}$ is an orthogonal $q \times q$ matrix and we define $\mathbf{K} = \mathbf{HR}'$ and $\mathbf{v}_t = \mathbf{Ru}_t$, then $\boldsymbol{\chi}_t = \mathbf{C}(L)\mathbf{v}_t$ with $\mathbf{C}(L) = \boldsymbol{\Lambda}\left(\mathbf{I}_r - \sum_{k=1}^{p} \mathbf{A}_k L^k\right)^{-1} \mathbf{K}$ is a representation equivalent to (2). By assuming orthogonal structural shocks, orthogonal transformations are the only admissible choice for $\mathbf{R}$. Therefore, as in SVARs, structural shocks and impulse response functions are unique up to an orthogonal transformation (i.e. a rotation) and structural analysis in Dynamic Factor models becomes analogous to the standard structural analysis in VARs. In order to determine $\mathbf{R}$, we just need to impose economic meaningful restrictions.

There are two main advantages of using Structural Dynamic Factor models instead of SVARs. First, once q is determined, in order to achieve identification, we have to impose just $q(q-1)/2$ restrictions (i.e. the number of degrees of freedom of $\mathbf{R}$), which, contrary to what happens in SVARs, is a number independent of the cross-sectional dimension n considered. Therefore, we can consider very large datasets without having to bother with the curse of dimensionality which is typical of SVARs. Second, given the possibility of dealing with large datasets, the problem of non-fundamentalness, a generic feature of small datasets as the ones considered in SVARs, becomes non-generic in Structural Dynamic Factor models. Indeed, in low-dimensional settings we are likely to have non-fundamental structural shocks, i.e. requiring future observations in order to be recovered, thus making VAR estimation often not suitable for structural analysis (see Alessi et al., 2011, for some examples). On the other side, in the high-dimensional setting of Structural Dynamic Factor models the structural shocks are guaranteed to be fundamental for the whole considered dataset, thus allowing for the correct identification of the space they span (see Forni et al., 2009, for a formal proof of this result).

2.3 Estimation

The number of dynamic factors q can be estimated by means of one among the following criteria: Hallin and Liška (2007); Bai and Ng (2007); Amengual and Watson (2007); Onatski (2009). Regarding the number of static factors r, we have at least two ways to proceed: we can either apply the criterion by Bai and Ng (2002), and its refinement in Alessi et al. (2010), or, given an estimate $\widehat{q}$, and by considering the equivalence between representations (2) and (3), we can fix $\widehat{r}$ such that the variance explained by the $\widehat{r}$ largest static factors is equal to the variance explained by the $\widehat{q}$ largest dynamic factors.[2]

[2]Hereafter, when indicating estimated quantities we use $\widehat{\ }$, but we omit any explicit reference to the sample length T and the cross sectional dimension n.

Once the number of dynamic and static factors, $\widehat{q}$ and $\widehat{r}$, is determined, estimation proceeds in three steps. First, the static factors are estimated as the $\widehat{r}$ largest ordinary principal components of $\mathbf{x}_t$. Precisely, given the sample covariance matrix of the data $\widehat{\mathbf{\Gamma}}^x$, the estimated loadings $\widehat{\mathbf{\Lambda}}$ are the normalized eigenvectors corresponding to the $\widehat{r}$ largest eigenvalues of $\widehat{\mathbf{\Gamma}}^x$, while the estimated static factors are $\widehat{\mathbf{f}}_t = \widehat{\mathbf{\Lambda}}'\mathbf{x}_t$. Second, a VAR($\widehat{p}$) is estimated on $\widehat{\mathbf{f}}_t$ and we get estimates of $\widehat{\mathbf{A}}(L)$ and of the residuals $\widehat{\boldsymbol{\epsilon}}_t$. The maximum lag $\widehat{p}$ is estimated with a usual information criterion as AIC or BIC. Third, given the sample covariance matrix of the estimated VAR residuals $\widehat{\mathbf{\Gamma}}^\epsilon$, we apply on it the spectral decomposition. Denote by $\widehat{\mathbf{M}}$ the $\widehat{q} \times \widehat{q}$ diagonal matrix containing the $\widehat{q}$ largest eigenvalues of $\widehat{\mathbf{\Gamma}}^\epsilon$ and denote by $\widehat{\mathbf{S}}$ the matrix containing the corresponding normalized eigenvectors, then $\widehat{\mathbf{\Gamma}}^\epsilon = \widehat{\mathbf{S}}\widehat{\mathbf{M}}\widehat{\mathbf{S}}'$ and $\widehat{\mathbf{K}} = \widehat{\mathbf{S}}\widehat{\mathbf{M}}^{1/2}$. The non-identified impulse response functions are then

$$\widehat{\mathbf{C}}(L) = \widehat{\mathbf{\Lambda}}\left(\mathbf{I}_{\widehat{r}} - \sum_{k=1}^{\widehat{p}} \widehat{\mathbf{A}}_k L^k\right)^{-1} \widehat{\mathbf{K}}.$$

By imposing structural identification restrictions (see the next section), we obtain an estimate of the orthogonal transformation $\widehat{\mathbf{R}}$. Impulse response functions and the corresponding structural shocks are estimated respectively as

$$\widehat{\mathbf{B}}(L) = \widehat{\mathbf{C}}(L)\widehat{\mathbf{R}} = \widehat{\mathbf{\Lambda}}\left(\mathbf{I}_{\widehat{r}} - \sum_{k=1}^{\widehat{p}} \widehat{\mathbf{A}}_k L^k\right)^{-1} \widehat{\mathbf{K}}\widehat{\mathbf{R}},$$

and

$$\widehat{\mathbf{u}}_t = \widehat{\mathbf{R}}'\widehat{\mathbf{K}}'\left(\mathbf{I}_{\widehat{r}} - \sum_{k=1}^{\widehat{p}} \widehat{\mathbf{A}}_k L^k\right)\widehat{\mathbf{f}}_t, \qquad t = 1, \ldots, T,$$

Consistency of this procedure as both n and T go to infinity is proved in Forni et al. (2009).

Finally, we build confidence intervals using a bootstrap algorithm. At each iteration d, we bootstrap the estimated structural shocks $\tilde{\mathbf{u}}_t^d$ and we generate new static factors as $\tilde{\mathbf{f}}_t^d = \left(\mathbf{I}_{\widehat{r}} - \sum_{k=1}^{\widehat{p}} \widehat{\mathbf{A}}_k^* L^k\right)^{-1} \widehat{\mathbf{H}}\tilde{\mathbf{u}}_t^d$, where the * stands for the fact that we correct for the distortion induced by the VAR estimation on the static factors as in Kilian (1998). We then repeat the second and third steps of the estimation procedure described above, thus obtaining new bootstrapped impulse response functions. Although this algorithm ignores the uncertainty brought about by idiosyncratic shocks, we are confident on the results obtained being this procedure very similar to the one used in FAVAR literature (e.g. Bernanke et al., 2005; Eickmeier, 2009).[3]

[3]Alternative procedures are suggested in Forni et al. (2009) who propose a block bootstrap algorithm on the $\mathbf{x}$s, and in Luciani (2010) who suggests a double bootstrap algorithm consisting in generating artificial variables as the sum of a common component obtained by a normal bootstrap procedure applied to the estimated structural shocks, and an idiosyncratic component obtained through a block-bootstrap algorithm.

3 Model setup

3.1 Data and data treatment

The analysis is carried out on a panel of 237 quarterly series from 1983:Q1 to 2007:Q4. Data include both euro area (EA) aggregates, main macroeconomic variables for single EA Member States, and key indicators for United Kingdom, United States, and Japan. The database contains 9 aggregate EA variables:[4] gross domestic product (GDP), consumer price index (CPI), short and long term rates, monetary aggregates (M1 and M3), unit labor cost, real effective exchange rate, and the euro/dollar exchange rate. We then have 35 variables for France, Germany, Italy, and the Netherlands, 34 variables for Spain, and 32 variables for Belgium. Variables included for the six main EA economies are: interest rates, monetary aggregates, real effective exchange rates, an index of stock prices, GDP and its expenditure components, unemployment rates, unit labor costs, GDP deflators, producer price indexes (PPI) and harmonized indexes of consumer prices (HICP) together with their respective disaggregated categories, retail sales and number of cars sold. In addition, we also include HICP, GDP, and interest rates for smaller EA countries (Finland, Greece, Ireland, Luxembourg, and Portugal), and for UK, US, and Japan, as well as the spot oil price.

All variables are first transformed in order to reach stationarity and then demeaned and standardized. As in Stock and Watson (2005) and Forni and Gambetti (2010b), we take the second difference of the log of both prices and monetary aggregates, and the first difference of interest rates. After transformation, all variables are stationary according to the Augmented Dickey Fuller test. For any further information on the database, the complete list of variables and transformations used is reported in Appendix B.

3.2 Number of factors

Before estimating the model, we have to determine the number of common shocks driving EA business cycle. This is an issue of particular interest going beyond the parameterization of the model. Indeed, Uhlig (2009) in his discussion of Boivin et al. (2009) argues that there are no comovements among EA variables, and that the common factors found by Boivin et al. (2009) are in fact the result of autocorrelations present in the data. However, our analysis is less affected by Uhlig's critique mainly for two reasons. First, while Boivin et al. (2009) take year on year growth rate of their variables, we take quarter on quarter growth rate. Second, we take the first difference of interest rates, and we differentiate twice the log of both prices and monetary aggregates. This means that our data are less autocorrelated than those used by Boivin et al. (2009). Therefore, we can rely on the results of the tests on the number of factors.

[4] Variables are taken from either Eurostat, or ECB, and, when necessary, they are backdated by using data from the Area Wide Model Database (Fagan et al., 2001).

In order to determine the number of common shocks, we apply the test proposed by Onatski (2009, see table 1) and the criterion by Hallin and Liška (2007). Each entry of table 1 shows the p-values of the null of q_0 common shocks against the alternative of $q_0 < q \leq q_1$ common shocks: results suggest the presence of 5 common shocks. On the other hand, the Hallin and Liška (2007) criterion suggests between 2 and 3 common shocks. Given that in general information criteria and statistical tests do not provide a well defined answer, we choose as our baseline specification 4 common shocks, the average of what suggested by the Onatski (2009) test and the Hallin and Liška (2007) criterion. We consider $\widehat{q} = 3, 5$ as a robustness check. It is also worth nothing that four common shocks is a parameterization that is considered plausible by the literature. In particular, in her discussion of Boivin et al. (2009), Reichlin (2009) rises some doubts about their choice of seven common shocks by arguing that a smaller number of common shock would be much more plausible: "when macroeconomists think of common shocks, they mention productivity, money, time preference, or government, and it is difficult to think of many other candidates" (p. 130).

Having determined the number of common shocks, one possible way of fixing the number of static factors is to choose $\widehat{r}$ so that the variance explained by the static factors is equal to the variance explained by the chosen $\widehat{q}$ dynamic factors. This method suggests 13 static factors (see table 2). Another way to determine the number of static factors is to resort to the criterion provided by Bai and Ng (2002) and its refinement by Alessi et al. (2010). Both methods suggest either 9 or 14 factors.[5] Once again, given that information criteria do not provide a well defined conclusion, we will choose as our baseline specification 12 static factors, i.e. the average of what the criteria suggest, and we keep $\widehat{r} = 9, 14$ for robustness analysis.

Finally, let us consider the variance explained by the 12 static factors. Table 2 shows the percentage of variance of the overall database explained by the largest 14 dynamic eigenvalues, as well as the variance of the overall database, and of selected key variables, explained by the 14 largest static factors. At the aggregate EA level, 12 static factors account for 85% of GDP, 81% of CPI, 77% of short term interest rate, and 57% of both M1 and M3 fluctuations, meaning that a parameterization with 12 static factors is able to account for a large part of fluctuations in the EA as an aggregate. At the country level, instead, we have a more heterogeneous picture: 12 static factors explain more than 40% of GDP fluctuations for all countries but the Netherlands and Spain (34%), Ireland (18%), Greece (18%), and Luxembourg (26%), while they explain more than 50% of prices fluctuations for all countries but Finland (34%) Ireland (38%), and Greece (13%). Hence, from table 2, we can conclude that, with the exception of Greece which seems mainly driven by national shocks, common EA shocks account for an important part of both GDP and prices fluctuations at the national level.

