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Abstract

The primary objective of this paper is to estimate a fiscal policy rule for each of the EMU member States from 1984 to 2005 in order to know if there has been a systematic response of the cyclically adjusted primary balance to output gap and debt level variations. Also, we aim to discover whether the change in the fiscal framework which took place after 1992 has had a substantial impact on the fiscal policy applied. The principal novelty is that the estimation is performed simultaneously by means of a SURE (Seemingly Unrelated Regression Estimator) model. We are thus able to obtain different coefficients for each country, while developing possible correlations between national fiscal policies which would reveal the existence of common factors. The results provide clear evidence of a structural break in the rule after the introduction of the new fiscal regulations and, as the hypothesis of equality in the national coefficients of the rule is clearly rejected, reveal a need to consider specific national factors.

1. Introduction:

The primary objective of this paper is to estimate a policy rule for the fiscal authorities of each of the EMU member States from 1984 to 2005 in order to know if there has been a systematic response of the cyclically adjusted primary balance to output gap and debt level variations.

The overall approach, therefore, lies within the framework of what is known as New Normative Macroeconomics (Taylor (2000a and 2000b)), the principal characteristic of which is the formulation of economic policy in the form of activist rules. These rules are expressed by more or less simple equations in which the instrument used by the authorities depends on a reduced number of variables indicating the state of the economy.

The use of policy rules has spread in academic literature as a useful tool for analysing economic policy from both a positive and normative perspective The best known example is the Taylor Rule[1]. The estimation of the Taylor Rule enables us to know if a central bank actively responds or not to changes in the inflation rate or income, and make comparisons between countries over time.

One paper of reference in the application of this method to fiscal policy in EMU countries is Galí and Perotti (2003). Their primary objective was to analyse the changes occurred in European fiscal policy as a result of the introduction of new fiscal rules in 1992 (Maastricht Treaty, MT) and 1997 (Stability and Growth Pact, SGP). In particular, from our perspective, the most important results obtained from estimating the rule are that the new fiscal policy framework have reduced the previously procyclical nature of the discretionary policies applied by

[1] Taylor (1993).

European governments, and that nonetheless, there has been no reduction in the application of corrective fiscal policies when public debt has increased.

Although a different rule is also estimated for each country separately, Galí and Perotti focus on common European trends, and obtain their main results from estimating a data panel in which the coefficients of the rule are the same for all EMU countries. Consequently, they are unable to appropriately distinguish the different fiscal policies applied by each European country.

This "common European factor", and in particular the introduction of new fiscal rules, has probably been of great importance for the development of the fiscal policies applied by the different governments. However, we cannot rule out the existence of "specific national factors" which have generated significant differences in the coefficients of the rule for each country. We have therefore simultaneously estimated all the national equations with a SURE[2] model, enabling us to use the information derived from both common and specific factors.

Indeed, the simultaneous estimation of all the equations makes use of the correlation between the errors terms of each national equation, including all factors with a common origin. But, at the same time, there is no initial constraint to the value of the national coefficients, which are not necessarily the same, enabling us to consider national differences. In fact, the results obtained clearly show that such differences are significant.

This paper is therefore supplementary to the work of Galí y Perotti, and its primary objective is to re-estimate the impact of the change in the European fiscal policy framework on the discretionary policies applied by European governments

[2] Seemingly Unrelated Regression Estimator.

while paying more attention to the differences between countries. In the second section, then, we define the fiscal policy rule to be estimated while, in the third, we justify the choice of method and approach some issues related to the data employed. The fourth section includes a brief summary of the coefficients estimation, together with the principal tests used to diagnose the model. Section five contains a more detailed interpretation of the results and the paper ends with our conclusions.

2. ***Identification of the fiscal policy rule:***

In this section, we present the fiscal policy to be estimated, requiring us to define both the variable to be used to represent the authorities' decisions and the variables whose evolution in turn determined fiscal policy changes. For comparison purposes, these variables are as used by Galí and Perotti (2003).

2.1. Variable representing fiscal policy:

The variable used in this paper to represent fiscal policy orientation is the cyclically adjusted primary balance (CAPB), the dependent variable of the regression. This variable represents the discretionary component of fiscal policy, that is, the part of the budgetary balance which directly depends on governmental decisions. In particular:

- We use the primary and not the total balance because the authorities have no short term impact on debt interest payments, since they depend on the evolution of the interest rate and accumulated debt. Furthermore, as Bohn (1998) shows, a condition sufficient to ensure the long-term sustainability of

public finance is that the authorities increase the primary balance whenever the public debt-GDP ratio grows. One of our objectives is precisely to determine the degree to which the authorities take sufficient action to ensure this.

