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An Empirical Analysis of Fluctuations in Economic Efficiency in European Countries*

Meltem Gülenay Chadwick†

Abstract

This paper analyses fluctuations in the economic efficiency in 15 European countries over more than a period of three decades, between 1970s and 2000s, using movements in the wedge between the marginal rate of substitution between leisure and consumption, and the marginal product of labour as a measure of economic efficiency. The time series measures of economic efficiency constructed for each country reveals that there have been periods of considerable welfare fluctuations in many European countries over this sample and that these movements are associated with cross-correlations to other countries. Furthermore, the results indicate considerable effects of identified monetary shocks in some countries for the within country welfare fluctuations, as well as cross-border welfare fluctuations. In addition, for the years studied, it has been observed that the European countries are far behind from having a common fluctuation within the framework of monetary policy shocks related to output, consumer prices and the exchange rates. The monetary policy shocks of 15 countries are dominated by their own policy cycles.

Keywords: economic efficiency; welfare gap; monetary policy shocks; Bayesian dynamic factor model

JEL Code: C11, E32, E52, F44

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1 Introduction

How does the economic efficiency behave in major European countries over the course of business cycles? Are there specific patterns in the movements of the economic efficiency across different countries? Is there any role of monetary shocks in explaining these variations? In line with these questions, this paper analyzes the business cycle properties of individual European countries, with a special focus on fluctuations of the economic efficiency over the course of last four decades. One issue that underlines the importance of this work is that the quantification of welfare costs of business cycles as well as their potential causes in European countries is quite an under investigated area. However, such an analysis has important implications for questions such as whether there has been potential gains from the establishment of European Monetary Union (EMU), or whether there has been a rationale for conducting a European Monetary Policy following a so-called German Dominance. In addition to that, we examined the level of integration among EMU countries, using a Bayesian dynamic factor model to see if there exists a common or global component that drives the monetary policy shocks of the countries in question.

For countries which have either been involved in or have potential to be involved in a more centrally determined stabilization policy, the analysis of the comovements of the economic variables in business cycle frequencies is an important issue. This importance arises mainly because the potential gains from economic cooperation across countries relies on whether these economies have tendency to show similar responses to the changes in the economic environment. For instance, in order to extract the potential benefits of policy coordination in the monetary policy design, it may be one of the most important ingredients for obtaining plausible economic outcomes to have similar responses in each member country to monetary shocks.

As far as the stabilization policy in Europe is concerned, the analysis of the potential gains from policy coordination becomes much more important. For some of the countries in our sample, the question is whether there were potential gains to be realized from the short term macroeconomic policies from the establishment of EMU, whereas for the other group of countries, it is important to answer whether there are potential gains from policy coordination through abandoning their own currencies and replacing it by Euro. Therefore, the results of this study may further be used as part of debates on whether the monetary union was a sound step for the current member countries as well as whether entering EMU is desirable for the non-member countries such as United Kingdom, Norway, Sweden or Denmark.

The attempts to identify the existence and the causes of a European business cycle have been made in couple of studies. For instance, Artis and Zhang (1997), Artis et al. (1997) and Artis and Zhang (1999) document the increase in the output correlations across European countries in 1980s and 1990s. The basic idea illustrated in these studies is that the launch of Exchange Rate Mechanism (ERM) in late 1970s has led to higher output comovements due to higher trade and financial links. In particular, they compare how the output correlations of European countries with both United States and Germany evolved over time, and conclude that there has been a tendency for a shift towards a more correlated pattern with Germany. On the other hand, for individual European countries, the analysis of fluctuation of economic efficiency over the business cycles has not been analyzed, and this creates a great motivation for this study. Considering the economic agents' aversion to the fluctuations in economic activity as one of the basic foundations of the business cycle analysis, it may be more appropriate, or at least a complementary attempt to existing literature on business cycles in Europe, to analyze the welfare fluctuations associated with business cycles in Europe.

The analysis considered in this paper relies on the construction of the time series measures for the variations in the economic efficiency for 15 European countries. Following the recent measure proposed by Gali et al. (2007), the time series measures of movements in the economic efficiency for each European Country using the households' leisure-labor trade-off.

As shown by Gali et al. (2007), the movements in this measure has a perfect negative correlation with the movements of price markups over the social marginal cost. On the other hand, the quantification of this measure using the wage or unit labor costs may be infeasible or misleading in the economies where the observed wage rate do not reflect changes in the labor market conditions. At this point, it is important to note that the working of labor markets in most European countries is far from perfectly competitive markets. As emphasized by Nickell (1997), the labor market frictions in Europe is quite prevalent due to the factors like unemployment benefit schemes or the wage bargaining process. These factors potentially lead to a case where the wages may not reflect to the changes in the economic developments. Despite the intensive efforts to increase labor market flexibility in most European countries in last two decades, the outcome is still far from the ideal. Therefore, such frictions make it appropriate to use the methodology followed in this paper.

Apart from analyzing the comovements of business cycles using the new gap series between and within the European countries, an interesting question is how the welfare cost of business cycle in a particular country responds to the monetary shocks of that country as well as the monetary shocks in other countries. Mainly due to the fact that the prices and the wages fail to adjust instantly as a response to changes in the economic conditions, the price and wage mark-ups may fluctuate over time. As shown by Gali et al. (2007), these fluctuations can be used as the basis of a measure for welfare cost of business cycles. To the extend that the prices and wages show a sluggish adjustment as a response to nominal shocks, one may expect that the monetary shocks will cause inefficient economic fluctuations. Identifying the sources of these fluctuations, however, can be important both from the theoretical point of view and as a matter of interest from policy making point of view in order to decrease the degree of these costs.

The within country and cross country responses of the constructed gap series to the monetary shocks can be viewed as a further evidence on whether the nominal shocks lead to movements in the economic efficiency. In this sense, the results of this study are similar to the results of Gali et al. (2007) and may be viewed as supportive of the idea that the movements in the economic efficiency are not exogenous using data from 15 European countries, which can be further associated with important policy implications. However, the key contribution of this study is two folds; first, to observe the efficiency fluctuations in major European countries and examine if they tend to move together, and second to analyze to what extent the countries are integrated by extracting a common component using their identified monetary policy shocks.

This study is constructed as follows: Section 2 gives the basic rationale behind using the methodology that we follow in quantifying the changes in the efficiency costs of the economic fluctuations. Section 2 also provides the detailed steps for the construction of the efficiency cost measure for each country, as well as the observed patterns in the movement of this variable across countries. Section 3 briefly discusses the potential links between the exogenous movements in the monetary policy and the variations in the economic efficiency. Section 4 discusses the econometric issues in identifying the monetary shocks for each country and for estimating the link between the monetary policy shocks and the measures of economic efficiency. Section 5 introduces the Bayesian dynamic factor model for evaluating the common components of EMU countries. Section 6 gives a brief idea on the level of integration between the countries used in the study with the help of the results used in section 5 and a variance decomposition methodology, while discussing the policy implications of the results found for European countries. Section 7 presents the concluding remarks.

2 The Welfare Gap

In order to understand the empirical results, it is essential to present the basics of methodology that we follow in quantifying the changes in the efficiency costs of the economic fluctuations. In a frictionless economy, the equilibrium requires that marginal rate of substitution between labor and leisure must be equal to the marginal product of labor, and the real wage corresponding to the equilibrium must be clearing the labor market. However, the equalities that clear the equilibrium hold as an approximation in an economy characterized by imperfect competition both in the labor and good markets. Instead, the equilibrium condition in the labor market requires the mark-ups in the prices and wages set by firms and workers respectively. If these mark-ups are constant, the equilibrium requires proportionality of marginal rate of substitution between labor and consumption, the marginal product of labor and the real wages. As a result, we have the following relationship, where C, L, N and K represent the consumption, leisure, labor and capital respectively.

$$\frac{U_2(C_t, L_t)}{U_1(C_t, L_t)} = F_2(K_t, N_t) = \frac{W_t}{P_t} \tag{1}$$

However, a variety of factors - such as nature of the unemployment benefits scheme, income tax structure, market power on labor and the goods market and the labor market regulations governing unionization, the minimum wages and the fringe benefits- may affect the institutional structure of the labor market in a way that the economy may face periods of deviations from this equilibrium condition as a response to exogenous changes. These movements correspond to the fluctuations in the economic welfare. In an economy characterized by the market power in both labor and the goods markets, the variations in the wedge between the marginal rate of substitution between labor and leisure and the marginal product of labor correspond to the measure of variations in economic efficiency, which shows how the distance between welfare associated with the first best outcome and the welfare associated with current economic outcome varies over time. This point has recently been shown by Gali et al. (2007). Following this point, we construct our welfare gap measure as the difference between the logarithm of marginal rate of substitution between leisure and consumption and the logarithm of marginal product of labor, denoted by MRS_t and MPN_t respectively.

In the absence of frictions, welfare gap would always be equal to zero, as the ratio of MPN_t and MRS_t would be equal to 1. However, as recently been emphasized by Mulligan (2002), number of economic factors may create a wedge between MRS_t and MPN_t. These factor themselves may be invariant at the business cycle frequencies. However, due to their existence, MRS_t and MPN_t may display fluctuations, the magnitude of which may be important in the analysis of business cycle fluctuations. As a result, we may observe fluctuations in the welfare around zero due to the fluctuations in MPN_t and MRS_t. These fluctuations, which are denoted by $\widetilde{gap}_t$ can simply be given as:

$$\widetilde{gap}_t = \widetilde{mpn}_t - \widetilde{mrs} \tag{2}$$

where $\widetilde{gap}_t$ gives the percentage deviation of ratio of MPN_t to MRS_t from its steady state value.

As shown by Gali et al. (2007), there is a one to one correspondence between the movements between the efficiency gap and the sum of wage and price mark-ups. As a result, the efficiency gap displays fluctuations around its steady state value due to the fluctuations of wage and price markups, which may be associated with sluggish adjustment of prices and wages to exogenous shocks. Therefore, to the extent that there are nominal rigidities in the economy, the efficiency gap is expected to vary with nominal shocks.

2.1 The Empirical Measure of the Welfare Gap for the European Countries

It has been documented in a number of studies in literature that the structure of the labor markets in Europe is quite apart from the case of competitive markets. For instance, a big proportion of the work force in most European countries is subject to collective bargaining in the wage and compensation process due to widespread unionization. In addition, the unemployment benefit system in most countries are quite generous, as a result of which there may be long-lasting inefficient fluctuations in employment following some exogenous shocks. One side effect of the labor market structure is that the real wage rigidity in Europe is quite high.[1] On the other hand, a more important issue is that the reported wage data may fail to allocate resources efficiently in an economy

[1] See Nickell (1997).

with such distortions. Therefore, the construction of a proper measure of welfare fluctuations in Europe require us to use a measure that does not directly rely on the wage series. This makes the measure mentioned in previous section an appropriate one for such an analysis.

The quantification of the variations in the welfare depends on three main factors. These main factors are the functional forms of technology and the preferences, the parameters underlying the economic fundamentals and the filtering method respectively. Concerning these points, a wide range of filters, functional forms and parameters have been used, which are consistent with business cycle literature. The plausibility of these points in terms of their compatibility to the theoretical implications and the empirical evidence is key for the validity of the constructed series as measures representing the variations in welfare effects of business cycles both quantitatively and qualitatively.