[5]Results for the Bai and Ng (2002) criterion, for its refinement by Alessi et al. (2010), as well as the criterion by Hallin and Liška (2007) are not shown here but are available upon request

3.3 Identification strategy

Having fixed the dimension of the factor space, we proceed to identify the monetary policy shock. Following Forni and Gambetti (2010a), let $\mathbf{B}^{(q)}(L)$ be the $q \times q$ sub-matrix of $\mathbf{B}(L)$ corresponding to the impulse responses of EA aggregate GDP, CPI, short term rate, and real effective exchange rate. We identify the monetary policy shock by selecting the rotation matrix $\mathbf{R}$ such that $\mathbf{B}^{(q)}(0)$ is lower triangular. That is, we assume that output and prices do not react contemporaneously to monetary policy shocks. This is a standard recursive scheme, with the monetary policy shock being the third shock (see Forni and Gambetti, 2010a, for a similar identification scheme using US data). Once the rotation matrix is determined, then all $n \times q$ impulse responses $\mathbf{B}(L)$ are identified and, in this paper, we focus just on the third column, i.e. $\mathbf{B}^{mp}(L)$, the column corresponding to the monetary policy shock.

Although the recursive identification scheme was recently criticized (Carlstrom et al., 2009; Castelnuovo, 2010), it is the simplest, and, still, most diffused identification scheme in the SVAR literature (Christiano et al., 1999; Peersman and Smets, 2003; Giannone et al., 2009; Weber et al., 2009). Moreover, the goal of this paper is to show that Factor Models are an appropriate tool for the analysis of the monetary policy transmission mechanism. In order to do so, we believe that the application of a standard identification scheme is the best choice. Finally, since we are able to solve a good number of puzzles by adopting a simple scheme, considering a different more complex identification strategy could all but strengthen our results.

4 Baseline specification results

4.1 The dynamic effects of monetary policy

Figures 1-9 show the impulse response functions for the main macroeconomic variables of interest together with 68% confidence bands obtained with the bootstrap procedure described in section 2.3. The monetary policy shock is normalized so that at impact it raises the EA short term rate of 50 basis points.

Short term interest rate:

After the monetary tightening, the policy rate increases for two quarters and then reverts to its baseline level, before displaying the typical negative response associated to the implementation of a counter cyclical feedback rule by the central bank (see figure 1).

Gross domestic product:

Aggregate EA real GDP falls on impact and declines steadily up to a minimum of about -1.5% after six-eight quarters before flattening. The magnitude of the estimated GDP reaction is somewhat larger than previous studies (Peersman and Smets, 2003; Peersman,

2004) but in line with the one found by Monticelli and Tristani (1999) and Cecioni and Neri (2010), by means of SVAR models, and by Eickmeier (2009) in a factor analysis.[6] The responses of single countries' GDPs are qualitatively similar to the aggregate one (see figure 2). However, from a quantitative point of view, we can classify countries in three different groups according to their response. The first group, which includes Belgium, France, Germany, Italy, Ireland, the Netherlands, and Spain, is characterized by a significant eight quarters-contraction, then stabilizing and slowly reverting towards zero. The second group, containing Finland and Portugal, exhibits a deeper contraction eight-nine quarters after the shock, with a long run effect for Portugal. Finally, the third group is made of Greece only, whose GDP goes unconventionally up after a tightening monetary policy shock. This is symptomatic of the asynchrony of Greece with respect to the rest of EA, thus confirming results in section 3.2, according to which Greek business cycle is mainly driven by national shocks.

Consumption and investment:

When looking at GDP components, we find heterogeneity in the responses of both consumption and investment (see figures 3 and 4 respectively). In particular, we find that consumption responses in Italy and Spain are respectively about five and three times larger than the one in France, and three and two times larger than the one in Germany. As noted by Boivin et al. (2009), asymmetries in consumption and investment responses are in turn probably due to the asymmetric reaction of long term yields (see figure 5).

Long term yields:

Aggregate long-term rate rises by 80 basis points, 30 more than the change in the policy rate (figure 1). This apparently puzzling behavior is uncovered when inspecting country-specific effects (figure 5). An increase in EA short-term rate produces a wider reaction (up to 90 basis points) of Italian and Spanish bond yields with respect to Germany, Netherlands, and Belgium, which display a reaction perfectly in line with the monetary policy shock. Accordingly, consumption and investment experiment a more severe contraction in Italy and in Spain than in Germany. A sizeable spread is also observed for France (70 basis points): however, only investment here displays a stronger fall than EA average.

Is there a puzzle?

Despite the reaction of Italian and Spanish consumption and investment is deeper than those of the other EA countries, the final impact of a monetary policy shock on aggregate output is quite similar: why is that? We believe that this can be explained by the

[6] In particular, Monticelli and Tristani (1999) estimate a monetary policy shock equal to 10 basis points, with a maximum effect of 0.4%, while Cecioni and Neri (2010) find a maximum contraction of 1.5% subsequent to a tightening of 50 basis points. This implies a ratio of respectively four and three times between the size of the shock and the largest impact on GDP. Eickmeier (2009) identifies an expansionary monetary policy shock equal to 5 basis points which raises output by about 0.5%.

exchange rate reaction (figure 6) which acts as a sort of re-balancing force. In fact, after a monetary policy shock, Italian and Spanish real exchange rates first rise on impact, but then depreciate. This may be due to the competitive devaluation policy often adopted in the past by Italy and Spain in order to dampen the decline in output.

Exchange rate:

Concerning EA real effective exchange rate and euro/dollar nominal exchange rate (see figure 1), they both increase on impact (about 3% and 5% respectively), staying up for about two quarters, and then converging to zero within five-eight quarters after the shock. Interestingly, the euro/dollar exchange rate closely mimics the policy rate dynamics, rising on impact, keeping steady for two quarters, and then reverting to its pre-shock level. Hence, similarly to Forni and Gambetti (2010a), which, to the best of our knowledge, is the first paper able to solve this puzzle for the US, we do not observe a delayed overshooting puzzle. Moreover, the impulse responses presented in Forni and Gambetti (2010a) are not statistically different from zero, while our estimated responses are strongly significant, displaying a more sluggish path. Finally, the size of the exchange rate reaction to a monetary tightening is in line with the results by Boivin et al. (2009), but it is somewhat larger than those found by SVAR literature (see Peersman and Smets, 2003, among others).

Prices:

EA aggregate prices (CPI) response is almost flat and not significant (see figure 1). Despite this, we should stress that we do not observe the so called *price puzzle*, contrary to most of the recent literature employing analogous identifying assumptions (see Weber et al., 2009, among others). Looking at single countries prices (HICP) behavior helps to unveil insights on the aggregate reaction (see figure 9). First, contrary to the evidence in Boivin et al. (2009), we have no trace of price puzzle in Germany. Second, while the reaction of most EA countries is either negative or not significant, it is immediate to notice the strong positive reaction of Italy, Portugal, and Greece. Hence, we can explain the aggregate result as arising from the aggregation of single countries heterogeneous reactions. Third, the estimated Italian response might be explained by the sharp increase in unit labor cost (see figure 7) which is symptomatic of the existence of a quite strong *cost channel* (see Ravenna and Walsh, 2006). This is in fact a matter of debate in literature (see Rabanal, 2007; Henzel et al., 2009).

Unemployment:

After a monetary policy tightening, unemployment rises in all EA countries (see figure 8). However, while Belgium, France, Germany, and the Netherlands exhibit very similar paths, the reaction of Italian and Spanish unemployment look totally different. Italian unemployment seems not to be related with EA business cycle as it declines on impact and then stabilizes around its baseline level. By contrast, Spanish unemployment rate experiments a strong boost with an effect four times larger than EA average, thus pointing at a deep connection between EA monetary policy and Spanish labor market fluctuations. The strong correlation between the housing sector and employment in Spain could explain this large elasticity (see Jarocinski and Smets, 2008; Vargas-Silva, 2008, for an evaluation of the effects of monetary policy on housing).

Monetary aggregates:

While M1 goes down on impact, displaying the canonical liquidity effect, although not very significant, M3 is permanently raised by the monetary tightening (see figure 1). Hence, for M3 the portfolio effect is dominating on the income effect. This is due to the strong positive correlation between the policy rate and the own rate of M3 (see e.g. De Santis et al., 2008) and it is consistent with evidence in Giannone et al. (2009). Peersman and Smets (2003) find analogous results for M1, whereas they observe a slow but negative reaction of M3. However, their sample terminates in 1998:Q4, while portfolio shifts in M3 and huge substitution effects closely related to the observed reaction of M3 in our analysis took place after 2003 (see De Santis et al., 2008; Fischer et al., 2009).

4.2 The contribution of monetary policy shocks

When considering the variance decomposition of aggregate EA variables, we observe two main results. First, monetary policy shocks do not represent a significant source of prices fluctuations (see table 3). On this regard, the evidence provided by the SVAR literature is mixed. Peersman and Smets (2003) analyzing a sample ending in 1998 find monetary policy to be an important source of price fluctuations (3% after one year and 18% after five years), while both Luciani (2004, 0.2% and 2.5%) and Sousa and Zaghini (2008, 0.9% and 1.4%), which include data after 1998 in their sample, find that monetary policy accounts for a negligible part of prices fluctuations. In addition, Eickmeier (2009) finds a modest contribution of monetary policy innovations in explaining price dynamics within a factor model framework. We interpret this result as a confirmation that, coherently with the prescription assigned by the Maastricht Treaty (1992), price stability is the primary objective pursued by the ECB. Moreover, given that since 1999 inflation has been kept in line with the target of 2%, our result suggests that the ECB drives prices stabilization by means of its *systematic* reaction to economic shocks, i.e. by a Taylor-type policy rule.

Second, monetary policy shocks have a non negligible effect on both real activity (they account for 20% of GDP fluctuations), and the term structure (46%, and 37% of the short and the long term rate respectively). As for monetary aggregates, a remarkable feature is that a monetary policy shock accounts for a large share of broad money, whereas it has a negligible effect on narrow money. Finally, the monetary policy shock has a marginal influence on exchange rates.

Country specific evidence corroborates our former findings. In table 4 we show the contribution of monetary policy to some of the most relevant macroeconomic variables.

Monetary policy is a large source of output fluctuations in France (40%), Italy (23%), and Spain (24%), while it accounts for a limited share of German (10%) and Irish (2%) output fluctuations. Also, our findings are clearly supportive of the particular nature of Italy and Spain job market for which the monetary policy shock accounts for 5% and 43% respectively of total unemployment fluctuations, compared to an EA average contribution of 25%. Consistently with the picture emerging from impulse response analysis, consumption deviations from the steady state result more policy dependent in Italy (36%) and Spain (50%), while the share of investment fluctuations accounted for by monetary policy shocks in Germany is one fourth than the average at the five years forecast horizon, i.e. 5%. Finally, and in accordance with former results on competitive devaluations, Italy and Spain real exchange rate fluctuations are the least affected by monetary policy shocks.

5 The impact of the Euro

A natural question arising when performing empirical analyses in the EA concerns the extent and the directions to which the introduction of the Euro in 1999 has changed the monetary transmission mechanism (Boivin et al., 2009; Weber et al., 2009). This is also a relevant issue in order to understand how much the results over the whole sample are affected from what it has happened before, and after, the introduction of the common currency. We have however to express a note of caution regarding the results presented in this section as the lack of degrees of freedom might not guarantee robustness of the analysis. In structural factor models subsample analysis is possible and it involves the following steps: (i) in each subsample we run an OLS estimation of x_{it} on $\widehat{\mathbf{f}_\mathbf{t}}$, where $\widehat{\mathbf{f}_\mathbf{t}}$ are the static factors estimated over the whole sample, thus obtaining the new factor loadings; then (ii) we estimate a new rotation matrix R as in section 3.3, and compute impulse responses and variance decompositions. Unfortunately, when we split the sample we end up with 62 observations prior 1999 and 36 observation post 1999. Having 12 static factors and 36 observations implies that we estimate the new factor loadings with 24 degrees of freedom: consistency of the estimates is not guaranteed in this case. However, we still believe that Euro effects are an extremely important topic to be investigated even though the econometric analysis cannot be considered robust.

In table 5 we show descriptive statistics for yearly GDP growth rates, and yearly inflation in the two considered subsamples 1983:Q1-1998:Q4 and 1999:Q1-2007:Q4. First, inflation is more stable in the post 1999 sample (variance is more than twice lower) and on average close to the ECB 2% target. Countries which have mostly benefited of the ECB commitment to price stability are France, Italy, Spain, Greece, and Portugal (variance is between three and nine times lower). Second, the GDP growth rate is as much volatile as, and slightly lower than, before Euro introduction. This is likely to be due to ECB statutory objective preference for price stability.