- We have also discounted the effects of the economic cycle from this primary balance, for two reasons. Firstly, the CAPB (or its increase) is the variable most often used in fiscal policy literature to measure the orientation (expansive or contractive) of discretionary fiscal policy, distinguishing it from the effect of automatic stabilisers which would be mixed into the total primary balance[3]. Secondly, as Galí and Perotti (2003) point out, given the more structural nature of the factors influencing the action of automatic stabilisers (for instance, the labour market or welfare state institutions of each country) are unlikely to have been significantly affected in the short tem by the Maastricht Treaty or the Stability and Growth Pact. Therefore, since another of our objectives is precisely to analyse the effect of introducing these rules into the behaviour of fiscal authorities, the CAPB appears to be a more appropriate variable.

2.2. Variables determining fiscal policy:

The variables used as regressors in this paper are the output gap, the debt-GDP ratio, a binary variable and the cyclically adjusted balance delayed one period:

- The choice of these variables is related to the objectives expected of the authorities when making their budgetary decisions. According to Favero and

[3] This analytical procedure is followed by the European Commission (2006) and in all the previous editions of *Public Finances in EMU*. Larch and Salto (2003) offer a discussion of the utility of this indicator to measure the sign of discretionary fiscal policy.

Monacelli (2003), these decisions largely obey a short-term objective (the cyclical stabilisation of the economy, which these authors qualify as the "active" component of fiscal policy) and another longer-term objective (the sustainability of public finance, or "passive" component of fiscal policy).

From a short-term perspective, the authorities may attempt to alter public revenue and expenditure in order to compensate for cyclical income fluctuations by means of their effect on aggregate demand. Some doubts have recently been expressed concerning the efficacy of fiscal policy in influencing income and employment levels, fundamentally based on the hypothesis of Ricardian Equivalence. However, neither the theoretical arguments[4] nor the empirical evidence appear to be sufficient to reject the use of fiscal policy to stabilise the economy. Indeed, numerous recent studies provide strong support for the idea that fiscal stimuli can have positive effects on the economy during periods of low growth[5]. In fact, the creation of the EMU itself, by centralising monetary policy decisions, is an additional argument for national authorities to operate in this way, further adapting the global sign of the single monetary policy to the specific cyclical conditions in each country. Therefore, one of the regression variables is the output gap (OG), to verify whether EMU countries

[4] Calmfors (2003) says that "the Ricardian equivalence results require very restrictive theoretical assumptions which are not likely to apply in reality". Blinder (2004) summarises the most common criticisms of this hypothesis.

[5] Burnside, Eichenbaum and Fisher (1999) and Fatás and Mihov (2000) point out that in the United States fiscal shocks also produce changes in output, consumption, investment and employment. Furthermore, Fatás and Mihov (2002), based on time and cross-section data pertaining to 51 countries, find that the relation between the magnitude of output changes and the use of discretionary fiscal policy is statistically significant, in the sense that countries with larger governments suffer less economic cycle volatility. On the other hand, Perotti (2002) studies the effects of fiscal measures on GDP, price and interest rate growth in five OECD countries (United States, Germany, United Kingdom, Canada and Australia) using autoregressive vectors. Firstly, the analysis reveals that the estimated effects of fiscal policy on the GDP tend to be positive, although minor, and that public expenditure multipliers (positive and mostly less than one) are usually larger in absolute values that those obtained as tax multipliers (negative). Hemming, Kell and Mahfouz (2002) present a selection of this empirical literature, showing that the estimated mean tax multiplier is 0.5.

have indeed worked in this way, systematically changing the CAPB to stabilise their economies. This would be confirmed by a positive regression coefficient.

With a more long-term perspective, another of the objectives at which countries should aim when making primary balance decisions is, as we have mentioned, to guarantee the long-term sustainability of public finance. This requires corrective measures when debt increases, and the second regressor variable is therefore the debt/GDP ratio (PD) at the end of the previous period. This variable's coefficient should also be positive if the authorities systematically apply policies which are sustainable in the long term.

- A second criterion for the choice of variables included in the regression is derived from the fact that the framework in which fiscal policy is applied in the European Union has changed substantially since the nineties with the introduction of the rules established first in the Maastricht Treaty and, later, with the Stability and Growth Pact. This suggests the possibility of a structural break in the value of the parameters[6] so, to account for this possible effect, we have included a binary variable (AM_{92it}) with zero value for the years before 1992 and a value of 1 from then on, accompanying both the output gap and public debt as the constant of the regression.

- Finally, we have included the value of the CAPB delayed one period, in so far as fiscal decisions are affected by a high level of inertia. Indeed, the results of the estimation show that this variable is significant in the fiscal policy of all EMU countries.