For the baseline scenario, the technology and preference specifications used by Gali et al. (2007) has been adjusted, which corresponds to Cobb-Douglas production function with no labor adjustment cost and CRRA utility function with additively separable consumption and leisure. Following this specification, the percentage deviation from the steady state relationship is given as[2]:

$$\widetilde{gap}_t = \sigma\widetilde{c}_t + \phi\widetilde{n}_t - (\widetilde{y}_t - \widetilde{n}_t) \tag{3}$$

In Equation (3), two issues are important for the quantification of the variations in the economic efficiency. These are concerned with the coefficient of relative risk aversion, given by σ, and the wage elasticity of labor supply governed by the parameter ϕ, which corresponds to the inverse of Frisch elasticity of labor supply. First, for given values of $\widetilde{c}_t$, $\widetilde{n}_t$ and $\widetilde{y}_t$, the higher values of intertemporal elasticity of substitution causes the economic fluctuations to create greater variations in the efficiency. Second, the variations in economic efficiency is also amplified, as the labor supply becomes more inelastic with respect to real wages.

The empirical estimates for these parameters vary across different studies and for different countries. Therefore, different values of parameters for the coefficient of relative risk aversion and the elasticity of labor supply with respect to wages has been utilized for checking the robustness of the results. Following some recent studies for Euro Area, we take $\phi = 1$ and $\phi = 3$ as two plausible

[2] $\widetilde{c}_t$, $\widetilde{n}_t$ and $\widetilde{y}_t$, are the logarithm of real private consumption per capita, logarithm of total employment and the logarithm of real GDP per capita respectively.

values[3]. The coefficient of relative risk aversion σ is taken to be equal to 1 or 5 in the construction of different measures for the robustness of the analysis. On the preference side, alternative specifications include Cobb-Douglas preferences and Greenwood-Hercowitz-Huffman preferences. As the baseline scenario, Cobb-Douglas technology as in the case of Gali et al. (2007) has been considered. As alternative specifications, $F(K_t, L_t)$ takes the form of a CES function. How the gap series are constructed with respect to different specifications are illustrated in Appendix A.

The robustness of our results are further checked by considering different parameter spaces, filtering methods and sample sizes. As part of baseline scenarios, the series constructed with band pass filter, suggested by Baxter and King (1999) has been used. In addition to the filters used, the results are also tested with HP filter, as well as 3^{rd} and 5^{th} order time polynomials for each of the series that have been formed. One significant point is that, the results reported are robust to the choice of filters in most cases.

In the baseline scenario, the gap measure is constructed by considering movements between frequencies of 6 quarters and 32 quarters, denoted by (6,32). As for the robustness check, the series are further constructed by using different frequencies, namely (2,60), (4,32), (8,32) and (6,40). Although there have been quantitative differences in the series that are constructed, these differences do not change the qualitative results of this study. However, for the filters that has movements with respect to less than 4 quarters periodicity, which can be considered as irregular movements, the welfare fluctuations appear to be stronger. However, their persistence falls significantly with such a filtering choice. Of these different frequency alternatives, series constructed with (2,60) are reported by Gali et al. (2007) as being fairly close to 5^{th} order time polynomial, which is used in the baseline scenario of their study as well as by Hall (1997). In addition, Agresti and Mojon (2001) reports that Band-Pass filter with (6,40) is the most appropriate measure in decomposing the European data into its trend, irregular components and the business cycle components in terms its compatibility with macroeconomic dynamics in Europe.

[3] $\phi = 1$ is consistent with the business cycle literature, whereas $\phi = 3$ is consistent with wide range of empirical studies in labor economics literature.

Table 1: AR(1) Coefficients of Different Gap Measures

	BP260-1	BP260-2	BP260-3	BP632-1	BP632-2	BP632-3	BP632-4	BP632-5	HP	3. Or. Poly.	5. Or. Poly.
AUS	0.13	0.07	0.36	0.85	0.83	0.89	0.85	0.85	0.37	0.87	0.79
BEL	0.76	0.81	0.84	0.86	0.88	0.89	0.83	0.84	0.87	0.96	0.96
DN	0.58	0.56	0.75	0.86	0.85	0.87	0.84	0.84	0.77	0.90	0.90
FIN	0.81	0.82	0.81	0.83	0.92	0.93	0.87	0.87	0.92	0.98	0.95
FR	0.30	0.51	0.63	0.89	0.86	0.90	0.83	0.83	0.57	0.90	0.83
GER	0.53	0.45	0.70	0.89	0.89	0.91	0.86	0.86	0.74	0.87	0.86
GR	0.57	0.68	0.79	0.82	0.87	0.83	0.84	0.85	0.73	0.90	0.89
IR	0.79	0.78	0.86	0.89	0.90	0.90	0.86	0.87	0.91	0.96	0.96
IT	0.59	0.56	0.56	0.88	0.89	0.89	0.84	0.85	0.75	0.95	0.86
NED	0.51	0.54	0.74	0.88	0.91	0.90	0.83	0.85	0.80	0.92	0.93
NOR	0.41	0.33	0.51	0.89	0.88	0.91	0.84	0.85	0.73	0.94	0.90
SP	0.75	0.75	0.83	0.89	0.88	0.93	0.86	0.88	0.90	0.97	0.98
SWE	0.32	0.18	0.59	0.90	0.87	0.92	0.88	0.88	0.65	0.94	0.89
SZ	0.59	0.85	0.61	0.88	0.92	0.89	0.85	0.85	0.81	0.94	0.88
UK	0.70	0.57	0.79	0.92	0.90	0.92	0.90	0.90	0.89	0.96	0.96

The examination of the constructed series reveal that the variations in the welfare has shown a persistent behavior over the period between mid-1960's and 2002, as can be seen from the AR(1) coefficients in Table (1). Due to the existence of the market power both in labor and goods markets, we would expect a suboptimal steady state outcome compared to the perfectly competitive allocations. In such an environment, pretty high values of AR(1) coefficients imply that the deviations from this suboptimal outcome can be quite persistent in both directions. In this respect, one may observe long-lasting periods of movements towards the first best outcome, as well as "further" long-lasting departures from the optimal outcome.

At this point, one possible question is how costly these fluctuations has been over the course of business cycles in the last 4 decades. The results concerning this question is given in Table (2). In total, the sum of all positive and negative deviations is fairly close to zero, implying that the positive and negative deviations from the steady state value have canceled each other to great extent. The results imply that there have been cases where economic efficiency in some of these economies were 5-7 percent below their steady state value, which is very likely to be below the first best outcome. However, considering that the results in Table (2) are calculated for the case of unit intertemporal elasticity of consumption and unit Frisch elasticity of labor, we can conclude that for other realistic parameters like $\sigma = 5$ or $\phi = 3$, the economic efficiency can be much below its steady state value, as well as the fluctuations in economic efficiency may be more severe (See Figure 1 and Figure 2).

Table 2: The Sample Properties of Efficiency Gaps ($\sigma = 1, \phi = 1$, BP(6,32))

	AUS	BEL	DN	FIN	FR	GER	GR	IR	IT	NED	NOR	SP	SWE	SZ	UK
1970Q1 2002Q2															
Min	-2.4	-2.1	-3.8	-6.4	-1.9	-2.8	-4.4	-6.8	-2.4	-2.8	-4.7	-4.2	-4.5	-3.8	-3.7
Max	1.8	2.9	4.3	5.1	1.2	3.6	4.2	3.8	4.4	3.1	5.1	3.1	3.0	4.9	3.4
Count<0	85	77	79	72	66	86	88	83	98	66	87	81	73	60	83
Count>0	60	87	85	92	86	78	72	81	66	52	77	80	91	65	81
Average	0.0	0.0	0.1	0.0	0.0	0.0	-0.1	0.0	-0.1	0.0	0.0	0.0	0.0	0.1	0.0
St. Dev.	0.7	0.9	1.4	1.9	0.7	1.2	1.8	1.9	1.3	1.1	1.6	1.5	1.5	1.5	0.4
1970Q1 1979Q1															
Min	-2.4	-2.0	-3.8	-3.4	-1.4	-2.8	-3.4	-2.9	-2.2	-1.5	-2.9	-1.6	-3.0	-3.8	-2.6
Max	1.8	2.9	2.7	3.8	1.2	0.9	2.9	3.8	2.7	1.8	5.1	2.0	2.9	2.6	3.0
Count<0	21	19	16	21	13	21	24	26	24	19	22	14	20	15	18
Count>0	19	21	24	19	27	19	16	14	16	21	18	26	20	21	22
Average	-0.1	0.0	0.2	-0.2	0.1	-0.3	-0.3	-0.3	-0.1	0.1	0.1	0.3	0.0	-0.2	0.0
St. Dev.	1.0	1.2	1.7	2.0	0.6	0.9	1.6	2.2	1.3	0.9	1.9	0.9	1.5	1.9	1.4
1980Q1 1989Q1															
Min	-1.3	-2.1	-2.4	-2.4	-1.9	-1.4	-3.4	-3.8	-0.9	-1.9	-4.7	-3.9	-2.0	-1.6	-3.7
Max	1.5	1.6	4.2	3.6	1.2	3.6	3.6	2.8	2.9	3.1	4.2	2.2	1.4	2.5	3.1
Count<0	31	21	25	15	22	24	19	19	24	24	19	23	18	14	21
Count>0	9	19	15	25	18	16	21	21	16	16	21	17	22	26	19
Average	-0.1	-0.2	-0.1	0.3	-0.1	0.1	0.0	-0.1	0.1	-0.2	0.2	-0.4	0.0	0.2	0.0
St. Dev.	0.6	0.8	1.6	1.2	0.7	1.3	1.7	1.6	0.9	1.3	2.2	1.6	0.9	1.0	1.9
1990Q1 2002Q2															
Min	-0.8	-1.8	-1.5	-6.4	-1.9	-1.4	-4.4	-6.8	-2.4	-2.8	-1.4	-4.2	-4.5	-1.8	-2.0
Max	1.2	1.7	1.9	5.1	1.2	2.8	4.2	3.7	4.4	1.9	1.4	3.1	3.0	4.9	3.4
Count<0	23	20	24	23	21	22	26	23	30	23	29	28	22	30	33
Count>0	27	30	26	27	29	28	24	27	20	27	21	22	28	20	17
Average	0.1	0.1	0.0	0.0	0.0	0.3	0.1	0.1	0.0	0.2	-0.2	0.0	0.0	0.1	-0.1
St. Dev.	0.5	0.9	0.9	2.4	0.8	1.1	2.2	2.2	1.5	1.1	0.8	1.8	1.4	1.4	1.1

Figure 1: Efficiency Gap Series ($\sigma = 1, \phi = 1$, BP(6,32))