Moving to the structural analysis, in figure 10 we present impulse response function to a monetary policy shock for the aggregate EA. The impulse responses estimated in the post 1999 sample are not significantly different from those on the whole sample. The only exception to this statement is the CPI response which is stronger than the one estimated over the whole sample (see figure 10). Finally, the real exchange rate appreciation appears well magnified, perhaps because competitive devaluations by Member States are no longer possible (see figure 10).

Moving to the country level, the main result concerns the synchronization of the Greek economy with the EA business cycle after the launch of the common currency. As we can see from figure 12, in this subsample Greek GDP responds conventionally to a contractionary monetary policy shock. Second, the common currency has slightly mitigated the heterogeneity in consumption and investments (see figures 13 and 14). Here, an explanation might come from the responses of both long term yields and real exchange rates which show a clear cut convergence path (see figures 15 and 16). Both results are due to the impossibility of competitive devaluation. Asymmetries in the long term rate markets were in fact probably due to the existence of a higher premium prior to 1999 for the risk of devaluation of respective national currencies (Boivin et al., 2009). A remarkable exception to the increased homogeneity is found for Italian consumption, which still experiments the deepest contraction, a result found also by Reichlin (2009).

Summing up, the evidence stemming from subsample analysis points out that: (*i*) the adoption of the Euro has synchronized the Greek economy to the EA business cycle; (*ii*) although we observe convergence in the responses of both the long-term yields, and the exchange rates, we do not have clear evidence pointing at the convergence of consumption and investment. Addressing which factors led to this latter outcome is still an open issue that would require setting up a theoretical dynamic equilibrium model, but this is beyond the scope of this paper.

6 The 2008 financial crisis

In our baseline specification we excluded 2008 data from our sample. The rational is that we wanted to analyze "standard" monetary policy (see section 3.1). In this section we show the implications of considering also data for 2008. In the first row of figure 17 we show the standardized EA GDP growth and the first difference of EA CPI inflation, together with their estimated common components which clearly account completely for the 2008 recession. Consistently with the common view on the 2008 recession being originated from the US sub-prime mortgage crisis, and the ensuing credit crunch, and in accordance to the idea behind factor models, the financial crisis in our model is an external global shock captured by the common component (see section 2.1).

In the second row of figure 17 we show the impulse responses of our baseline specification and those obtained by adding 2008 data. Results change considerably. In particular, the reaction of GDP to a monetary policy shock is well magnified: after an unexpected rise of 50 basis point of the policy rate, GDP decreases to a minimum of 4.3%. This magnitude is much higher than the one usually estimated by the literature, thus suggests that our identification scheme is indeed over estimating the effects of a monetary policy shock, perhaps also capturing some sort of financial shock. This leads us to conclude that in order to consider also 2008 data we would need a more sophisticated identification scheme, a task going behind the scope of this paper and left for future research.

7 Conclusions

In this paper, we estimate a Structural Dynamic Factor model on a panel of 237 quarterly euro area (EA) series from 1983 to 2007. We find that the EA business cycle can be well characterized by four structural sources of fluctuations, and we identify one of them as a monetary policy shock by means of a standard recursive identification scheme.

Our main findings can be summarized as follows: (*i*) monetary policy shocks influence euro area real activity, while they have a negligible effect on prices. (*ii*) We estimate an almost flat response of prices to a monetary policy shock, because there is large variation in the response within countries. (*iii*) Greece seems totally asyncronized with EU business cycle. Finally, we find relevant asymmetric responses in terms of consumption, investment, long terms rates, exchange rates, and unemployment, in both Italy and Spain.

We then investigated the effects of the Euro's introduction on monetary transmission: our results indicate that, after 1999, the CPI reaction is stronger than the one observed before 1999, and that the Greece economy synchronized with the euro area business cycle. Moreover, as in Reichlin (2009), although after 1999 we observe the convergence of the response of both the long-term yields, and the exchange rates, we do not have clear evidence pointing at the convergence of consumption and investment.

In conclusion, we also consider data for 2008. We conclude that, in order to properly analyze the period of the financial crisis, it is necessary a full identification scheme which appropriately disentangle the effects of different structural shocks, a task going behind the scope of this paper and left for future research.

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Tables

Table 1: Determining the Number of Common Shocks: *Onatski (2009)*

q_0 *vs.* q_1	1	2	3	4	5	6	7	8
0	0.031	0.054	0.074	0.093	0.11	0.128	0.143	0.16
1		0.471	0.19	0.255	0.191	0.225	0.259	0.287
2			0.105	0.19	0.154	0.191	0.225	0.259
3				0.842	0.112	0.154	0.191	0.225
4					0.063	0.112	0.154	0.191
5						0.949	0.36	0.474
6							0.199	0.36
7								0.521

This table shows p-values of the null of q_0 dynamic factors against the alternative of $q_0 < q \leq q_1$ dynamic factors. The Discrete Fourier Transformation of the data is computed for $\omega_j = 2\pi s_j/T$, with $s_j \in [2, ..., 20]$, thus to includes waves between 1 and 12 years.

Table 2: Determining the Number of Static Factors:
Cumulated Variance

N Factors	1	2	3	4	5	6	7	8	9	10	11	12	13	14
q	0.21	0.34	0.43	0.51	0.58	0.64	0.69	0.73	0.76	0.79	0.82	0.84	0.86	0.88
r	0.09	0.16	0.23	0.27	0.31	0.34	0.37	0.40	0.42	0.45	0.47	0.49	0.51	0.53
EA.GDP	0.32	0.46	0.52	0.61	0.68	0.68	0.68	0.72	0.76	0.76	0.77	0.85	0.85	0.85
EA.CPI	0.10	0.47	0.47	0.49	0.49	0.54	0.68	0.71	0.71	0.77	0.78	0.81	0.83	0.83
EA.STR	0.23	0.23	0.46	0.54	0.55	0.61	0.61	0.69	0.70	0.76	0.77	0.77	0.78	0.78
EA.LTR	0.36	0.37	0.55	0.67	0.69	0.73	0.85	0.85	0.86	0.87	0.87	0.87	0.92	0.94
EA.ULC	0.13	0.28	0.56	0.59	0.60	0.62	0.63	0.63	0.65	0.65	0.65	0.73	0.74	0.74
EA.M1	0.01	0.01	0.01	0.01	0.01	0.24	0.24	0.25	0.35	0.38	0.49	0.57	0.59	0.59
EA.M3	0.01	0.07	0.07	0.07	0.07	0.16	0.17	0.22	0.32	0.45	0.57	0.57	0.58	0.59
EA.EER	0.05	0.13	0.25	0.60	0.60	0.62	0.70	0.80	0.81	0.81	0.82	0.83	0.88	0.88
useu	0.03	0.11	0.20	0.48	0.48	0.50	0.59	0.73	0.73	0.74	0.76	0.77	0.79	0.79
BG.GDP	0.42	0.46	0.46	0.51	0.51	0.51	0.51	0.52	0.54	0.54	0.54	0.56	0.56	0.57
FR.GDP	0.45	0.61	0.63	0.65	0.67	0.67	0.68	0.69	0.70	0.70	0.71	0.71	0.71	0.72
GE.GDP	0.09	0.15	0.28	0.32	0.39	0.39	0.39	0.40	0.47	0.48	0.51	0.67	0.67	0.67
IT.GDP	0.15	0.21	0.29	0.37	0.39	0.39	0.40	0.40	0.41	0.41	0.43	0.43	0.44	0.44
NL.GDP	0.13	0.14	0.15	0.21	0.23	0.25	0.25	0.28	0.28	0.30	0.31	0.34	0.34	0.38
ES.GDP	0.19	0.20	0.21	0.21	0.26	0.27	0.28	0.33	0.33	0.33	0.35	0.35	0.39	0.39
FI.GDP	0.24	0.30	0.38	0.39	0.41	0.41	0.49	0.49	0.54	0.57	0.57	0.58	0.58	0.60
GR.GDP	0.03	0.03	0.04	0.07	0.07	0.07	0.07	0.17	0.18	0.18	0.18	0.19	0.32	0.32
IE.GDP	0.12	0.13	0.15	0.16	0.16	0.16	0.17	0.18	0.18	0.18	0.18	0.18	0.20	0.21
PT.GDP	0.15	0.17	0.20	0.21	0.36	0.41	0.43	0.44	0.44	0.44	0.45	0.51	0.53	0.57
BG.CPI	0.06	0.45	0.47	0.47	0.48	0.49	0.52	0.52	0.55	0.56	0.57	0.57	0.57	0.58
FR.CPI	0.09	0.49	0.52	0.53	0.55	0.56	0.60	0.61	0.62	0.64	0.66	0.66	0.69	0.69
GE.CPI	0.04	0.40	0.41	0.42	0.42	0.57	0.57	0.60	0.60	0.65	0.68	0.68	0.69	0.70
IT.CPI	0.05	0.16	0.16	0.20	0.20	0.22	0.38	0.45	0.48	0.61	0.62	0.67	0.70	0.70
NL.CPI	0.02	0.08	0.09	0.10	0.13	0.18	0.18	0.21	0.36	0.41	0.65	0.66	0.69	0.70
ES.CPI	0.04	0.13	0.13	0.14	0.15	0.15	0.34	0.46	0.48	0.69	0.70	0.71	0.74	0.74
FI.CPI	0.04	0.09	0.09	0.15	0.16	0.18	0.28	0.32	0.33	0.33	0.34	0.34	0.39	0.39
GR.CPI	0.01	0.05	0.05	0.05	0.05	0.08	0.09	0.10	0.12	0.12	0.13	0.13	0.13	0.15
IE.CPI	0.02	0.09	0.11	0.15	0.19	0.20	0.23	0.25	0.27	0.32	0.37	0.38	0.41	0.46
PT.CPI	0.04	0.12	0.13	0.14	0.15	0.16	0.25	0.28	0.29	0.43	0.49	0.49	0.50	0.50

The first and the second row show respectively the percentage of overall variance explained by the first q dynamic factors estimated with the method of dynamic principal components as in Forni et al. (2000), and the first r static factors estimated by static principal components. The remaining rows shows the variance of the common component of selected variables explained by the first r static factors.
BG = Belgium; FR = France; GE = Germany; IT = Italy; NL = Netherlands; ES = Spain; FI = Finland; GR = Greece; IE = Ireland; PT = Portugal.

Table 3: Forecast Error Variance Decomposition
EA Aggregates

years	GDP	CPI	STR	LTR	M1	M3	EER	useu
0	0.00	0.00	45.93	37.45	0.09	16.28	10.01	6.20
1	20.22	0.07	4.59	17.93	0.27	20.03	17.83	8.96
5	44.46	0.02	5.43	12.97	0.12	27.69	10.52	4.10

Table 4: Forecast Error Variance Decomposition

	Years	BG	FR	GE	IT	NL	ES	FI	GR	IE	PT
GDP	0	3.84	0.21	7.54	2.29	3.98	3.02	49.91	5.20	0.58	20.18
	1	14.37	17.96	2.95	12.98	15.82	15.29	54.81	4.21	1.21	25.08
	5	27.26	40.58	10.75	23.11	25.49	24.04	11.23	4.12	1.97	37.18
CPI	0	1.89	0.23	0.29	4.02	1.99	0.54	0.10	2.61	8.32	1.34
	1	4.35	1.53	0.04	7.51	4.86	0.73	1.18	4.78	20.28	6.61
	5	6.27	4.81	0.34	5.69	5.77	0.86	0.22	4.66	14.32	9.58
UR	0	0.26	1.10	0.10	19.64	23.68	7.34	-	-	-	-
	1	5.08	9.64	8.22	16.81	25.21	30.28	-	-	-	-
	5	20.01	28.91	27.76	4.74	38.52	43.12	-	-	-	-
C	0	9.89	19.81	3.17	26.54	4.57	7.66	-	-	-	-
	1	16.41	5.17	4.23	31.90	14.87	28.95	-	-	-	-
	5	30.35	12.12	11.17	35.59	18.74	50.09	-	-	-	-
I	0	2.30	0.05	3.87	0.20	1.96	4.47	-	-	-	-
	1	10.54	20.78	1.15	7.64	25.25	18.93	-	-	-	-
	5	16.30	47.32	4.97	18.76	30.73	24.05	-	-	-	
EER	0	11.69	16.56	7.17	0.16	13.30	5.48	-	-	-	-
	1	18.45	27.87	15.16	2.26	20.18	9.41	-	-	-	-
	5	15.89	29.77	10.93	0.82	19.82	3.41	-	-	-	-
LTR	0	27.11	28.37	12.16	45.25	14.18	40.90	-	-	-	-
	1	13.97	18.72	6.85	18.29	6.25	15.93	-	-	-	-
	5	15.85	19.37	4.91	7.79	3.23	13.38	-	-	-	-

BG = Belgium; FR = France; GE = Germany; IT = Italy; NL = Netherlands; ES = Spain; FI = Finland; GR = Greece; IE = Ireland; PT = Portugal.