[6] A Chow test and other statistics have confirmed us such a structural rupture in 1992. See section 4.1.

2.3. *Estimated equation and meaning of the coefficients:*

In conclusion, once the independent and dependent variables have been defined, the estimated equation is as follows:

$$CAPB_{it} = \alpha_{0i} + \alpha_{1i} AM_{92it} + \beta_{1i} OG_{it} + \beta_{2i} AM_{92it} OG_{it} + \beta_{3i} PD_{it-1} + \beta_{4i} AM_{92it} PD_{it-1} + \beta_{5i} CAPB_{it-1} + u_{it} \quad (1)$$

As we will see later, this equation was estimated simultaneously for each of the 11 EMU countries for which data is available from 1984 (all of them except Luxembourg) taken from OECD (2006). An equation is also estimated for the mean EMU data.

As we mentioned earlier, CAPB is the cyclically adjusted primary balance, OG is the output gap, PD represents public debt, AM is the variable representing the effect of the introduction of new fiscal rules in the EU from 1992 on, and Table 1 shows the economic meaning of the coefficients. Sub-index i represents the ith country, whereas sub-index t represents the period to which the variables correspond.

Insert Table 1 here

3. ***Method of estimation and data used:***

One of the main issues we have approached in this paper is the choice of a method of estimation meeting two important conditions.

In the first place, we are working with 11 countries which form part of a strongly integrated economic area, the fiscal policies of which have been conditioned by a highly significant institutional change, represented by the new

fiscal discipline rules included in the Maastricht Treaty and the Stability and Growth Pact. Their fiscal policies can therefore be expected to have some common features.

Secondly, however, we are also interested in determining whether the systematic behaviour of the different national fiscal authorities – shown in the coefficients of the rule – reveals differences, and whether the effects of introducing the new fiscal framework have been homogeneous across EMU countries. This seems particularly important as, throughout the integration process, economic policy coordination did not include the centralisation of fiscal policies which, although subject to a multilateral supervision process, remain under the authority of the national governments. Furthermore, after the creation of the EMU, fiscal policy is now the only macroeconomic instrument available to these governments for stabilising their economies, so each country can be expected to adapt it to its own specific situation.

In other words, the method of estimation has to contemplate the interrelation between fiscal policies, while distinguishing different national behaviours.

Taking the work of Galí and Perotti (2003) and IMF (2004) as representative of recent literature concerning the estimation of fiscal policy rules in EMU countries, we see that they have used a similar modelling strategy. Each national equation is first estimated separately, subsequently estimating a panel with data from all the countries, permitting the existence of fixed national effects but taking the other coefficients between the fiscal rules of different countries as equal.

Galí and Perotti (2003) justify this second step by referring to a problem of insufficient degrees of freedom in the estimation of each national equation

separately, whereas IMF (2004) underlines the possibility of changes in the coefficients derived from processes common to the entire euro area, such as the introduction of a new fiscal framework. This global effect could be insufficiently contemplated in the individual national estimations.

The principal innovation in our work is the use of a SURE (Seemingly Unrelated Regression Estimator) model[7], which will enable *simultaneous estimation by generalised least squares* of the 11 national equations considered. In our opinion, there are two primary reasons for preferring this choice to the alternative used in the two aforementioned publications:

1. On the one hand, this estimation procedure enables the use of the correlation matrix of the error terms of each equation to gain efficiency. The growing interdependence of these economies, the convergence of their economic policies[8] or the existence of common shocks will give the error terms of the equations of the different countries a common component, representing a far from negligible contemporaneous correlation[9]. It is therefore not efficient to estimate the 11 fiscal policy equations separately for each country.
2. Furthermore, our model does not initially limit the behaviour of the different countries because they belong to the EMU, but tests the values of the coefficients to determine whether behaviour is homogeneous or varies among the different national authorities. In other words, it considers the possible importance of specific national factors (political, economic or institutional)

[7] See Green (1999), Chap. 15.
[8] European Commission (2004).
[9] The data used in the study are annual and, due to their low frequency, there are unlikely to be important non-contemporaneous correlations. The cross correlation functions calculated from the GLS residuals of the different countries have confirmed this.

for explaining the fiscal authorities' different reactions to changes in the cyclic situation or levels of debt. Indeed, as we shall see later, the hypotheses of homogeneous behaviour by countries have always been rejected.

This type of estimation, therefore, by enabling us to simultaneously obtain different coefficients for each country, is more efficient for distinguishing national behaviours than the fixed effects of the data panel.