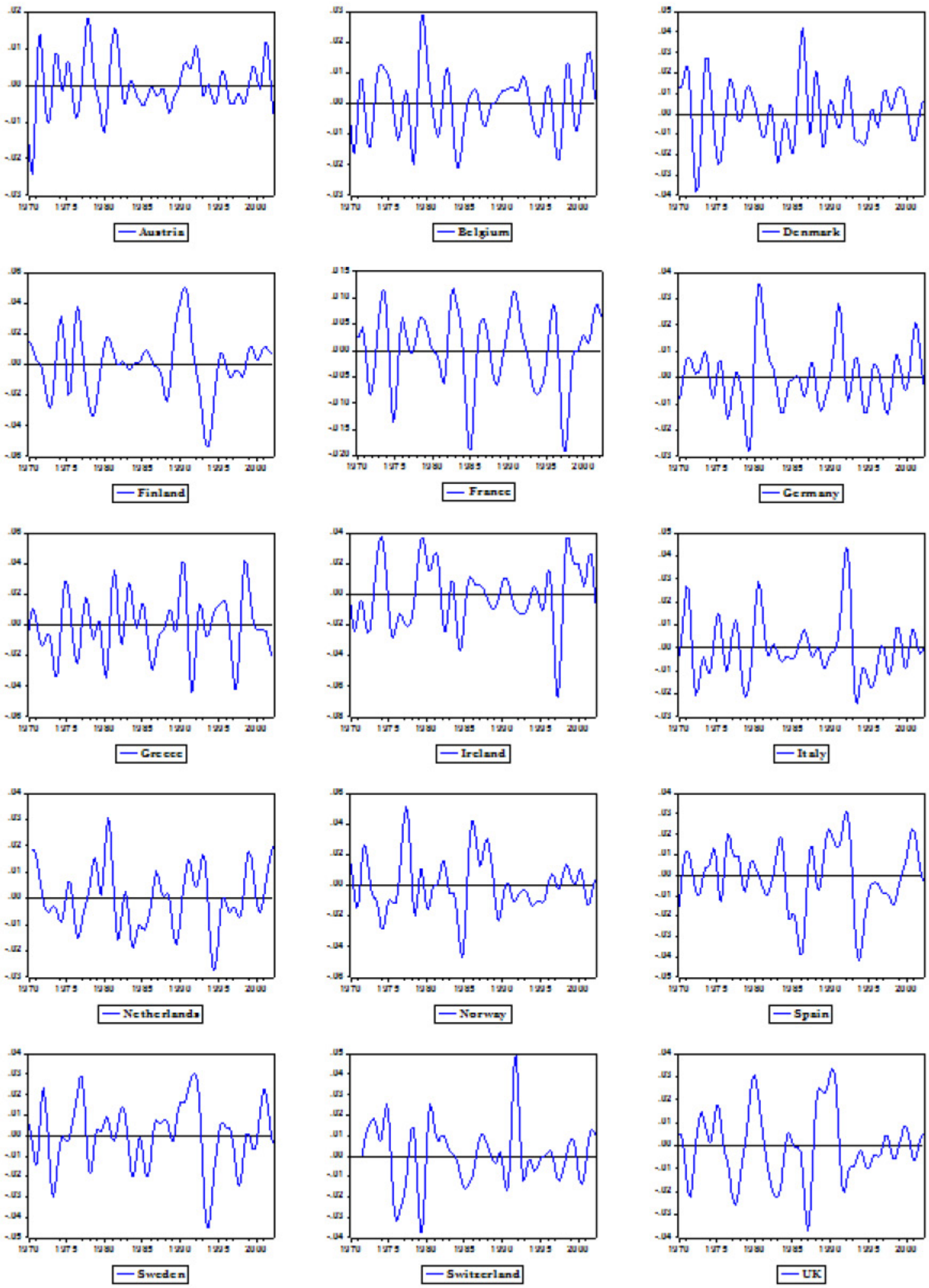
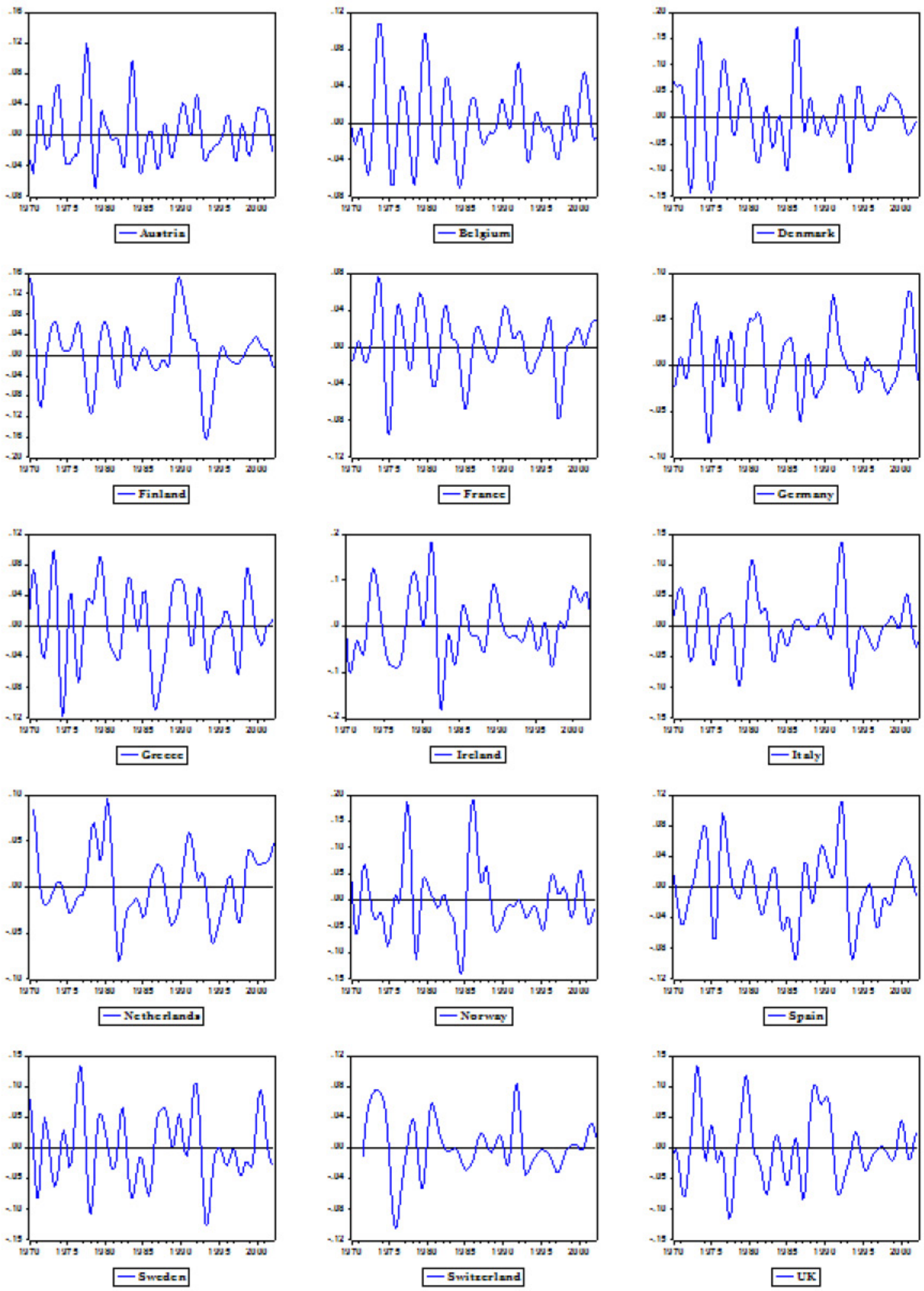


Figure 2: Efficiency Gap Series ($\sigma = 5, \phi = 1$, BP(6,32))



Another point that is worth emphasizing is that the standard deviations given in Table (2) is around 1-2 percent, which can be much bigger for other values for σ and ϕ in the parameter space that we consider. These results imply that there may be important efficiency gains, especially for the cases of recessions, from the stabilization of economic efficiency around its steady state level.

One particular point that is worth mentioning is that, although slight differences in the correlations across countries from one efficiency measure to another has been observed both in terms of the sign and the magnitude, in general it has been discovered that there is a strong tendency for the gap series to move together, as can be seen in Figure (1) and Figure (2). In particular, for the case of our baseline scenario with band pass filter with frequencies of 6 and 32 quarters, and the different parameter values, a high degree of comovement is observed for the fluctuations in economic efficiency in different countries.

Table 3: Correlation of Gap with Output

	GAP1	GAP2	GAP3	GAP4	GAP5
AUS	-0.09	0.66	0.15	-0.88	-0.81
BEL	-0.09	0.47	0.17	-0.81	-0.72
DN	0.04	0.76	0.53	-0.70	-0.59
FIN	0.53	0.97	0.53	-0.44	-0.34
FR	0.43	0.63	0.66	-0.70	-0.50
GER	0.23	0.61	0.44	-0.61	-0.42
GR	-0.53	0.33	-0.34	-0.87	-0.80
IR	0.07	0.63	0.31	-0.72	-0.60
IT	0.01	0.57	0.24	0.76	-0.66
NED	-0.02	0.40	0.20	-0.66	-0.54
NOR	-0.06	0.28	0.10	-0.65	-0.56
SP	-0.01	0.52	0.21	-0.68	-0.55
SWE	0.14	0.40	0.34	-0.50	-0.32
SZ	-0.02	0.37	0.29	-0.64	-0.45
UK	0.38	0.68	0.50	-0.48	-0.34

In general, the analysis shows that the variations in the gap is procyclical for various gap series constructed with CRRA preferences, Cobb-Douglas production function and the CES production function for a wide range of parameter values (see Table 3). This implies that the inefficiencies arising from structure of the goods market and the labor market tend to decrease during expansions, and increase during recessions. However, Table (3) also suggests that one should be careful in generalizing the procyclicality result, as it may be sensitive to the functional forms and the parameter values. For example, the correlations in the columns 2, 3 and 4 given in Table (3), are calculated for CRRA preferences and Cobb-Douglas production function. The only difference is that $\phi = \sigma = 1$ for GAP1, $\sigma = 5$ and $\phi = 1$ for GAP2, and $\sigma = 1$ and $\phi = 3$ for GAP3 series. As can be seen above, although procyclicality of the welfare gap is mostly obtained in a considerable amount of outcome, fair amount of countercyclicalities, or acyclicalites has also been observed. The columns titled GAP4 and GAP5 series present the results, for which the gap series have been constructed using Cobb-Douglas preferences and Greenwood-Hercowitz-Huffman Preferences respectively. It is worth emphasizing that the movements in the gap clearly appear to be countercyclical for these two functional forms, which have been utilized in various studies analyzing business cycles. This finding underlines the importance of assumptions about the functional forms and parameter values, and therefore leads us to conclude that the more accurate results requires the support from applied microeconomic studies for employing the most plausible welfare measure.

3 The Monetary Policy and the Welfare Gap

One of the main hypothesis tested in this paper is whether the welfare gap in Europe responds to the monetary shocks originated by either the countries themselves, or by the other countries in the area. The answer to this question is important both from theoretical point of view and from practical point of view. The basic motivation for this hypothesis is that in an economy characterized by rigidities caused by the institutional background of the labor market and the goods market, the real effects of the monetary shocks are likely to cause welfare fluctuations in the economy. For the case of European countries, there is a considerable amount of macroeconomic and microeconomic studies analyzing the structure of the goods market and the labor market.

One of the main channels that can make the monetary policy effective in determining the movements in the economic efficiency is the way that the labor markets work in Europe. The labor markets in Europe have been documented to be intensively unionized in many studies.[4] The union's main economic motive may be to keep the earnings of its members as high as possible. The reflection of this is downward nominal wage rigidity in the case of recessions, which not only can make the documented wage and compensation rate unrepresentative of the scarcities, but also may

[4] See Nickell (1997).

lead to fluctuations in the employment as a costly outcome of rigid wages caused by the unions will be the fluctuation in the employment for the non-union workers.[5] This, however, will lead to variations in the wedge between marginal rate of substitution between the leisure and consumption and the marginal product of labor. Other structural features of labor markets in most European countries, such as the minimum wage laws, or the regulations about the provision of various fringe benefits for the workers, may lead to variations in the welfare following monetary shocks.