Table 5: The effects of Euro

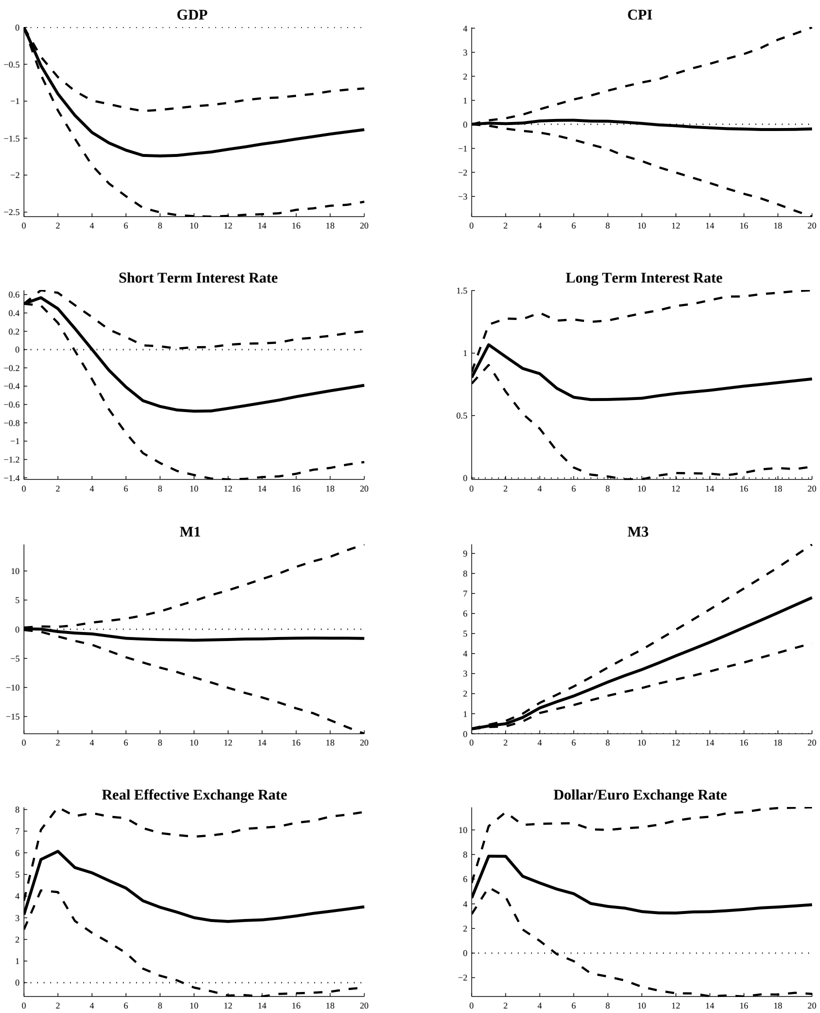
Descriptive Statistics

Country	GDP Growth Rate			CPI Growth Rate		
	83-98	99-08	83-08	83-98	99-08	83-08
Belgium	2.15	2.14	2.15	2.75	2.19	2.54
	1.4	1.32	1.36	1.87	0.99	1.61
France	2.06	2.01	2.04	3.28	1.9	2.75
	1.38	1.19	1.3	2.2	0.7	1.9
Germany	2.36	1.49	2.02	2.19	1.67	1.99
	1.64	1.48	1.63	1.48	0.69	1.26
Italy	2.08	1.21	1.74	5.79	2.4	4.49
	1.52	1.45	1.55	2.96	0.52	2.86
Netherlands	2.9	2.39	2.7	1.75	2.36	1.99
	1.37	1.58	1.47	1.13	1.15	1.17
Spain	2.87	3.39	3.07	5.88	3.16	4.83
	1.86	1.2	1.65	2.72	0.71	2.55
Finland	2.26	3.09	2.58	3.66	1.76	2.93
	3.48	1.67	2.93	2.35	1.09	2.17
Greece	1.56	3.96	2.48	13.31	3.29	9.45
	2.83	1.09	2.59	4.91	0.65	6.24
Ireland	4.96	5.38	5.12	3.6	3.3	3.48
	3.27	3.78	3.46	2.36	1.05	1.96
Portugal	3.07	1.52	2.47	9.99	2.85	7.24
	2.78	1.62	2.51	6.82	0.81	6.39
Euro Area	2.25	2.01	2.16	3.38	2.16	2.91
	1.27	1.23	1.26	1.58	0.57	1.42

For each country the first row is the average, and the second row is the standard deviation for yearly GDP growth rate, and yearly CPI inflation rate. For each variable the first column refer to the 1983-1998 sub-sample, the second column to the 1999-2008 subsample, and the third column to the the entire sample (1983-2008).

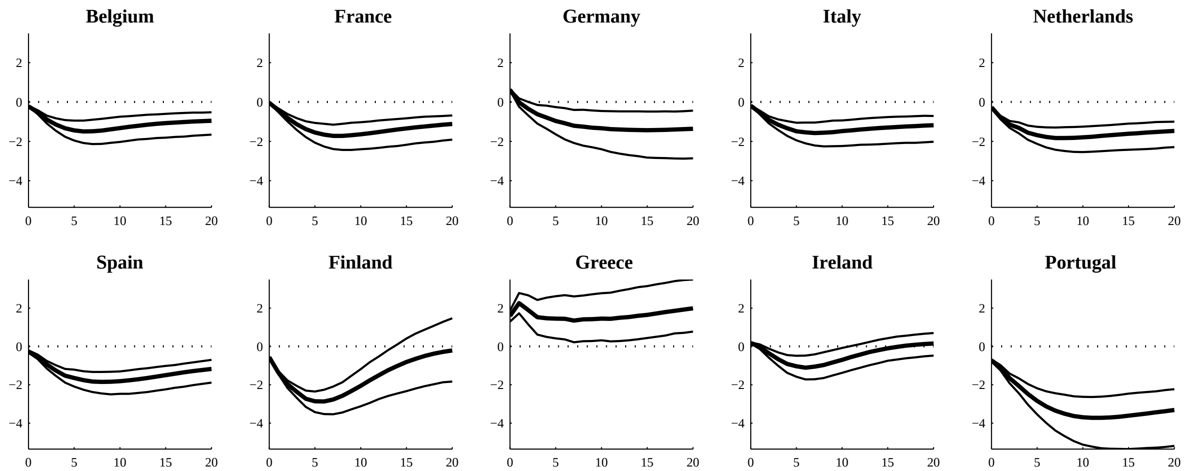
Figures

Figure 1: Impulse Responses to a Monetary Policy Shock
EA Aggregates



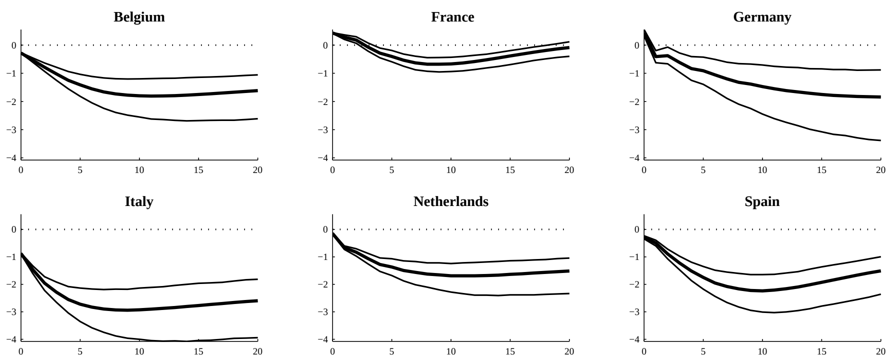
Solid line is the estimated impulse responses. Dashed lines are 68% bootstrap confidence band

Figure 2: Impulse Responses to a Monetary Policy Shock
Gross Domestic Product



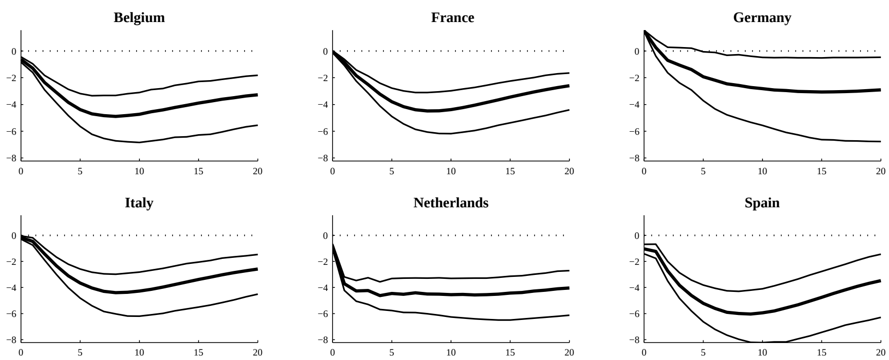
Solid line is the estimated impulse responses. Dashed lines are 68% bootstrap confidence band

Figure 3: Impulse Responses to a Monetary Policy Shock
Consumption



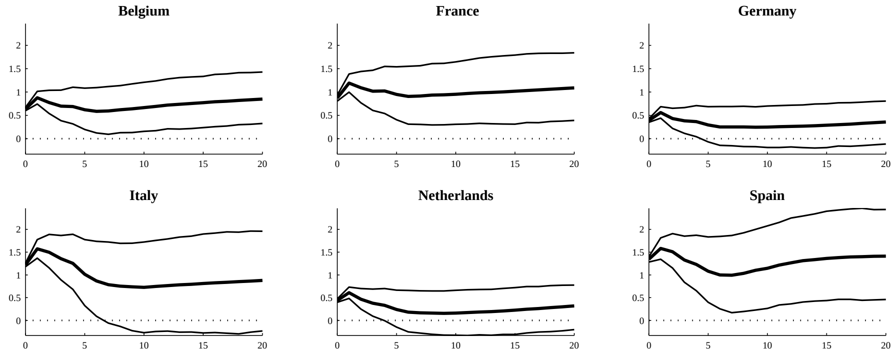
Solid line is the estimated impulse responses. Dashed lines are 68% bootstrap confidence band

Figure 4: Impulse Responses to a Monetary Policy Shock
Investment



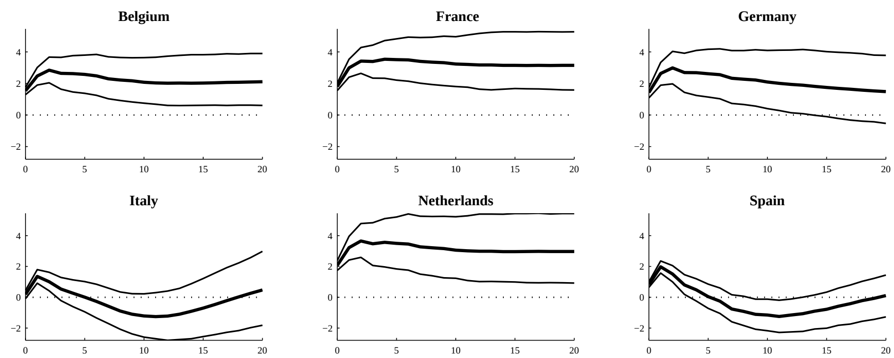
Solid line is the estimated impulse responses. Dashed lines are 68% bootstrap confidence band

Figure 5: Impulse Responses to a Monetary Policy Shock
Long Term Rate



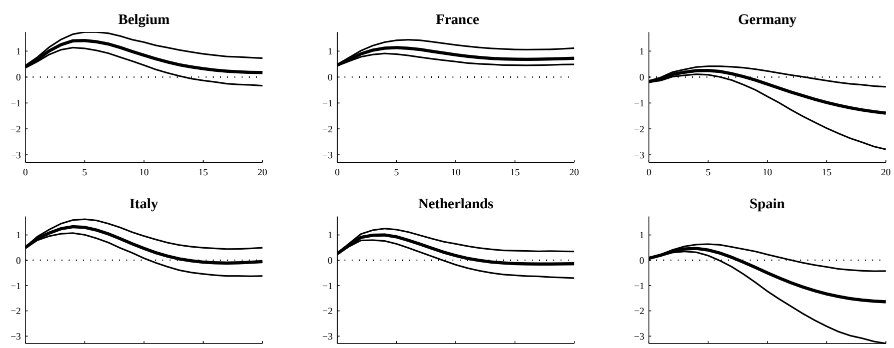
Solid line is the estimated impulse responses. Dashed lines are 68% bootstrap confidence band