Another potential channel, which leads to the variations in the economic efficiency following monetary shocks, is due to the joint outcome of price rigidities and search frictions in the economy. In particular, such a variation can be the outcome of the real effects of monetary shocks in the goods market, as a result of which the advertised job vacancies in firms may increase in expansionary periods. In this setting, exogenous changes in the monetary stance may have effects on the welfare costs not only due to direct real effects in the goods market, but also the indirect employment effects as a result of new job matches due to higher number of advertised vacancies.

As for the cross-border welfare effects of monetary shocks, we can mainly talk about two possible channels. The first one is the exchange rate regime. The exchange rate regime may matter for the cross-border welfare effects of monetary policy via affecting the potent of a country to conduct an independent monetary policy in the case of an external shock. For instance, the ERM that was in effect from late 1970's to 1990's made the monetary policies of many European countries dependent on Germany, despite some limited flexibility in the form of an exchange rate band or central parity adjustments. However, this also implied that whenever there was a monetary shock in Germany, its effect could potentially be transmitted to the member countries of ERM as a result of the need for keeping their exchange rates stable around German Mark.

The second channel through which the monetary policy in a country may have cross-border welfare spillovers may exist if the prices of country latter's exportables to the former are sticky and set in term's of country former's currency. The incomplete nominal adjustment combined with price setting behavior of exporter firms in terms of the importer countries' currencies has recently been identified by Betts and Devereux (2000) as the main source of on the deviation from the law of one price. This so-called "Pricing-To-Market" behavior has been documented to be prevalent in Europe by Engel (2000). Following this finding, if the stickiness in the buyer's currency is the

[5] Lewis (1986) documents that the relative wages of the union workers and the non-union workers display a clear cyclical pattern mainly due to the existence of the downward wage rigidities caused by the presence of the unions.

case, then the employment in exporter country will respond to changes in monetary policy in the importer country due to well known nonneutrality arguments, depending on the size of the country and the size of the exports market. Although the existence of this channel does not require a particular setting with respect to the exchange rate regime, the strength of this channel may be potentially amplified when it is combined with fixed exchange rates.

4 Estimation of Monetary Policy Shocks

The investigation of how the welfare fluctuates in response to the monetary shocks require us to identify the unsystematic movements in the variables indicating the monetary policy stance. The idea is simply that the unsystematic variations of the operating variables of the monetary policy should be distinguished from the variations that are the results of monetary authority's intentional policy responses to the changes in the macroeconomic environment.

Following the influential papers in the area of identification of the monetary shocks, such as Sims (1992), Bernanke and Mihov (1998) and Christiano et al. (1999), the monetary shocks are identified for each country by using the vector-auto-regression (VAR) methodology. In this respect, first, the monetary policy instrument and the specification of the monetary instruments' feedback to the other endogenous and exogenous variables has been determined, and second identifying assumptions concerning the interactions between the endogenous variables has been made.

In a study where the main interest is on the "cross-border" welfare spillovers of the monetary shocks in each country, we need to be careful about identifying the monetary shocks in each European countries in the sense that the interactions between output, prices and monetary policy implementation may differ from one country to another. Regarding the issue of identification of the monetary shocks in Europe using VAR methodology, Dornbusch et al. (1998) argue that the VAR studies disregarding the existence of country specific factors by concentrating on the same set of policy variables and the macroeconomic variables may lead to inappropriate conclusions. As a result, the VAR system for each country using country specific control variables has been estimated and taking into account the monetary policy variables, which is presented in Table (4).

Table 4: The Variables of VAR Model

	Y*	X**	Lags(Y)***	Lags(X)
AUS	Y, P, R	R_GER	5	5
BEL	Y, P, R	R_GER	4	4
DN	Y, P, R	R_GER, PCOM	1	1
FIN	Y, P, R	R_GER, PCOM	2	2
FR	Y, P, R_GER,R	PCOM	2	2
GER	Y, P, R	PCOM	2	2
GR	Y, P, R	PCOM	4	4
IR	Y, P, R	P_UK, R_UK	6	6
IT	Y, P, R_GER,R	PCOM	2	2
NED	Y, P, R	P_GER, R_GER, Y_GER	3	3
NOR	Y, P, R	PCOM, R_GER, Y_GER	2	2
SP	Y, P, R	OIL, P_GER, R_GER, Y_GER	6	1
SWE	Y, P, R	R_GER, PCOM	2	2
SZ	Y, P, R	R_GER, Y_GER	4	4
UK	Y, P, R	OIL, PCOM	3	3

*: Y=Log of Real GDP, P*Log of CPI, R=Money Market Rate, PCOM=Log of Commodity Prices, Oil=Log of Oil Prices

**: Seasonal Dummies and Trend is included for all of the countries

***: Lag selection criteria=AIC, BIC, FPE, HQ, SC

The identifying assumption for the monetary shocks is that the monetary policy does not have contemporaneous impact on output and on the prices. As mentioned in Bernanke and Mihov (1998), this identifying assumption may initially look quite implausible in a model with quarterly data. However, apart from its convenience, this identification assumption is plausible as it has been supported both empirically and theoretically. For instance, Rotemberg and Woodford (1997) explains the economic rationality of this identifying assumption on the basis of sluggish nominal adjustment and the informational lags in the consumption and the output decisions of the economic agents on the real side of the economy.[6]

For each of the countries, following VAR system has been run separately to identify the exogenous variations in the monetary policy:

$$Y_t^i = \sum_{j=1}^{k} A_j^i Y_{t-j}^i + \sum_{i=0}^{k} B_j^i X_{t-j}^i + C^i \epsilon_t^i \tag{4}$$

[6] Mankiw and Reis (2002) recently shows that the informational imperfections in the form of so called "sticky information" may lead to lagged responses of macroeconomic variables following a monetary shock. Further, Woodford (2001) argues that the effects of strategic interactions in price setting behavior of imperfectly competitive firms combined with higher uncertainty about the rival firms' knowledge about the monetary policy developments can create a realistic degree of insensitivity of prices and output to monetary shocks, as a result of which we can conclude that there need not be contemporaneous real effects of monetary shocks in a model with quarterly data.

In this set-up, Y_t^i is the vector used for endogenous macroeconomic variables of the country i. These variables include the logarithm of output, the logarithm of price index and the operational instruments of the monetary policy in this order. X_t^i is the vector of exogenous variables controlling for the developments about the world business cycles, the oil and commodity prices, and the variables representing the monetary policy stance of Germany[7]. The inclusion of the German monetary policy variables in the list of exogenous variables for many European countries is due to the historical evidence that monetary policy in some European countries closely followed that of Germany's due to Germany's dominance in the economic activity in the area as well as the existence of ERM mechanism between 1979 and mid 1990's.[8] The lag number k determines the nature of the dynamic relationship across the variables.[9] A, B and C are the matrices of coefficients to be estimated.

Equation (4) is estimated using OLS for each country indexed by i, and the estimated values of the residual term gives the monetary shock series. In obtaining the monetary shock series, the identifying assumption mentioned above has been used in two different forms, both of which is based on the assumption that there is no feedback from the monetary policy to the prices and the economic activity. However, these two cases differ from each other in the sense that no monetary policy feedback to contemporaneous price and output changes in one of these specifications is assumed, which is an overidentifying assumption. The plausibility of the results have been cross-checked with the impulse response tables. The response of the output, prices and the money market rate to the money market rate is illustrated in Figure (3). One important point is that the absence of "price puzzle" has been used as a choice criteria when choosing among different VAR specifications for each country.

In addition to output and prices, bilateral real exchange rates and some form of money stock has also been put in the estimation of VAR equations. However, the results did not change significantly with the inclusion of those variables, so those variables are not included in the specification.[10]

After the identification of the monetary shocks for each country, the second part of the econo-

[7]In addition to the control variables, linear trend and seasonal dummies are also included in the estimation.

[8]See Mojon and Peersman (2001) for a detailed analysis on this issue.

[9]In determining the number of lags in VAR analysis, we compare the outcomes of different criteria like Akaike, Schwartz, Hannan-Quinn, FPE and LR. Whenever we obtain different results for number lags, we choose the higher number of lags, as excluding appropriate lags is more problematic than including unnecessary lags. See Killian (2001) and Garratt et al. (2003).

[10]Another reason why money stock variable has not been included is that, especially for the Euro Area countries the data ends in 1998 that does not allow for including the effect of 1999-2004 period into the analysis. It is also important to note that "liquidity puzzle" has not been observed as a result of inclusion of money stock into the VAR system.

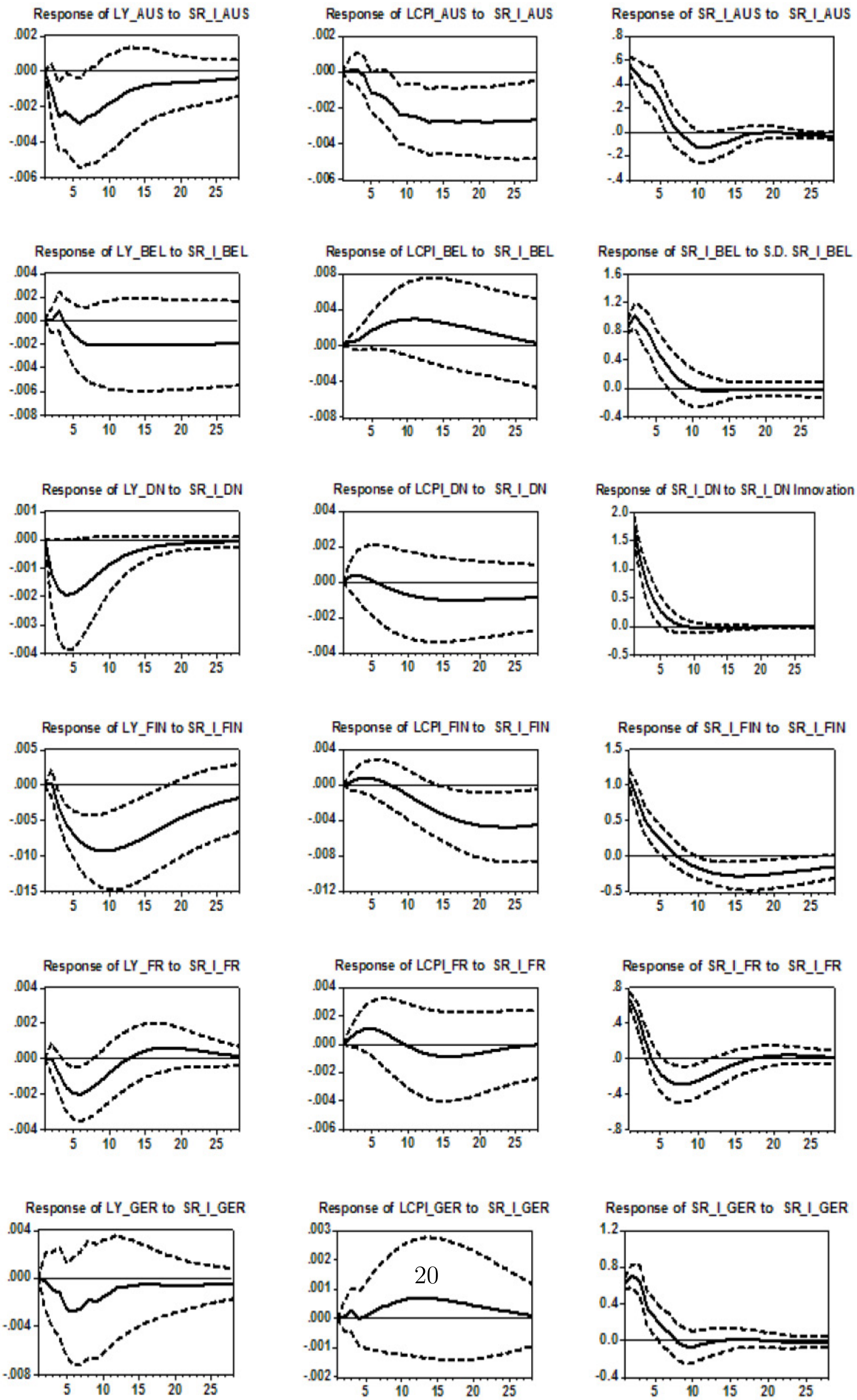
metric analysis constitutes the determination of the causalities between the identified monetary shocks and the efficiency gaps. For this purpose, pairs of Granger causality tests for each country, as well as the efficiency gaps in each country with foreign monetary policy shocks has been conducted. Concerned with the later point, the focus is mainly on the monetary policy shocks of Germany and United Kingdom. This choice is made considering the size of these economies as well as well as their ability to conduct independent monetary policy. Considering these two criteria, the monetary policy shocks originated by the other 13 countries has not been considered either because these economies are small economies in Europe, or they were conducting monetary policy within the context of ERM.

5 Bayesian Dynamic Factor Model and the Common Components of Monetary Policy Shocks

The main goal of this part is to propose an original framework to measure the level of economic integration between 15 European Union countries. To do so, we use a Bayesian dynamic latent factor model for a vector of data which represents the identified monetary policy shocks that has been extracted from the VAR model described in the previous part of this section. The new political and economic context of Europe after the Maastricht Treaty of 1992 lead to the single European currency, to the harmonization of fiscal and monetary policies for all countries. It has been claimed by many scholars that the period after the single currency brought a synchronization of the business cycles as the union secures a permanently fixed exchange rate. Artis and Zhang (1999) and Artis et al. (2004), among others, suggest that economic integration in Europe results in a convergence of business cycles across the EMU countries.

Most of the recent business cycle literature is build on the approach of Prescott (1986) building on the notion that collections of economic time series, while displaying some idiosyncratic fluctuations, move together as if responding to a small number of underlying dynamic factors. Sargent and Sims (1977) argue that these factors capture what Burns and Mitchell (1946) had in mind while pursuing regularities in business cycles. The factors may be unobservable indexes as in Sargent and Sims (1977), or technology shocks as in Prescott (1986).

Figure 3: Impulse of Monetary Policy Instrument



On the question of, if there exists a common business cycle among the Euro Area countries, related questions take place commonly in the literature of business cycles. Recent studies have indeed provided evidence that there are many cross-country links in macroeconomic fluctuations. For example, studies of pairwise correlations by Backus et al. (1992) and Baxter (1995) find that business cycles in major industrialized economies are quite similar. Gerlach (1988), using spectral methods, find that movements in industrial production indices in a number of OECD countries are correlated. Crucini (1997) establishes a link between those studies employing stochastic dynamic macroeconomic models, that try to explain common fluctuations across countries, and those empirical studies documenting features of international business cycles.

More structured time series analysis also find comovement in subsets of countries. In particular, Gregory et al. (1997) use Kalman filtering and dynamic factor analysis to identify the common fluctuations across macroeconomic aggregates in G-7 countries. Stockman (1988) employs an error-correction method and finds that a substantial fraction of variation in industrial production is due to global sector-specific and country-specific disturbances in major industrialized economies. Norrbin and Schlagenhauf (1996) also employ a dynamic factor model to examine the role of world, nation specific, and industry specific factors in explaining common movements across G-7 countries, Belgium, and Netherlands. Their results indicate that while the world and country-specific factors explain some fraction of industrial output, the industry specific factor plays a minor role. Lumsdaine and Prasad (2003) develop a weighted aggregation procedure, and examine the correlations between the fluctuations in industrial output in seventeen OECD countries and estimated common component, and find evidence for a world business cycle and for a European business cycle.

Regarding the literature on business cycle theory, better understanding of the dynamic factors that drive the economy will lead to better understanding of factors or common components that define the state of the economy. In this respect, the state of the Euro Area economy has been addressed by providing a Bayesian treatment of the unobservable index structure. We employ a Bayesian dynamic factor model to simultaneously estimate a dynamic common factor to all aggregate shocks that we call the global factor, a set of three dynamic factors common to aggregate shocks created by different macroeconomic movement. In addition to that we have 15 country factors to capture the dynamic comovement across different shocks within each country. Lastly we estimate a common component for each aggregate set of shocks that captures idiosyncratic dynamics.

After the estimation of the Bayesian dynamic factor model to get the common component of the monetary policy shocks, in order to observe the level of integration that the EMU countries experience, we decompose the volatility in each aggregate shock into the fraction due to global, country and idiosyncratic components. The empirical results obtained from the estimation procedure is linked to the economic structures of the 15 countries in the sample.

The econometric methodology we employ permits us to examine multiple common factors. Otrok and Whiteman (1998) developed a Bayesian single dynamic factor model to study coincident and leading economic indicators using the data of state of Iowa. Later, Kose et al. (2003) extended their work to a multiple factor setting and employ it in an international business cycle content. We adopted their model that has been utilized in their later work, to estimate the Euro Area comovements using the monetary policy shocks. The reason behind using the Bayesian procedure is that the model works well with the large cross sectional data and also the model can handle a large number of dynamic factors. A static factor provides a description of the spectral density matrix of a set of time series, and thus the factors describe contemporaneous and temporal covariation among the variables.

In our implementation of dynamic factor model, we utilized the same structure in Kose et al. (2003). There are K dynamic unobserved factors thought to characterize the temporal comovements in the cross-country panel of monetary policy shocks. Let N denote the number of countries (we have 15 European countries), M the number of monetary policy shocks per country (we have 45 monetary policy shocks, i.e, first set comes from the output shock, second set is related to consumption shock and the third set is related to exchange rate shock), and T the length of the time series (in our case it starts from the third quarter of 1976 till the fourth quarter of 2003). Observable variables are denoted by $y_{i,t}$, for $i = 1, ..., M \times N,\ t = 1, ..., T$. There are three types of factors that will be estimated within the model. The first set of factors are the N country specific factors (${f_n}^{country}$, one per country), R will be the factors related to each specific monetary policy shock (${f_r}^{shock}$, one per group of 15 shocks coming from output, exchange rates and consumption), and there will be a common single global factor that will represent all the countries and the monetary policy shocks (f^{global}). Thus for observable i:

$$
\begin{aligned}
y_{i,t} &= \alpha_i + \beta_i{}^{global} f_t{}^{global} + \beta_i{}^{shock} f_{r,t}{}^{shock} + \beta_i{}^{country} f_{n,t}{}^{country} + \varepsilon_{i,t} \\
E(\varepsilon_{i,t}\varepsilon_{j,t-s}) &= 0 \quad for \quad i \neq j,
\end{aligned}
$$

where r denotes the monetary policy shock number and n denotes the country number. The coefficients $\beta_i{}^j$, are the factor loadings, and reflect the degree to which variation in $y_{i,t}$ can be explained by each factor. Notice that there are $M \times N$ time series to be explained by the fewer $N+R+1$ factors. The unexplained idiosyncratic errors $\varepsilon_{i,t}$ are assumed to be normally distributed but may be serially correlated. They follow p_i-order autoregressions:

$$
\begin{aligned}
\varepsilon_{i,t} &= \phi_{i,1}\varepsilon_{i,t-1} + \phi_{i,2}\varepsilon_{i,t-2} + ... + \phi_{i,p_i}\varepsilon_{i,t-p_i} + u_{i,t} \\
E(u_{i,t}, u_{j,t-s}) &= \sigma_i{}^2 \quad for \quad i = j \quad and \quad s = 0, \quad 0 \; otherwise.
\end{aligned}
$$

The evolution of the factors is likewise governed by an autoregression, of order q_k with normal errors:

$$
\begin{aligned}
f_{k,t} &= \varepsilon_{f_k,t} \\
\varepsilon_{f_k,t} &= \phi_{f_k,1}\varepsilon_{f_k,t-1} + \phi_{f_k,2}\varepsilon_{f_k,t-2} + ... + \phi_{f_k,q_k}\varepsilon_{f_k,t-q_k} + u_{f_k,t} \\
E(u_{f_k,t}, u_{f_k,t}) &= \sigma_{f_k}{}^2; \; E(u_{f_k,t}, u_{i,t-s}) = 0 \quad \forall k, i, \quad and \; s.
\end{aligned}
$$

Notice that all the innovations, $ui, t, \; i = 0, ..., M \times N$ and $uf_k, t, \; k = 1, ..., K$, are assumed to be zero mean, contemporaneously uncorrelated normal random variables. Thus all comovements is mediated by the factors, which in turn all have autoregressive representations (of possibly different orders).

There are two related identification problems in the model described above: neither the signs nor the scales of the factors and the factor loadings are separately identified. Signs are identified by requiring one of the factor loadings to be positive for each of the factors. In particular, we require that the factor loading for the global factor be positive for output shocks, country factors are identified by positive factor loadings for output shocks for each country, and the shock factors are identified by positive loadings for the output shock of the first country listed for each shock. Scales are identified following Sargent and Sims (1977) and Stock and Watson (1989, 1992, 1993) by assuming that each ${\varepsilon_{f_k}}^2$ is equal to a constant.

5.1 Model Details and Data Augmentation

Because the factors are unobservable, special methods must be employed to estimate the model. Otrok and Whiteman (1998) used an alternative based on a recent development in the Bayesian literature on missing data problems, that of "data augmentation " procedure of Tanner and Wong (1987). We used the same procedure of Otrok and Whiteman (1998), where the data augmentation can be describes as follows.

If the factors were observable, under a conjugate prior the model described given the equations above would be a simple set of regressions with Gaussian autoregressive errors; that simple structure can in turn be used to determine the conditional normal distribution of the factors given the data and the parameters of the model. Then it is straightforward to generate random samples from these conditional distribution, and such samples can be employed as a basis for the unobserved factors. Because the full set of conditional distribution is known-parameters given data and factors, factors given data and parameters- it is possible to generate random samples from the joint posterior distribution for the unknown parameters and the unobserved factor using a MCMC procedure. In particular, taking starting values of the parameters and factors as given, we first sample from the posterior distribution of the parameters conditional on the factors; next we sample from the distribution of the global factor conditional on the parameters and the country, and shock related factors; then we sample each shock related factor conditional on the global factor and the country factors related to the specific monetary policy shock; finally, we complete one step of the Markov chain by sampling each country factor conditioning on the global factor and the appropriate monetary policy shock factor. The sampling order within each step is irrelevant. All that matters is that samples are taken from each of the blocks of unknown parameters related to global, country and monetary policy shock factors, conditional on the data and all the other blocks. This sequential sampling of the full set of conditional distributions is known as Gibbs Sampling.[11]

[11] See Chib and Greenberg (1994), Geweke (1996).