Figure 6: Impulse Responses to a Monetary Policy Shock
Real Effective Exchange Rate



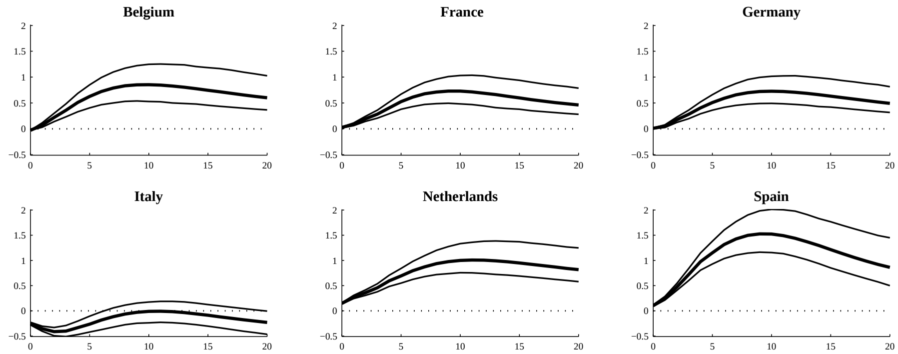
Solid line is the estimated impulse responses. Dashed lines are 68% bootstrap confidence band

Figure 7: Impulse Responses to a Monetary Policy Shock
Unit Labor Cost



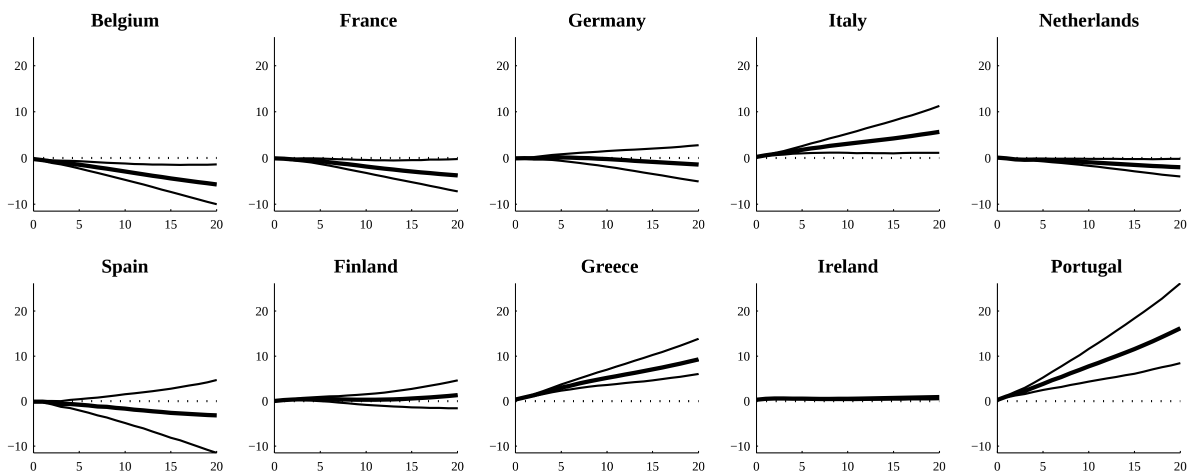
Solid line is the estimated impulse responses. Dashed lines are 68% bootstrap confidence band

Figure 8: Impulse Responses to a Monetary Policy Shock
Unemployment Rate



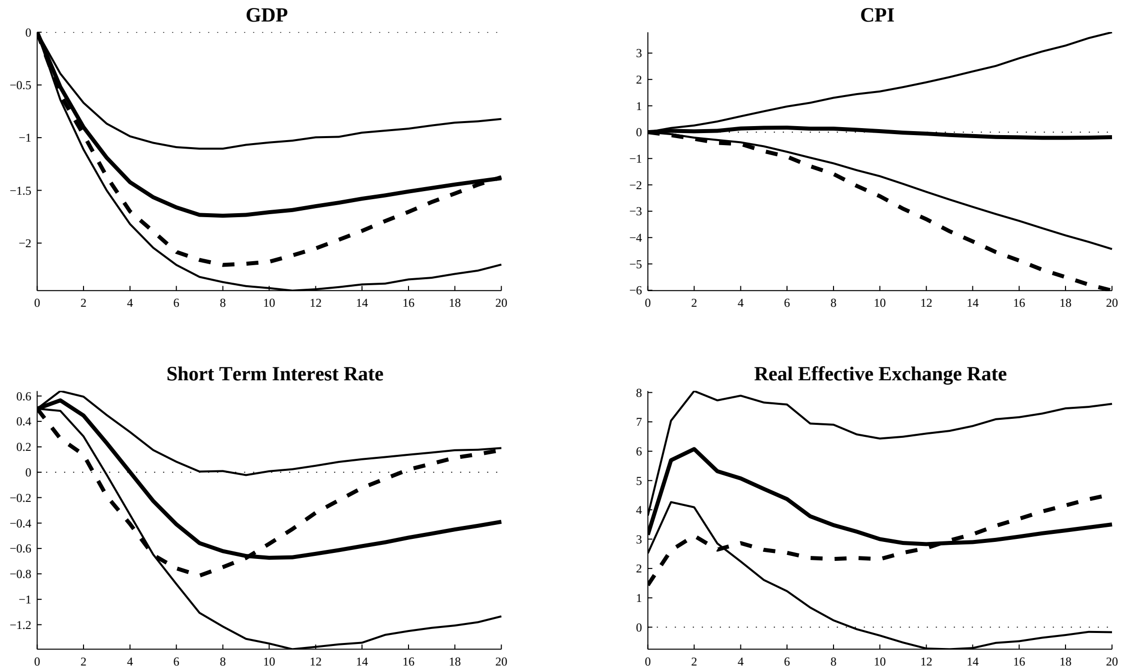
Solid line is the estimated impulse responses. Dashed lines are 68% bootstrap confidence band

Figure 9: Impulse Responses to a Monetary Policy Shock
Consumer Price Index



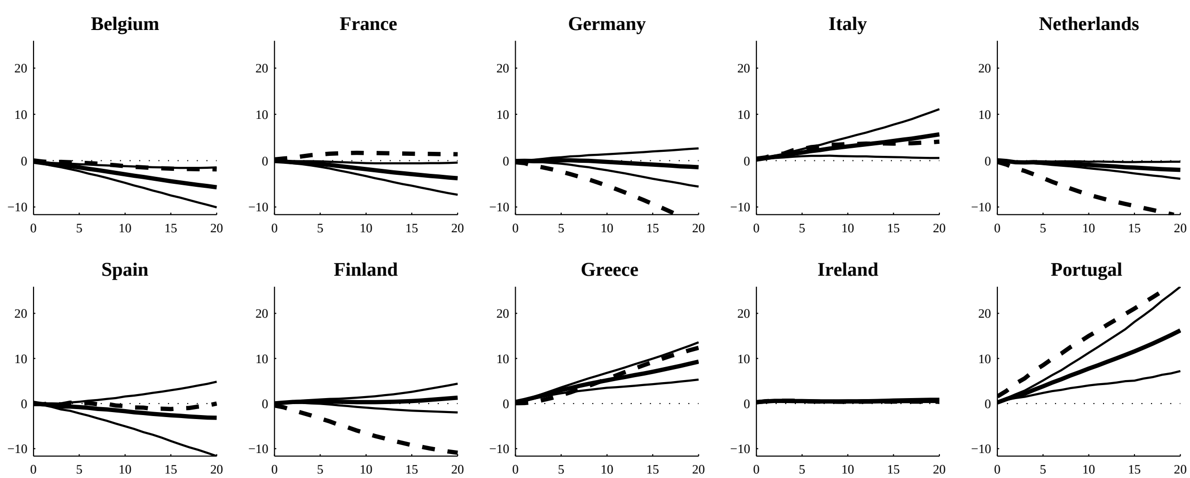
Solid line is the estimated impulse responses. Dashed lines are 68% bootstrap confidence band

Figure 10: The impact of the Euro
EA Aggregates



Solid thick lines and solid thin lines are, respectively, the estimated response, and 68% confidence band, obtained with the benchmark model. Dashed thick lines are the estimated responses on the Euro subsample.

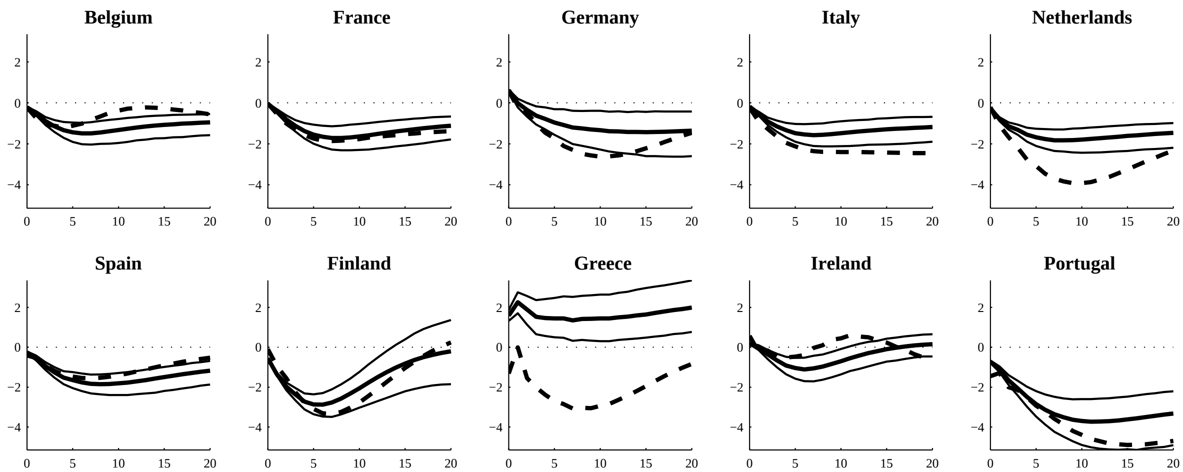
Figure 11: The impact of the Euro
Consumer Price Index



Solid thick lines and solid thin lines are, respectively, the estimated response, and 68% confidence band, obtained with the benchmark model. Dashed thick lines are the estimated responses on the Euro subsample.

Figure 12: The impact of the Euro

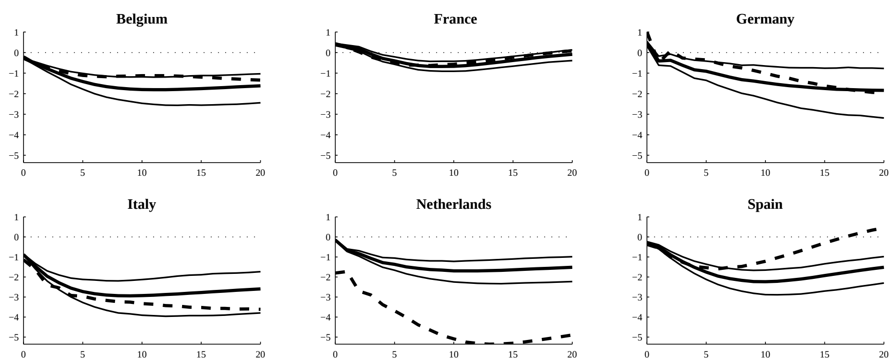
Gross Domestic Product



Solid thick lines and solid thin lines are, respectively, the estimated response, and 68% confidence band, obtained with the benchmark model. Dashed thick lines are the estimated responses on the Euro subsample.

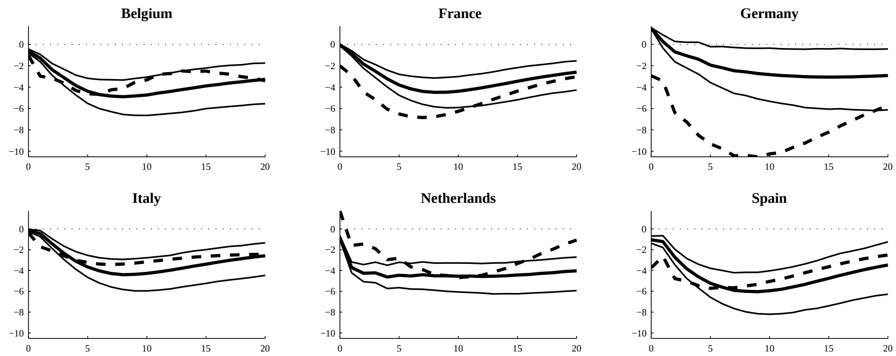
Figure 13: The impact of the Euro

Consumption



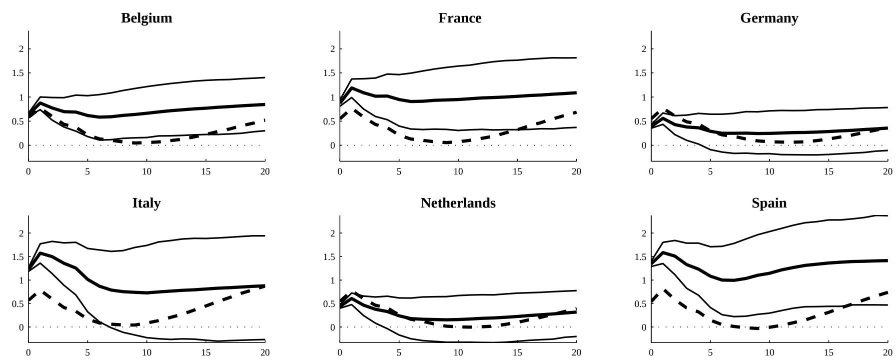
Solid thick lines and solid thin lines are, respectively, the estimated response, and 68% confidence band, obtained with the benchmark model. Dashed thick lines are the estimated responses on the Euro subsample.