In our implementation, the length of both the idiosyncratic and factor autoregressive polynomials is three. the prior on all the factor loadings coefficients is $N(0, 1)$. For the autoregressive polynomial parameters, the procedure for ensuring the stationarity of the lag polynomial involves drawing from a truncated normal distribution in the Metropolis Hastings step of Chib and Greenberg (1994). Experimentation with tighter and looser priors for both the factor loadings and the autoregressive parameters did not produce qualitatively important changes in the results reposted below. The prior on the innovation variances in the observable equations is Inverted Gamma (6, 0.001), which is quite diffuse.

Table 5: Descriptive Statistics of Global Components for 15 European Countries

	Global Dynamic Factor	PCA Global Factor
Mean	0.000	0.000
Median	0.035	-0.189
Maximum	0.765	5.613
Minimum	-1.661	-4.509
Std. Dev.	0.344	1.969
Skewness	-1.064	0.335
Kurtosis	7.215	3.277
Jarque-Bera	102.182	2.416
Probability	0.000	0.299
Sum	0.021	0.000
Sum Sq. Dev.	12.936	422.561
Observations	110	110

Table (5) illustrates the descriptive statistics of the global component that we extracted using the Bayesian dynamic factor model and the common component we get via PCA. Table (6) shows the correlation coefficient between these two series and the movements of the two series can be observed via Figure (4). On the other hand, Table (7) presents the correlation coefficients of the country factors. The highest correlation is 0.27 that is between Netherland and Greece. The next section will be composed of a more detailed examination of the components via variance decomposition method. The figures illustrating the common components of 15 European countries takes place in Appendix C.

Figure 4: Global Components for 15 European Countries

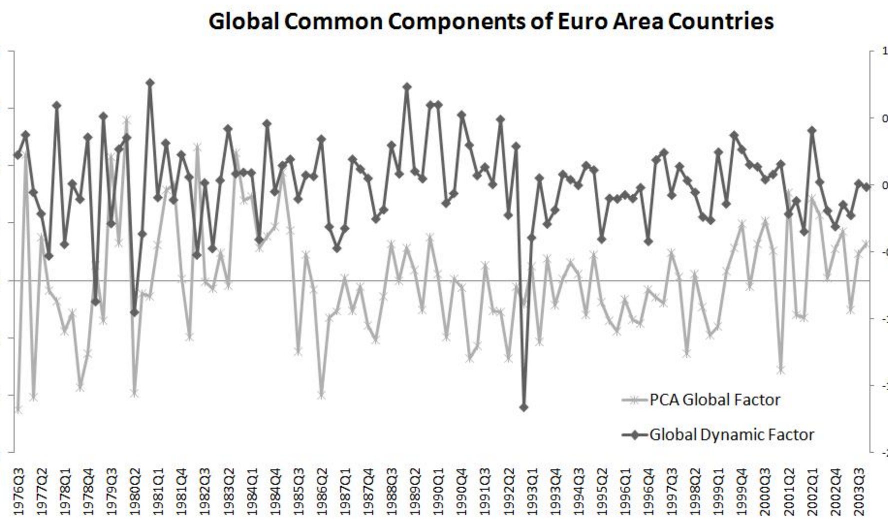


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Table 6: Correlation Coefficients for Global Components of 15 European Countries

	Global Dynamic Factor	PCA Global Factor
Global Dynamic Factor	1.000	0.120
PCA Global Factor	0.120	1.000

Table 7: Correlation Coefficients for Country Components of 15 European Countries

	AUS	BEL	DEN	FIN	FR	GER	GR	IR	IT	NED	NOR	SP	SWE	SZ	UK
AUS	1.00	-0.13	0.02	0.14	0.24	-0.03	-0.05	0.08	-0.01	0.10	-0.02	-0.15	0.03	0.06	0.05
BEL	-0.13	1.00	-0.07	-0.04	0.23	-0.06	0.06	0.10	-0.02	-0.22	-0.08	-0.13	0.04	0.03	0.07
DEN	0.02	-0.07	1.00	0.16	0.07	-0.14	-0.08	-0.10	0.15	-0.21	0.00	-0.04	-0.08	-0.04	0.02
FIN	0.14	-0.04	0.16	1.00	-0.01	-0.12	0.01	-0.03	0.00	-0.03	-0.06	0.08	0.02	0.24	-0.01
FR	0.24	0.23	0.07	-0.01	1.00	0.05	-0.12	0.03	-0.06	0.02	-0.17	-0.17	-0.02	-0.04	-0.04
GER	-0.03	-0.06	-0.14	-0.12	0.05	1.00	0.14	0.21	0.02	0.10	0.13	0.07	0.19	-0.01	0.02
GR	-0.05	0.06	-0.08	0.01	-0.12	0.14	1.00	0.14	-0.07	0.27	-0.07	0.19	-0.05	0.14	-0.09
IR	0.08	0.10	-0.10	-0.03	0.03	0.21	0.14	1.00	0.11	0.02	0.10	-0.04	0.22	-0.19	-0.02
IT	-0.01	-0.02	0.15	0.00	-0.06	0.02	-0.07	0.11	1.00	-0.07	0.05	-0.01	0.00	0.03	-0.07
NED	0.10	-0.22	-0.21	-0.03	0.02	0.10	0.27	0.02	-0.07	1.00	0.01	-0.11	0.21	-0.05	-0.02
NOR	-0.02	-0.08	0.00	-0.06	-0.17	0.13	-0.07	0.10	0.05	0.01	1.00	0.00	0.05	0.03	-0.14
SP	-0.15	-0.13	-0.04	0.08	-0.17	0.07	0.19	-0.04	-0.01	-0.11	0.00	1.00	-0.08	0.15	-0.04
SWE	0.03	0.04	-0.08	0.02	-0.02	0.19	-0.05	0.22	0.00	0.21	0.05	-0.08	1.00	-0.01	-0.01
SZ	0.06	0.03	-0.04	0.24	-0.04	-0.01	0.14	-0.19	0.03	-0.05	0.03	0.15	-0.01	1.00	0.00
UK	0.05	0.07	0.02	-0.01	-0.04	0.02	-0.09	-0.02	-0.07	-0.02	-0.14	-0.04	-0.01	0.00	1.00

6 Variance Decomposition Results and Discussion

To measure the relative contributions of the global, monetary policy shock and country factors to variations in aggregate variables in each country we estimate the share of the variance of each aggregate due to each factor. We decompose the variance of each observable into the fraction that comes from each of the three factors and the idiosyncratic component. Even though the factors are uncorrelated, samples taken at each pass of the Markov chain will not be uncorrelated, purely because of sampling error. To ensure adding up, we took a further step for these calculations, and orthogonalized the sampled factors, ordering the global factor first, the monetary shock factor second, and the country factor third. With orthogonal factors the variance of observable i can be written:

$$\begin{aligned} Var(y_{i,t}) &= ({\beta_i}^{global})^2 Var({f_t}^{global}) + ({\beta_i}^{shock})^2 Var({f_{r,t}}^{shock}) \\ &+ ({\beta_i}^{country})^2 Var({f_{n,t}}^{country}) + Var(\varepsilon_{i,t}) \end{aligned}$$

The fraction of volatility due to, say, the world factor would be:

$$\frac{({\beta_i}^{global})^2 Var({f_t}^{global})}{Var(y_{i,t})}$$

These measures are calculated at each pass of the Markov chain; dispersion in their posterior distributions reflects uncertainty regarding their magnitudes.

Table 8: Variance Decomposition of Countries with respect to Output Shocks

	Global Comp.			Country Comp.			Shock Comp.			Idiosyn. Comp.		
	1/3	Med.	2/3	1/3	Med.	2/3	1/3	Med.	2/3	1/3	Med.	2/3
AUS	0.01	0.00	0.03	0.09	0.05	0.13	0.01	0.01	0.03	0.85	0.81	0.88
BEL	0.01	0.00	0.01	0.10	0.06	0.15	0.01	0.00	0.02	0.87	0.82	0.91
DEN	0.02	0.01	0.03	0.10	0.05	0.17	0.02	0.01	0.04	0.83	0.76	0.88
FIN	0.02	0.01	0.08	0.06	0.03	0.11	0.02	0.01	0.06	0.76	0.70	0.83
FR	0.02	0.01	0.03	0.17	0.11	0.23	0.03	0.01	0.04	0.76	0.69	0.82
GER	0.01	0.00	0.02	0.01	0.00	0.02	0.01	0.00	0.02	0.96	0.94	0.97
GR	0.01	0.00	0.02	0.02	0.01	0.03	0.01	0.01	0.03	0.94	0.92	0.96
IR	0.02	0.01	0.04	0.05	0.02	0.10	0.02	0.01	0.04	0.86	0.82	0.90
IT	0.02	0.01	0.03	0.02	0.01	0.05	0.01	0.01	0.03	0.92	0.90	0.94
NED	0.02	0.01	0.03	0.03	0.01	0.05	0.03	0.01	0.04	0.90	0.87	0.93
NOR	0.18	0.10	0.26	0.01	0.01	0.03	0.15	0.07	0.23	0.62	0.58	0.65
SP	0.01	0.01	0.03	0.02	0.01	0.04	0.01	0.00	0.02	0.93	0.90	0.95
SWE	0.01	0.00	0.01	0.01	0.00	0.03	0.01	0.00	0.01	0.96	0.94	0.98
SZ	0.04	0.02	0.08	0.08	0.04	0.13	0.03	0.01	0.06	0.77	0.70	0.82
UK	0.09	0.05	0.15	0.08	0.04	0.13	0.06	0.03	0.10	0.71	0.61	0.81

Table 9: Variance Decomposition of Countries with respect to Price Shocks

	Global Comp.			Country Comp.			Shock Comp.			Idiosyn. Comp.		
	1/3	Med.	2/3	1/3	Med.	2/3	1/3	Med.	2/3	1/3	Med.	2/3
AUS	0.06	0.03	0.09	0.10	0.06	0.14	0.06	0.03	0.10	0.72	0.68	0.76
BEL	0.02	0.01	0.03	0.01	0.00	0.02	0.01	0.01	0.03	0.92	0.89	0.96
DEN	0.01	0.00	0.01	0.02	0.01	0.04	0.01	0.00	0.02	0.95	0.93	0.97
FIN	0.02	0.01	0.03	0.11	0.05	0.17	0.01	0.01	0.03	0.82	0.76	0.86
FR	0.03	0.02	0.05	0.04	0.02	0.07	0.02	0.01	0.03	0.88	0.84	0.91
GER	0.01	0.01	0.03	0.01	0.00	0.02	0.02	0.01	0.04	0.93	0.91	0.95
GR	0.03	0.01	0.05	0.01	0.01	0.03	0.05	0.03	0.07	0.88	0.86	0.90
IR	0.01	0.00	0.02	0.04	0.02	0.07	0.01	0.00	0.02	0.92	0.89	0.94
IT	0.01	0.01	0.02	0.02	0.01	0.03	0.01	0.00	0.02	0.94	0.92	0.96
NED	0.00	0.00	0.01	0.01	0.00	0.02	0.01	0.00	0.01	0.97	0.95	0.98
NOR	0.04	0.02	0.07	0.09	0.04	0.17	0.07	0.04	0.10	0.76	0.68	0.83
SP	0.08	0.04	0.13	0.05	0.02	0.09	0.13	0.07	0.19	0.66	0.57	0.74
SWE	0.03	0.01	0.06	0.31	0.10	0.49	0.05	0.02	0.08	0.59	0.38	0.80
SZ	0.01	0.00	0.02	0.05	0.02	0.10	0.01	0.01	0.02	0.91	0.86	0.94
UK	0.02	0.01	0.05	0.23	0.11	0.34	0.03	0.01	0.07	0.66	0.53	0.79