Figure 14: The impact of the Euro
Investment



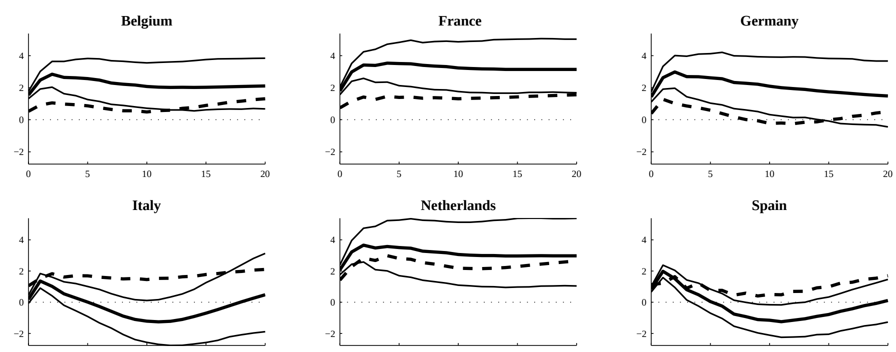
Solid thick lines and solid thin lines are, respectively, the estimated response, and 68% confidence band, obtained with the benchmark model. Dashed thick lines are the estimated responses on the Euro subsample.

Figure 15: The impact of the Euro
Long Term Rate



Solid thick lines and solid thin lines are, respectively, the estimated response, and 68% confidence band, obtained with the benchmark model. Dashed thick lines are the estimated responses on the Euro subsample.

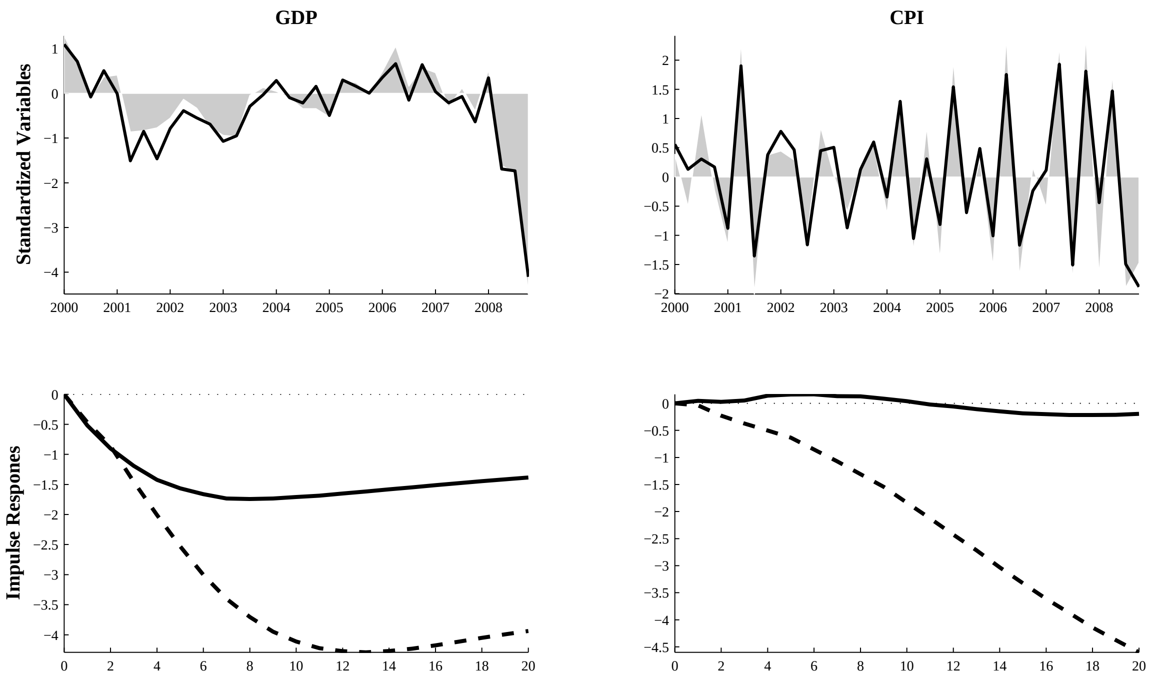
Figure 16: The impact of the Euro
Real Effective Exchange Rate



Solid thick lines and solid thin lines are, respectively, the estimated response, and 68% confidence band, obtained with the benchmark model. Dashed thick lines are the estimated responses on the Euro subsample.

Figure 17: Considering the Financial Crisis

EA Aggregates



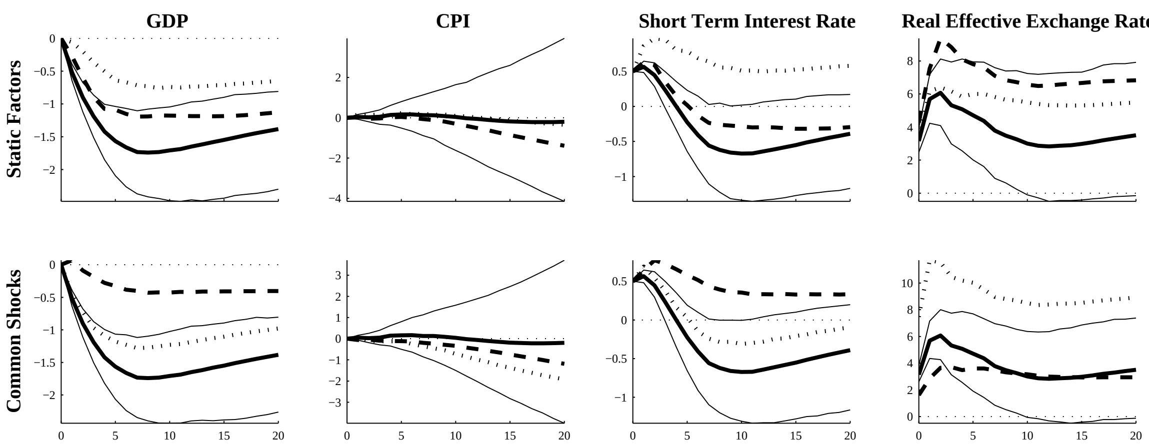
For the graphs in the first row, the shaded area is the standardized variable, while the thick line is the common component of each variable. For the graphs in the second row, solid line is estimated over the benchmark sample, while the dotted line is the impulse response estimated including also 2008 data.

Appendix A - Robustness Analysis

In this appendix we evaluate the robustness of our results with respect to the number of static factors, and the number of common shocks. The first row of figure 18 shows impulse responses for different number of static factors, while the second row shows impulse responses for different number of common shocks. A technical note on the estimation of the model when we allow for a different number of common shocks. In the benchmark specification, identification is achieved by selecting the rotation matrix $\mathbf{R}$ such that $\mathbf{B}_q(0)$ is lower triangular, where $\mathbf{B}_q(L)$ is the matrix of impulse responses of EA GDP, CPI, short term interest rate, and the real effective exchange rate. When we allow for a different number of common shocks we use exactly the same procedure except that when $q = 3$, $\mathbf{B}_q(L)$ is the matrix of impulse responses of EA GDP, CPI, and the short term interest rate only, while when $q = 5$ $\mathbf{B}_q(L)$ is the matrix of impulse responses of EA GDP, CPI, short term interest rate, M3, and the real effective exchange rate.

The conclusion of the robustness analysis is that impulse response are stable: in all cases, but a few exceptions, the estimated responses to a monetary policy shock lies within the confidence band of the benchmark model.

Figure 18: Robustness Analysis
EA Aggregates



For the first row, solid thick lines are the benchmark impulse responses, dotted thick lines are obtained with ten static factors, while dashed thick line are obtained with fourteen static factors. Solid thin lines are 68% bootstrap confidence band for the benchmark specification. For the second row, solid thick lines are the benchmark impulse responses, dotted thick lines are obtained with three common shocks, while dashed thick lines are obtained with five common shocks. Solid thin lines are 68% bootstrap confidence band for the benchmark specification

Appendix B - The euro area Dataset

Belgium

N	dsmnemonic	Variable	Source	Unit	F.	SA	T
1	BGOCFGDPD	GDP (REAL)	OEO	2004Mil€	Q	1	3
2	BGOCFPCND	PRIVATE CONSUMPTION EXPENDITURE (REAL)	OEO	2004Mil€	Q	1	3
3	BGOCFINVD	GFCF (REAL)	OEO	2004Mil€	Q	1	3
4	BGOCFEGSD	EXPORTS OF GOODS & SERVICES (REAL)	OEO	2004Mil€	Q	1	3
5	BGOCFIGSD	IMPORTS OF GOODS & SERVICES (REAL)	OEO	2004Mil€	Q	1	3
6	BGOCFDGDE	GDP - IPD	OEO	2004=100	Q	1	4
7	BGOCFDCNE	PRIVATE CONSUMPTION - IPD	OEO	2004=100	Q	1	4
8	BGOCFDINE	GROSS DOMESTIC FIXED CAPITAL FORMATION - IPD	OEO	2004=100	Q	1	4
9	BGOCFEPCE	EXPORTS OF GOODS AND SERVICES - IPD	OEO	2004=100	Q	1	4
10	BGOCFIPCE	IMPORTS OF GOODS & SERVICES - IPD	OEO	2004=100	Q	1	4
11	BGOSLI12O	PASSENGER CAR REGISTRATIONS	MEI	Thous.	M	1	3
12	BGOBS076Q	BTS: MANUFACTURING - CAPACITY UTILISATION JUDG-MENT	MEI	%	Q	1	2
13	BGOCFEMPO	EMPLOYMENT	OEO	Thous.	Q	1	3
14	BGOCFUNRQ	UNEMPLOYMENT RATE	OEO	%	Q	1	2
15	BGOULC..T	UNIT LABOUR COSTS - TOTAL (TREND)	MEI	2005=100	Q	0	3
16	BGOULCC.T	U.L.C. - CONSTRUCTION (ISIC F) (TREND)	MEI	2005=100	Q	0	3
17	BGOULCM.T	U.L.C. - MANUFACTURING (ISIC D) (TREND)	MEI	2005=100	Q	0	3
18	BGOULCS.T	U.L.C. - MARKET SERVICES (ISIC GK) (TREND)	MEI	2005=100	Q	0	3
19	BGOULCF.T	U.L.C. - FINANCIAL & BUSINESS SERVICES (ISIC JK)(TR)	MEI	2005=100	Q	0	3
20	BGOCC011	REAL EFFECTIVE EXCHANGE RATES	MEI	2005=100	M	0	3
21	BGOSLI15G	TOTAL RETAIL TRADE (VOLUME)	MEI	2005=100	M	1	3
22	BGOPP017F	PPI MANUFACTURED GOODS	MEI	2005=100	M	2	4
23	BGOCP049F	CPI - HARMONISED	MEI	2005=100	M	2	4
24	BGOCP042F	CPI All items non-food non-energy	MEI	2005=100	M	2	4
25	BGOCP041F	CPI Energy	MEI	2005=100	M	2	4
26	BGOCFISTR	INTEREST RATE - SHORT TERM	OEO	%	Q	0	2
27	BGOCFILTR	INTEREST RATE - LONG TERM	OEO	%	Q	0	2
28	BGOSP001F	BEL SHARE PRICES ALL SHARES †	MEI	2005=100	M	0	3
29	BGOLC007E	HOURLY EARNINGS MALES: INDUSTRY(DISC.)	MEI	2005=100	Q	1	3
30	BGM1....A	BG MONEY SUPPLY: M1 (EXCL. CURR IN CIRC.) CURN ‡	NCB	Mil€	M	2	4
31	BGM3....A	BG MONEY SUPPLY: M3 (EXCL. CURR IN CIRC.) CURN ‡	NCB	Mil€	M	2	4

† Series backdated by data in Eickmeier (2009)

‡ Series backdated by Eurostat "DS-070950 Former series for euro area countries on monetary aggregates and credit"

France

N	dsmnemonic	Variable	Source	Unit	F.	SA	T
32	FROCFGDPD	GDP (REAL)	OEO	2000Mil€	Q	1	3
33	FROCFPCND	PRIVATE CONSUMPTION EXPENDITURE (REAL)	OEO	2000Mil€	Q	1	3
34	FROCFINVD	GFCF (REAL)	OEO	2000Mil€	Q	1	3
35	FROEX003D	Government final consumption expenditure	MEI	2000Mil€chd	Q	1	3
36	FROCFEGSD	EXPORTS OF GOODS & SERVICES (REAL)	OEO	2000Mil€	Q	1	3
37	FROCFIGSD	IMPORTS OF GOODS & SERVICES (REAL)	OEO	2000Mil€	Q	1	3
38	FROCFDGDE	GDP - IPD	OEO	2005=100	Q	1	4
39	FROCFDCNE	PRIVATE CONSUMPTION - IPD	OEO	2005=100	Q	1	4
40	FROCFDINE	GROSS DOMESTIC FIXED CAPITAL FORMATION - IPD	OEO	2005=100	Q	1	4
41	FROCFEPCE	EXPORTS OF GOODS AND SERVICES - IPD	OEO	2005=100	Q	1	4
42	FROCFIPCE	IMPORTS OF GOODS & SERVICES - IPD	OEO	2005=100	Q	1	4
43	FROSLI05O	TOTAL CAR REGISTRATIONS	MEI	Thous.	M	1	3
44	FROBS076Q	BTS: MANUFACTURING - CAPACITY UTILISATION JUDGMENT	MEI	%	Q	1	2
45	FROCFEMPO	EMPLOYMENT	OEO	Thous.	Q	1	3
46	FROCFUNRQ	UNEMPLOYMENT RATE	OEO	%	Q	1	2
47	FROULC..T	UNIT LABOUR COSTS - TOTAL (TREND)	MEI	2005=100	Q	0	3
48	FROULCC.T	U.L.C. - CONSTRUCTION (ISIC F) (TREND)	MEI	2005=100	Q	0	3
49	FROULCM.T	U.L.C. - MANUFACTURING (ISIC D) (TREND)	MEI	2005=100	Q	0	3
50	FROULCS.T	U.L.C. - MARKET SERVICES (ISIC G K) (TREND)	MEI	2005=100	Q	0	3
51	FROULCF.T	U.L.C. - FINANCIAL & BUSINESS SERVICES (ISIC J K)(TR)	MEI	2005=100	Q	0	3
52	FROCC011	REAL EFFECTIVE EXCHANGE RATES	MEI	2005=100	M	0	3
53	FROSLI15G	TOTAL RETAIL TRADE (VOLUME)	MEI	2005=100	M	1	3
54	FROPP017F	PPI Manufactured products	MEI	2005=100	M	2	4
55	FROCP049F	CPI - HARMONISED	MEI	2005=100	M	2	4
56	FROCP042F	CPI NON FOOD NON ENERGY	MEI	2005=100	M	2	4
57	FROCP019F	CPI Food	MEI	2005=100	M	2	4
58	FROCP041F	CPI ENERGY	MEI	2005=100	M	2	4
59	FROCP054F	CPI Rent	MEI	2005=100	M	2	4
60	FROCFISTR	INTEREST RATE - SHORT TERM	OEO	%	Q	1	2
61	FROCFILTR	INTEREST RATE - LONG TERM	OEO	%	Q	1	2
62	FROSP001F	FRA SHARE PRICES SBF 250	MEI	2005=100	M	0	3
63	FROLC007E	HOURLY WAGE RATE: INDUSTRY(DISC.)	MEI	2005=100	Q	1	3
64	FRM1....A	MONEY SUPPLY - M1 (NATIONAL CONTRIBUTION TO M1)	NCB	Mil€	M	2	4
65	FRM3....A	MONEY SUPPLY - M3 (NATIONAL CONTRIBUTION TO M3)	NCB	Mil€	M	2	4

Germany

N	dsmnemonic	Variable	Source	Unit	F.	SA	T
66	BDOCFGDPD	GDP (REAL)	OEO	2000Mil€	Q	1	3
67	BDOCFPCND	PRIVATE CONSUMPTION EXPENDITURE (REAL)	OEO	2000Mil€	Q	1	3
68	BDOCFINVD	GFCF (REAL)	OEO	2000Mil€	Q	1	3
69	BDOEX003D	GOVERNMENT FINAL CONSUMPTION EXPENDITURE	MEI	2000Mil€chd	Q	1	3
70	BDOCFEGSD	EXPORTS OF GOODS & SERVICES (REAL)	OEO	2000Mil€	Q	1	3
71	BDOCFIGSD	IMPORTS OF GOODS & SERVICES (REAL)	OEO	2000Mil€	Q	1	3
72	BDOCFDGDE	GDP - IPD	OEO	2000=100	Q	1	4
73	BDOCFDCNE	PRIVATE CONSUMPTION - IPD	OEO	2000=100	Q	1	4
74	BDOCFDINE	GROSS DOMESTIC FIXED CAPITAL FORMATION - IPD	OEO	2000=100	Q	1	4
75	BDOCFEPCE	EXPORTS OF GOODS & SERVICES - IPD	OEO	2000=100	Q	1	4
76	BDOCFIPCE	IMPORTS OF GOODS & SERVICES - IPD	OEO	2000=100	Q	1	4
77	BDOSLI05O	TOTAL CAR REGISTRATIONS	MEI	Thous.	M	1	3
78	BDOBS076Q	BTS: MANUFACTURING - CAPACITY UTILISATION JUDGMENT	MEI	%	Q	1	2
79	BDOCFEMPO	EMPLOYMENT	OEO	Thous.	Q	1	3
80	BDOCFUNRQ	UNEMPLOYMENT RATE	OEO	%	Q	1	2
81	BDOULC..T	UNIT LABOUR COSTS - TOTAL (TREND)	MEI	2005=100	Q	0	3
82	BDOULCC.T	U.L.C. - CONSTRUCTION (ISIC F) (TREND)	MEI	2005=100	Q	0	3
83	BDOULCM.T	U.L.C. - MANUFACTURING (ISIC D) (TREND)	MEI	2005=100	Q	0	3
84	BDOULCS.T	U.L.C. - MARKET SERVICES (ISIC GK) (TREND)	MEI	2005=100	Q	0	3
85	BDOULCF.T	U.L.C. - FINANCIAL & BUSINESS SERVICES (ISIC JK)(TR)	MEI	2005=100	Q	0	3
86	BDOCC011	Real Effective Exchange Rate	MEI	2005=100	M	0	3
87	BDOSLI15G	TOTAL RETAIL TRADE (VOLUME)	MEI	2005=100	M	1	3
88	BDOPP017F	PPI Manufacturing Industry	MEI	2005=100	M	2	4
89	BDOCP049F	CPI - HARMONISED	MEI	2005=100	M	2	4
90	BDOCP042F	CPI Non-food non-energy	MEI	2005=100	M	2	4
91	BDOCP019F	CPI Food + alcohol-free drinks (excl rest) / Index publicati	MEI	2005=100	M	2	4
92	BDOCP041F	CPI - ENERGY (EXCL. GASOLINE BEFORE 1991)	MEI	2005=100	M	2	4
93	BDOCP053F	CPI Housing - rental services	MEI	2005=100	M	2	4
94	BDOCFISTR	INTEREST RATE - SHORT TERM	OEO	%	Q	1	2
95	BDOCFILTR	INTEREST RATE - LONG TERM	OEO	%	Q	1	2
96	BDOSP001F	SHARE PRICES CDAX	MEI	2005=100	M	0	3
97	BDOLC007E	HOURLY EARNINGS: MANUFACTURING	MEI	2005=100	Q	1	3
98	BDM1....A	MONEY SUPPLY - GERMAN CONTRIBUTION TO EURO M1	NCB	Bil€	M	2	4
99	BDM3....A	MONEY SUPPLY - GERMAN CONTRIBUTION TO EURO M3	NCB	Bil€	M	2	4

Italy

N	dsmnemonic	Variable	Source	Unit	F.	SA	T
100	ITOCFGDPD	GDP (REAL)	OEO	2000Mil€	Q	1	3
101	ITOCFPCND	PRIVATE CONSUMPTION EXPENDITURE (REAL)	OEO	2000Mil€	Q	1	3
102	ITOEX004D	GFCF	MEI	2000Mil€chd	Q	1	3
103	ITOEX003D	GOVERNMENT FINAL CONSUMPTION EXPENDITURE	MEI	2000Mil€chd	Q	1	3
104	ITOCFEGSD	EXPORTS OF GOODS & SERVICES (REAL)	OEO	2000Mil€	Q	1	3
105	ITOCFIGSD	IMPORTS OF GOODS & SERVICES (REAL)	OEO	2000Mil€	Q	1	3
106	ITOCFDGDE	GDP - IPD	OEO	2000=100	Q	1	4
107	ITOCFDINE	GROSS DOMESTIC FIXED CAPITAL FORMATION - IPD	OEO	2000=100	Q	1	4
108	ITOCFDCNE	PRIVATE CONSUMPTION - IPD	OEO	2000=100	Q	1	4
109	ITOCFEPCE	EXPORTS OF GOODS & SERVICES - IPD	OEO	2000=100	Q	1	4
110	ITOCFIPCE	IMPORTS OF GOODS & SERVICES - IPD	OEO	2000=100	Q	1	4
111	ITOSLI05O	TOTAL CAR REGISTRATIONS	MEI	Thous.	M	1	3
112	ITOBS076Q	BTS: MANUFACTURING - CAPACITY UTILISATION JUDGMENT	MEI	%	Q	1	2
113	ITOCFEMPO	EMPLOYMENT	OEO	Thous.	Q	1	3
114	ITOCFUNRQ	UNEMPLOYMENT RATE	OEO	%	Q	1	2
115	ITOULC..T	UNIT LABOUR COSTS - TOTAL (TREND)	MEI	2005=100	Q	0	3
116	ITOULCC.T	U.L.C. - CONSTRUCTION (ISIC F) (TREND)	MEI	2005=100	Q	0	3
117	ITOULCM.T	U.L.C. - MANUFACTURING (ISIC D) (TREND)	MEI	2005=100	Q	0	3
118	ITOULCS.T	U.L.C. - MARKET SERVICES (ISIC GK) (TREND)	MEI	2005=100	Q	0	3
119	ITOULCF.T	U.L.C. - FINANCIAL & BUSINESS SERVICES (ISIC JK)(TR)	MEI	2005=100	Q	0	3
120	ITOCC011	REAL EFFECTIVE EXCHANGE RATE - CPI BASED	MEI	2005=100	M	0	3
121	ITRETTOTF	IT RETAIL SALES NADJ	X	X	M	2	3
122	ITOPP017F	PPI(DISC.)	MEI	2005=100	M	2	4
123	ITOCP049F	CPI - HARMONISED	MEI	2005=100	M	2	4
124	ITOCP042F	CPI - EXCLUDING FOOD & ENERGY	MEI	2005=100	M	2	4
125	ITOCP019F	CPI - FOOD	MEI	2005=100	M	2	4
126	ITOCP041F	CPI - ENERGY	MEI	2005=100	M	2	4
127	ITOCP057F	CPI - HOUSING	MEI	2005=100	M	2	4
128	ITOCFISTR	INTEREST RATE - SHORT TERM: 3 MONTH EURIBOR	OEO	%	Q	0	2
129	ITOCFILTR	INTEREST RATE - LONG TERM: 10 YR TREASURY BONDS	OEO	%	Q	0	2
130	ITOSP001F	SHARE PRICES - ISE MIB STORICO	MEI	2005=100	M	0	3
131	ITOLC007E	HOURLY WAGE RATE : INDUSTRY(DISC.)	MEI	2005=100	M	1	3
132	ITM1....A	MONEY SUPPLY: M1 - ITALIAN CONTRIBUTION TO EURO M1	NCB	Mil€	M	2	4
133	ITM3....A	MONEY SUPPLY: M3 - ITALIAN CONTRIBUTION TO EURO M3	NCB	Mil€	M	2	4