Table 10: Variance Decomposition of Countries with respect to Exchange Rate Shocks

	Global Comp.			Country Comp.			Shock Comp.			Idiosyn. Comp.		
	1/3	Med.	2/3	1/3	Med.	2/3	1/3	Med.	2/3	1/3	Med.	2/3
AUS	0.01	0.00	0.01	0.13	0.08	0.19	0.01	0.00	0.01	0.84	0.78	0.88
BEL	0.01	0.01	0.02	0.13	0.07	0.20	0.02	0.01	0.03	0.82	0.75	0.87
DEN	0.01	0.00	0.01	0.03	0.02	0.06	0.01	0.00	0.01	0.93	0.90	0.95
FIN	0.01	0.00	0.01	0.01	0.01	0.03	0.01	0.00	0.01	0.96	0.93	0.97
FR	0.01	0.00	0.02	0.07	0.04	0.11	0.01	0.00	0.02	0.87	0.83	0.91
GER	0.03	0.01	0.06	0.02	0.01	0.04	0.05	0.03	0.07	0.87	0.84	0.89
GR	0.02	0.01	0.04	0.01	0.00	0.02	0.03	0.02	0.05	0.91	0.89	0.93
IR	0.10	0.06	0.15	0.01	0.00	0.02	0.08	0.03	0.13	0.78	0.75	0.80
IT	0.03	0.01	0.04	0.01	0.01	0.03	0.02	0.01	0.03	0.92	0.90	0.94
NED	0.02	0.01	0.04	0.02	0.01	0.04	0.03	0.02	0.05	0.90	0.87	0.92
NOR	0.04	0.02	0.08	0.10	0.05	0.18	0.06	0.03	0.14	0.67	0.55	0.80
SP	0.03	0.01	0.05	0.13	0.05	0.24	0.02	0.01	0.04	0.79	0.68	0.86
SWE	0.27	0.16	0.38	0.11	0.07	0.16	0.16	0.08	0.26	0.37	0.28	0.47
SZ	0.02	0.01	0.04	0.19	0.09	0.30	0.01	0.01	0.03	0.75	0.64	0.83
UK	0.06	0.03	0.10	0.01	0.00	0.03	0.07	0.03	0.11	0.82	0.78	0.85

We present the variance shares attributable to the common factors for EMU countries in Tables (8), (9) and (10). As summary measures of the importance of factors, these tables present shock medians of posterior quantiles as well as 33 percent and 67 percent quantiles of posterior shares for each country. As Table (8) shows, the idiosyncratic component explains a significant fraction of the fluctuations for all the countries. The country factor edges all other components as dominant. It is interesting to see that UK and Norway are two countries that are more affected by the monetary policy shock effect through output channel. This is mostly due to the fact that both countries stay outside the monetary union.

Table (9) also shows that idiosyncratic component explains a significant portion of the fluctuations. Again, the local component dominates the global component. For Table (10), the results seem similar, idiosyncratic component explains a significant portion of the fluctuations for exchange rate shocks, however, we can observe that, for Sweden global component has a prominent share.

The analysis on welfare gaps and the Bayesian dynamic factor analysis mainly yields several prominent categories of results. The first group of results imply that the monetary shocks in 15 European countries that has been analyzed in the paper lead to variations in the economic efficiency in these countries in business cycle frequencies. This has couple of implications, i.e , the monetary policy potentially had a role in reducing the variations in economic efficiency. At this point, one may question whether the monetary policy could be used to keep the economy as close as possible to the first best outcome, associated with perfectly competitive outcome. Although this question was not the focus of this analysis, it can be argued briefly that monetary policy has very limited scope, if at all, in keeping the economy close to the first best outcome. Indeed, the Bayesian dynamic factor analysis supports this view by illustrating that, the common component out of the monetary shocks does not explain the fluctuations of the countries in question. This is due to two reasons. First, if the monetary policy tries to do this intentionally with "positive monetary shocks", this action may no longer be seen as a shock, as the agents would update their beliefs about the monetary policy stance. Once this objective of monetary authority is anticipated, the economic efficiency is likely fall in a way to offset the welfare gain from expansion. Second point is that these inefficiencies are mainly the outcomes of structural deficiencies in the economy, such as the imperfect competition in goods and labor markets, and therefore should be offset by the structural reforms in order to attain an efficient economic outcome. As a result, the potential impact of monetary shocks on the efficiency gap should be seen as the source of monetary policy's potential to stabilize the efficiency variations.

Table 11: Granger Causality of Monetary Policy Shocks to Efficiency Gaps

($\sigma = 1, \phi = 1$, BP(6,32)) Between 1970-2003[12]

	Germany (Shock)	UK (Shock)	Self (Shock)
AUS (GAP)	4 Lag (0.05)*	5 Lag (0.09)	3 Lag (0.04)
BEL (GAP)	No Effect	No Effect	4 Lag (0.08)
DEN (GAP)	4 Lag (0.06)	No Effect	No Effect
FIN (GAP)	No Effect	No Effect	10 Lag (0.03)
FR (GAP)	4 Lag (0.02)	No Effect	10 Lag (0.05)
GER (GAP)	4 Lag (0.04)	5 Lag (0.03)	4 lag (0.04)
GR (GAP)	4 Lag (0.03)	No effect	No Effect
IR (GAP)	No Effect	No Effect	No Effect
IT (GAP)	No Effect	5 lag (0.03)	5 Lag (0.07)
NED (GAP)	5 Lag (0.05)	8 Lag (0.04)	5 Lag (0.07)
NOR (GAP)	1 Lag (0.01)	No Effect	4 Lag (0.00)
SP (GAP)	No Effect	4 Lag (0.03)	4 lag (0.04)
SWE (GAP)	1 Lag (0.03)	No Effect	No Effect
SZ (GAP)	4 Lag (0.03)	4 lag (0.01)	No Effect
UK (GAP)	No Effect	4 Lag (0.05)	4 Lag (0.05)

*The numbers in parenthesis are probabilities

Table (11) illustrates the Granger causality test results side result of the Granger causality tests conducted in this paper is that none of the monetary shocks identified in previous parts are affected by the efficiency gaps and the monetary shocks of other countries. As a result, we can conclude that our study makes an acceptable account of the monetary policy shocks in European countries over the last four decades both due to the absence of well known puzzles encountered in VAR studies and due to the exogeneity of these shocks to other variables. In addition to that, although there are many studies in the literature that aims to present the degree of integration between the European countries, the variance decomposition method illustrated at the last part combined with the welfare fluctuations gives a different and new dimension to the business cycle literature.

The second group of results illustrate evidence that the economic efficiency varies endogenously. In contrast, Hall (1997) argues that the measure of economic efficiency fluctuates exogenously for the case of United States and this result has been interpreted as a support for exogenous taste and preference shocks leading to variations to economic efficiency. The causal effects running from the monetary shocks toward the variations in the economic efficiency implies that these movements are not exogenous. This finding is similar to the findings of Gali et al. (2007) for United States.

The third group of results related with the analysis of the welfare gaps imply that there have been important cross-country welfare effects of the monetary shocks for the case of German monetary shock. These results can be observed from Table (11) in detail. The first column of Table (11) illustrates the causality from German policy shocks to the 14 countries welfare gap series, which shows that most of the countries welfare gap is affected from German policy shocks. Apart from providing some support for rationale for monetary policy coordination in Euro Area, considering the potential stabilizing effects of German monetary policy in most European countries, the results of the analysis provide a clear support for attaching a big role to Germany in policy making of ECB. On the other hand, the results also show that there is no German dominance in the Euro-Area in the sense that not every country responds to German monetary shocks. This result raises the question whether the European monetary policy should be under major influence by Germany, as some of the countries do not respond to monetary policy shocks in Germany.

The fourth result has two important corollaries. First, it may be plausible to ask why the countries such as Italy and Spain whose variations of economic efficiency are unaffected by monetary shocks to Germany find it beneficial to participate in EMU. Although the answer to this question may be a further matter of interest, one possible answer may be the fiscal discipline imposed by the accession to Euro. Second corollary is that considering the potential benefits of having an influential role for UK besides Germany, along with the fiscal discipline imposed by EMU, it can be concluded that countries like Italy and Spain would have broader range of benefits from participation in EMU upon a change in the nature of monetary policy of ECB, if UK were part of EMU and had an influential role at ECB.

One point should also be emphasized with respect to the questioning of potential effects of UK monetary shocks in the area. Table (11) shows that all countries in the sample except for Ireland, Finland and Belgium can be classified either as part of the group responding to UK monetary policy shocks or the group corresponding to German monetary policy shocks. Detailed examination of the Granger causality results shows that the German monetary policy shock leads to movements in neighbor countries; whereas UK monetary policy shocks lead to movements in other countries. For the case of Ireland, it has been observed that the welfare gap gives no response to shocks of both the Germany and the UK.

The last result is about the question of whether the monetary policy shocks of the countries studied in this section have a common component that dominates all other components. Using variance decomposition method, it has been observed that the idiosyncratic components dominates the monetary policy shock fluctuations and in addition to that the local shocks are more prominent when compared with the global component. The low level of integration may reflect to the fact that, European countries still have to concentrate to synchronize their monetary policy. Other explanation can be the non-existence of fiscal policy shocks in the analysis. The idiosyncratic component may be picking the effects coming from the regulation of the fiscal policy.

7 Conclusion

In this study, the nature of the changes in the economic efficiency over the business cycle has been examined for 15 European countries. Accordingly, welfare gap measure has been constructed for each country following Gali et al. (2007), by considering a wide range of assumptions related with the technology and preference parameters as well as various filtering methods. A principal conclusion with respect to the properties and the cyclicality of these series is that the fluctuations in economic efficiency in Europe is closely correlated across countries. In addition, the variations in the gap is procyclical, implying that the inefficiencies arising from structure of the goods market and the labor market tend to decrease during expansions, and increase during recessions. However, the results are vulnerable to changes in the assumptions about the functional forms and parameter values, and therefore leads us to conclude that the more accurate results requires the support from applied microeconomic studies for us to employ the most plausible welfare measure.

Another basic block that has been analyzed in this paper is whether the welfare gap in Europe responds to the monetary shocks originated by either the countries themselves, or by the other countries in the area. The answer to this question is important both from theoretical point of view and from practical point of view. The Granger causality test results between the identified monetary policy shocks and the welfare gaps of the countries proves that the welfare gap in nearly all European countries responds to either German monetary shock or UK monetary shock or both, along with their own monetary policy shocks. These results have important implications for the potential welfare effects of EMU's expansion to include new countries like United Kingdom, as well as for indicating the need for a monetary policy stance in ECB, considering both UK's and Germany's potential influence in the region.

Conclusively, it can be stated that for the years studied in this part of the thesis, it has been observed that the European countries are far behind from having a common fluctuation within the framework of monetary policy shocks related to output, consumer prices and the exchange rates. The monetary policy shocks of 15 countries are dominated by their own policy cycles.