Netherlands

N	dsmnemonic	Variable	Source	Unit	F.	SA	T
134	NLOCFGDPD	GDP (REAL)	OEO	2001Mil€	Q	1	3
135	NLOCFPCND	PRIVATE CONSUMPTION EXPENDITURE (REAL)	OEO	2001Mil€	Q	1	3
136	NLOCFINVD	GFCF (REAL)	OEO	2001Mil€	Q	1	3
137	NLOCFEGSD	EXPORTS OF GOODS & SERVICES (REAL)	OEO	2001Mil€	Q	1	3
138	NLOCFIGSD	IMPORTS OF GOODS & SERVICES (REAL)	OEO	2001Mil€	Q	1	3
139	NLOCFDGDE	GDP - IPD	OEO	2001=100	Q	1	4
140	NLOCFDCNE	PRIVATE CONSUMPTION - IPD	OEO	2001=100	Q	1	4
141	NLOCFDINE	GROSS DOMESTIC FIXED CAPITAL FORMATION - IPD	OEO	2001=100	Q	1	4
142	NLOCFEPCE	EXPORTS OF GOODS & SERVICES - IPD	OEO	2001=100	Q	1	4
143	NLOCFIPCE	IMPORTS OF GOODS & SERVICES - IPD	OEO	2001=100	Q	1	4
144	NLOSLI12O	PASSENGER CAR REGISTRATIONS	MEI	Thous.	M	1	3
145	NLOBS076Q	BTS: MANUFACTURING - CAPACITY UTILISATION JUDGMENT	MEI	%	Q	1	2
146	NLOCFEMPO	EMPLOYMENT	OEO	Thous.	Q	1	3
147	NLOCFUNRQ	UNEMPLOYMENT RATE	OEO	%	Q	1	2
148	NLOULC..T	U.L.C. - TOTAL (TREND)	MEI	2005=100	Q	0	3
149	NLOULCC.T	U.L.C. - CONSTRUCTION (ISIC F) (TREND)	MEI	2005=100	Q	0	3
150	NLOULCM.T	U.L.C. - MANUFACTURING (ISIC D) (TREND)	MEI	2005=100	Q	0	3
151	NLOULCS.T	U.L.C. - MARKET SERVICES (ISIC GK) (TREND)	MEI	2005=100	Q	0	3
152	NLOULCF.T	U.L.C. - FINANCIAL & BUSINESS SERVICES (ISIC JK)(TR)	MEI	2005=100	Q	0	3
153	NLOCC011	REAL EFFECTIVE EXCHANGE RATES	MEI	2005=100	M	0	3
154	NLOSLI15G	TOTAL RETAIL TRADE (VOLUME)	MEI	2005=100	M	1	3
155	NLOPP017F	PPI MANUFACTURING	MEI	2005=100	M	2	4
156	NLOCP049F	CPI - HARMONISED	MEI	2005=100	M	2	4
157	NLOCP042F	CPI ALL ITEMS NON FOOD-NON ENERGY	MEI	2005=100	M	2	4
158	NLOCP019F	CPI FOOD	MEI	2005=100	M	2	4
159	NLOCP041F	CPI ENERGY	MEI	2005=100	M	2	4
160	NLOCP053F	CPI RENT INCL. IMPUTED RENT	MEI	2005=100	M	2	4
161	NLOCFISTR	INTEREST RATE - SHORT TERM	OEO	%	Q	0	2
162	NLOCFILTR	INTEREST RATE - LONG TERM	OEO	%	Q	0	2
163	NLOSP001F	SHARE PRICES ALL SHARES INDEX	MEI	2005=100	M	0	3
164	NLOLC007E	HOURLY WAGE RATE MANUFACTURING(DISC.)	MEI	2005=100	M	1	3
165	NLM1....A	MONEY SUPPLY - M1	NCB	Mil€	M	2	4
166	NLM3....A	MONEY SUPPLY - M3	NCB	Mil€	M	2	4

Spain

N	dsmnemonic	Variable	Source	Unit	F.	SA	T
167	ESOCFGDPD	GDP (REAL)	OEO	2000Mil€	Q	1	3
168	ESOCFPCND	PRIVATE CONSUMPTION EXPENDITURE (REAL)	OEO	2000Mil€	Q	1	3
169	ESOCFINVD	GFCF (REAL)	OEO	2000Mil€	Q	1	3
170	ESOCFEGSD	EXPORTS OF GOODS & SERVICES (REAL)	OEO	2000Mil€	Q	1	3
171	ESOCFIGSD	IMPORTS OF GOODS & SERVICES (REAL)	OEO	2000Mil€	Q	1	3
172	ESOCFDGDE	GDP - IPD	OEO	2000=100	Q	1	4
173	ESOCFDCNE	PRIVATE CONSUMPTION - IPD	OEO	2000=100	Q	1	4
174	ESOCFDINE	GROSS DOMESTIC FIXED CAPITAL FORMATION - IPD	OEO	2000=100	Q	1	4
175	ESOCFEPCE	EXPORTS OF GOODS & SERVICES - IPD	OEO	2000=100	Q	1	4
176	ESOCFIPCE	IMPORTS OF GOODS & SERVICES - IPD	OEO	2000=100	Q	1	4
177	ESOSLI12O	PASSENGER CAR REGISTRATIONS	MEI	Thous.	M	1	3
178	ESOBS076Q	BTS: MANUFACTURING - CAPACITY UTILISATION JUDGMENT	MEI	%	Q	1	2
179	ESOCFEMPO	EMPLOYMENT	OEO	Thous.	Q	1	3
180	ESOCFUNRQ	UNEMPLOYMENT RATE	OEO	%	Q	1	2
181	ESOULC..T	UNIT LABOUR COSTS - TOTAL (TREND)	MEI	2005=100	Q	0	3
182	ESOULCC.T	U.L.C. - CONSTRUCTION (ISIC F) (TREND)	MEI	2005=100	Q	0	3
183	ESOULCM.T	U.L.C. - MANUFACTURING (ISIC D) (TREND)	MEI	2005=100	Q	0	3
184	ESOULCS.T	U.L.C. - MARKET SERVICES (ISIC GK) (TREND)	MEI	2005=100	Q	0	3
185	ESOULCF.T	U.L.C. - FINANCIAL & BUSINESS SERVICES (ISIC JK)(TR)	MEI	2005=100	Q	0	3
186	ESOCC011	REAL EFFECTIVE EXCHANGE RATES	MEI	2005=100	M	0	3
187	ESOPP017F	PPI Manufacturing - proxy PPI All Items	MEI	2005=100	M	2	4
188	ESOCP049F	CPI - HARMONISED	MEI	2005=100	M	2	4
189	ESOCP042F	CPI/NONFOOD/NONENERGY	MEI	2005=100	M	2	4
190	ESCPFDTBF	ES CPI - FOOD AND NON-ALCOHOLIC BEVERAGES NADJ	X	2006=100	M	2	3
191	ESOCP041F	CPI ENERGY	MEI	2005=100	M	2	4
192	ESOCP057F	CPI RENT	MEI	2005=100	M	2	4
193	ESOCFISTR	INTEREST RATE - SHORT TERM	OEO	%	Q	0	2
194	ESOCFILTR	INTEREST RATE - LONG TERM	OEO	%	Q	0	2
195	ESSHRPRCF	MADRID S.E - GENERAL INDEX	MEH	31/12/85=100	M	0	3
196	ESOLC007E	HOURLY EARNINGS: INDUSTRY EXCL. CONSTRUCTION(DISC.)	MEI	2005=100	Q	1	3
197	ESM1....A	MONEY SUPPLY: M1 - SPANISH CONTRIBUTION TO EURO M1 †	NCB	Mil€	M	2	4
198	ESM3....A	MONEY SUPPLY: M3 - SPANISH CONTRIBUTION TO EURO M3 †	NCB	Mil€	M	2	4

† Series backdated by Eurostat "DS-070950 Former series for euro area countries on monetary aggregates and credit"

Other Countries

N	Country	dsmnemonic	Variable	Source	Unit	Freq.	SA	T
199		FNOCFGDPD	GDP (REAL)	OEO	2000Mil€	Q	1	3
200	Finland	FNOCP049F	CPI - HARMONISED	MEI	2005=100	M	2	4
201		FNOCFISTR	INTEREST RATE - SHORT TERM	OEO	Percentage	Q	0	2
202		FNOCFILTR	INTEREST RATE - LONG TERM	OEO	Percentage	Q	0	2
203		GROCFGDPD	GDP (REAL)	OEO	1995Mil€	Q	1	3
204	Greece	GROCP049F	CPI - HARMONISE	MEI	2005=100	M	2	4
205		GROCFISTR	INTEREST RATE - SHORT TERM	OEO	Percentage	Q	0	2
206		IROCFGDPD	GDP (REAL)	OEO	2004Mil€	Q	1	3
207	Ireland	IROCP049F	CPI - HARMONISED	MEI	2005=100	M	2	2
208		IRI60B..	MONEY MARKET RATE	IFS	Percentage	M	0	2
209		IROCFILTR	INTEREST RATE - LONG TERM	OEO	Percentage	Q	0	2
210	Luxembourg	LXOCFGDPD	GDP (REAL)	OEO	2000Mil€	Q	1	3
211		LXOCP049F	CPI - HARMONISED	MEI	2005=100	M	2	4
212		PTOCFGDPD	GDP (REAL)	OEO	2000Mil€	Q	1	3
213	Portugal	PTOCP049F	CPI - HARMONISED	MEI	2005=100	M	2	4
214		PTOCFISTR	INTEREST RATE - SHORT TERM	OEO	Percentage	Q	0	2
215		PTOCFILTR	INTEREST RATE - LONG TERM	OEO	Percentage	Q	0	2
216		UKOCFGDPD	GDP (REAL)	OEO	2003Mil.£	Q	1	3
217	United	UKOCP049F	CPI - HARMONISED	MEI	2005=100	M	2	4
218	Kingdom	UKOCFISTR	INTEREST RATE - SHORT-TERM	OEO	Percentage	Q	0	2
219		UKOCFILTR	INTEREST RATE - LONG-TERM	OEO	Percentage	Q	0	2
220		JPOCFGDPD	GDP (REAL)	OEO	2000Mil¥	Q	1	3
221	Japan	JPCPIGLAF	CPI: GENERAL	MIAC	2005=100	M	2	4
222		JPOCFISTR	INTEREST RATE - SHORT TERM	OEO	Percentage	Q	0	2
223		JPOCFILTR	INTEREST RATE - LONG TERM	OEO	Percentage	Q	0	2
224		USOCFGDPD	GDP (REAL)	OEO	2000Mil$	Q	1	3
225	United	USOCP009F	CPI ALL ITEMS	MEI	2005=100	M	2	4
226	States	USOCFISTR	INTEREST RATE - SHORT-TERM	OEO	Percentage	Q	0	2
227		USOCFILTR	INTEREST RATE - LONG-TERM	OEO	Percentage	Q	0	2
228		EAESNGDPD	GDP †	EUR	Bil€2000chd	Q	1	3
229		EMCP....F	CPI (DS CALCULATED BEFORE 1990 HARMONISED)	EUR	2005=100	M	2	4
230	Euro	EMESEFI3R	3-MONTH INTEREST RATES (AVERAGE) †	EUR	Percentage	M	0	2
231	Area	EMESEFIGR	LONG TERM GOVERNMENT BOND YIELDS †	EUR	Percentage	M	0	2
232		EKEBLBCSE	UNIT LABOUR COSTS - TOTAL ECONOMY †	ECB	2000=100	Q	1	3
233		EMECBM1.A	MONEY SUPPLY: M1 (EP)	ECB	Bil€	M	2	4
234		EMECBM3.A	MONEY SUPPLY: M3 (EP)	ECB	Bil€	M	2	4
235		EMECBEXGR	REAL EFFECTIVE EXCHANGE RATE †	ECB	1990=100	Q	0	3
236	World	USESXECU	US DOLLAR TO ECU (MEAN)	EUR	$/€	M	0	3
237		UKI76AAZA	MARKET PRICE - UK BRENT	IFS	$	M	0	3

† Series backdated by using the AWM database data

List of Abbreviations

Source		Transformations		Seasonally Adjustement	
NCB -	National Central Bank	1	none	0	Not Seasonally Adjusted
MEI	OECD Main Economic Indicators	2	Δ	1	Seasonally Adjusted
OEO	OECD Economic Outlook	3	$\Delta \log$	2	SA with dummy variables regression
ECB	European Central Bank	4	$\Delta\Delta \log$		
IFS	IMF International Financial Statistics	5	log		
EUR	Eurostat				
MEH	Ministerio de Economia y Hacienda				
MIAC	Ministry of Internal Affairs and Communications				