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Appendix A The Construction of Gap Measures

1) Cobb-Douglas Preferences with Cobb-Douglas

$$U(C_t, L_t) = \frac{\left[C_t^{\beta} L_t^{1-\beta}\right]^{1-\sigma}}{1-\sigma},\ 0 < \beta < 1 \text{ and } \sigma > 0. \tag{A.1}$$

$$Y_t = A_t K_t^{\alpha} N_t^{1-\alpha},\ 0 < \alpha < 1 \tag{A.2}$$

$$\widetilde{gap}_t = \frac{\overline{N}}{\overline{L}}(1-\beta)\widetilde{n}_t + \beta\widetilde{c}_t - (\widetilde{y}_t - \widetilde{n}_t) \tag{A.3}$$

2) Cobb-Douglas Preferences with CES Production Function:

$$U(C_t, L_t) = \frac{\left[C_t^{\beta} L_t^{1-\beta}\right]^{1-\sigma}}{1-\sigma},\ 0 < \beta < 1 \text{ and } \sigma > 0 \tag{A.4}$$

$$Y_t = A_t \left[bK_t^{-\rho} + (1-b)N_t^{-\rho}\right]^{-\frac{1}{\rho}},\ \rho \in (-1, \infty) \text{ and } 0 < b < 1 \tag{A.5}$$

$$\widetilde{gap}_t = \frac{\overline{N}}{\overline{L}}(1-\beta)\widetilde{n}_t + \beta\widetilde{c}_t - A^{-\rho}\left[b\left[\frac{\overline{K}}{\overline{Y}}\right]^{-\rho}\widetilde{k}_t + (1-b)\left[\frac{\overline{N}}{\overline{Y}}\right]^{-\rho}\widetilde{n}_t\right] \tag{A.6}$$

3) CRRA Utility Function with Cobb-Douglas Technology:

$$U(C_t, N_t) = \frac{C_t^{1-\sigma}}{1-\sigma} - \frac{N_t^{1+\phi}}{1+\phi},\ \sigma > 0 \text{ and } \phi > 0 \tag{A.7}$$

$$Y_t = A_t K_t^{\alpha} N_t^{1-\alpha},\ 0 < \alpha < 1 \tag{A.8}$$

$$\widetilde{gap}_t = \sigma\widetilde{c}_t + \phi\widetilde{n}_t - (\widetilde{y}_t - \widetilde{n}_t) \tag{A.9}$$

4) CRRA Utility Function with CES Technology:

$$U(C_t, N_t) = \frac{C_t^{1-\sigma}}{1-\sigma} - \frac{N_t^{1+\phi}}{1+\phi}, \ \sigma > 0 \text{ and } \phi > 0 \tag{A.10}$$

$$Y_t = A_t \left[bK_t^{-\rho} + (1-b)N_t^{-\rho} \right]^{-\frac{1}{\rho}}, \ \rho \in (-1, \infty) \text{ and } 0 < b < 1 \tag{A.11}$$

$$\widetilde{gap}_t = \sigma\widetilde{c}_t + \phi\widetilde{n}_t - A^{-\rho} \left[b \left[\frac{\overline{K}}{\overline{\overline{Y}}} \right]^{-\rho} \widetilde{k}_t + (1-b) \left[\frac{\overline{N}}{\overline{\overline{Y}}} \right]^{-\rho} \widetilde{n}_t \right] \tag{A.12}$$

5) Greenwood-Hercowitz-Huffman Preferences with Cobb-Douglas Technology:

$$U(C_t, N_t) = \frac{[C_t - \xi N_t^{\nu}]^{1-\sigma}}{1-\sigma}, \ \sigma > 0 \ and \ \nu > 1. \tag{A.13}$$

$$Y_t = A_t K_t^{\alpha} N_t^{1-\alpha}, \ 0 < \alpha < 1 \tag{A.14}$$

$$\widetilde{gap}_t = (\nu - 1)\widetilde{n}_t - (\widetilde{y}_t - \widetilde{n}_t) \tag{A.15}$$

Appendix B Data

Countries AUS: Austria

BEL: Belgium

DN: Denmark

FIN: Finland

FR: France

GER: Germany

GR: Greece

IR: Ireland

IT: Italy

NET: Netherlands

NOR: Norway

SP: Spain

SWE: Sweden

SZ: Switzerland

UK: United Kingdom

Data

The sources of the raw data are the OECD Economic Outlook N. 75 and the IMF, Internatinal Financial Statistics. The data used in the paper is quarterly data from 1960:Q1 to 2004:Q2.

Data used for the calculation of gap series

LY_PC: logarithm of real GDP per capita

LC_PC: logarithm of real private consumption per capita

LN: logarithm of total employment

POP: Total Population

Data used for the estimation of VAR

LY: logarithm of real GDP

LCPI: logarithm of consumer price indices

SR_I: Money Market Rate

LOIL: Logarithm of Crude Oil Prices, US$/Barrel

LCOMMP: logarithm of world commodity price index

Appendix C FIGURES

Figure C.1: Components for Individual European Countries

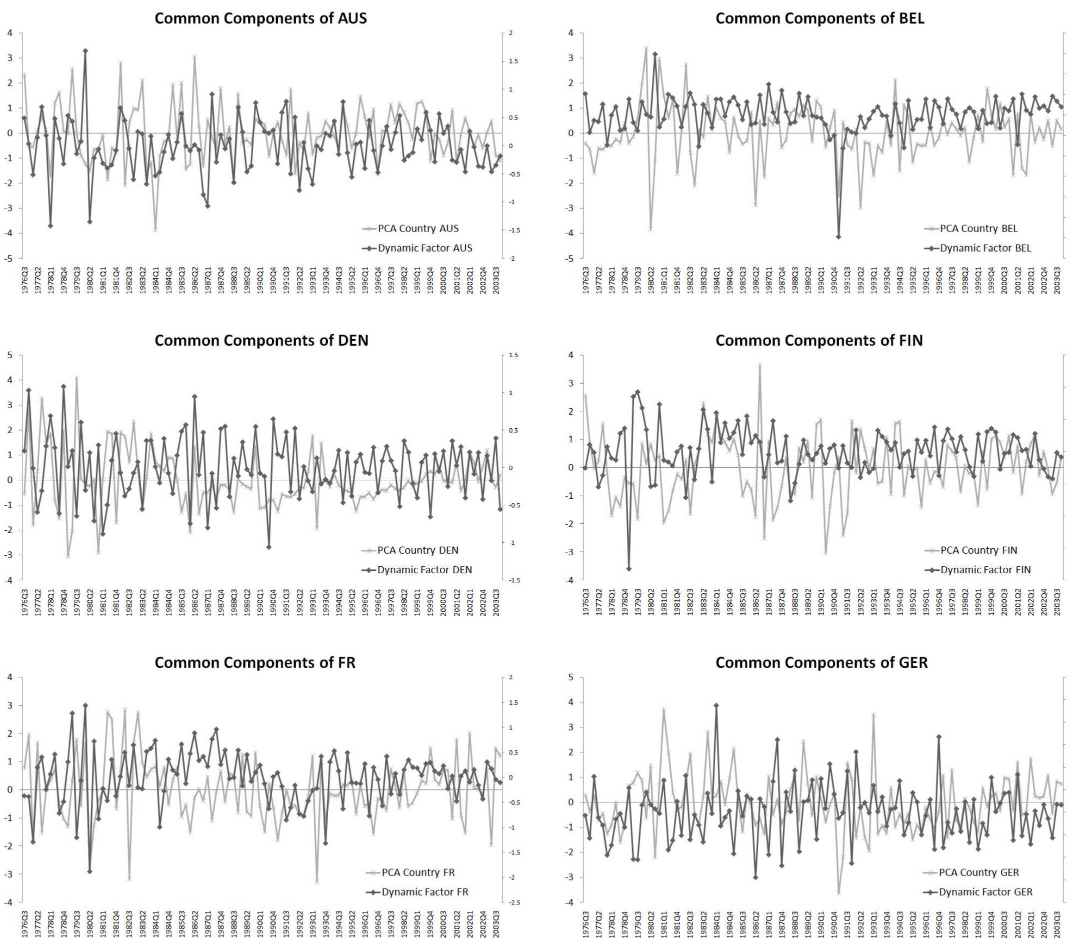

Figure C.2: Components for Individual European Countries

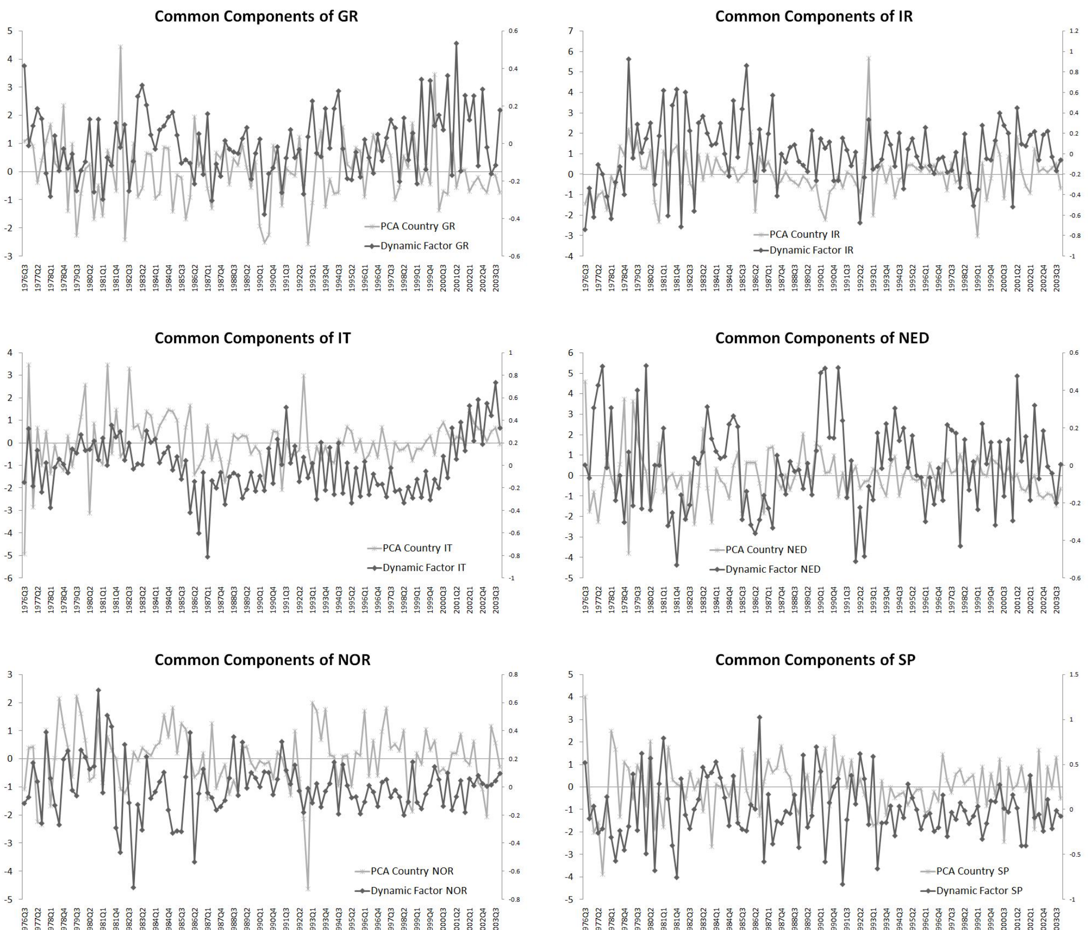

Figure C.3: Components for Individual European Countries