Taking this into account, the estimation is by generalised least squares (GLS) to gain efficiency, contemplating the contemporaneous correlations between countries. To justify this, we start by specifying the covariance matrix of the enlarged vector formed with the error terms of all the simultaneous equations. A simple and realistic assumption concerning the structure of this covariance matrix comprises the following hypotheses[10]:

1. In each equation, the error term presents neither autocorrelation nor heteroscedasticity[11]:

$$E\left(u_i u_i'\right) = \sigma_i^2 I_T \text{ ; i = 1,2, ..., m}$$[12]

The fact that the lagged dependent variable itself appears as the regressor also shows that, with this assumption, the error term does not present correlation.

2. The only non null correlation between the errors of the different equations is contemporaneous:

[10] Novales (1993), page 274.
[11] Although there can be heteroscedasticity between the different countries.
[12] m is the number of equations in the model.

$$E(u_i u_i') = \sigma_{ij} I_T \; ; \; i \neq j; \; i,j = 1,2, \ldots, m$$

That is, it is assumed that the covariance is independent from the moment in time considered [E ($u_{it}u'_{jt}$) = σ_{ij}, for all t = 1,2, ..., T] and it is also admitted that E ($u_{it}u'_{js}$) = 0 for all t ≠ s, t, s = 1, 2, ..., T.

With the above assumptions, the general covariance matrix of the shocks can be written using the Kronecker product: $\Omega = \Sigma \otimes I_t$, where Σ is the contemporaneous variance-covariance matrix of the residuals. Matrix Ω is not scalar and, therefore, if our assumptions are true, the usual ordinary least squares (OLS) estimator will not be efficient, since it ignores the information contained in the covariances between contemporaneous observations of different equations. The efficient estimation, considering the covariance matrix between the error terms of different equations, can be performed by generalised least squares *(GLS)* by means of the following expression:

$$\hat{\beta}^{MCG} = \left(X^T \Omega^{-1} X\right)^{-1} \left(X^T \Omega^{-1} Y\right)$$

And the covariance matrix of the estimation is given by:

$$\text{var}\, \hat{\beta}^{MCG} = \left(X^T \Omega^{-1} X\right)^{-1}$$

Our analysis of the residuals of the estimated national equations has confirmed our assumptions about the covariance matrix and, therefore, the convenience of simultaneous estimation by GLS.

This is shown, for instance in the heteroscedasticity test between groups and cross-section correlation[13] (Table 2). This tests the hypothesis that the elements outside the diagonal of the covariance matrix estimated from the OLS residuals are zero, that is, that there is no correlation between EMU countries. If the null hypothesis is rejected, as it is here, it is more efficient to estimate a SURE model by GLS, as the model is not restricted by a single parameter vector and the correlation matrix of the error terms is used in the estimation to gain efficiency.

Insert Table 2 here

Furthermore, the contemporaneous correlation matrix of the residuals estimated by GLS (Table 3) contains significant values, confirming the need to take these correlations into account when estimating the model.

Insert Table 3 here

Finally, Graph 1 shows the autocorrelation functions of the residuals estimated by GLS. As we can see, the error term of each equation does not present autocorrelation, which is one of the other assumptions established concerning the covariance matrix of the error terms.

Insert Graph 1 here

[13] Green (1999), page. 571.

One final issue that has to be considered in relation to the method of estimation employed refers to the data available. We have used the annual data provided in the Statistical Annex of *OECD Economic Outlook* (No. 79, May 2006), which includes both fiscal variables and the estimation of the output gap and the separation between the discretionary component of fiscal policy and the use of automatic stabilisers.

The estimated period includes every year for which data is available for the 11 countries for which the fiscal policy rule has been estimated: from 1984 to 2005. This period is particularly interesting, because it includes enough years before and after the approval of the fiscal rules currently applicable in the EMU, enabling us to analyse a possible structural change.

One problem with our method of estimation is that, since the sample is relatively short, the number of observations is small in relation to the number of parameters to be estimated. To reduce this possible over-parameterisation problem, it may be a good idea to increase the data frequency or increase the period backwards in time. We have ruled out both these options, however, for the following reasons:

- In the first place, most of the tests we have used for diagnosing the model, analysing the fit of the estimation with the original series or testing the existence of a structural break, have rejected the null hypothesis considered. And, although the tests are not very powerful because of the short sample used, if the null hypothesis considered is rejected, as it is here, there will be very clear evidence in favour of this rejection.

- Although there are some quarterly fiscal data interpolated from annual figures, they are not homogeneous and, furthermore, budgetary decision-making takes place on an annual basis. This, for instance, is the frequency with which the budgets of EMU countries are approved and compliance with the requirements of the Stability and Growth Pact is analysed.

- We would also prefer not to go much further back than the contemplated period, as the seventies are characterised by important supply shocks (rising oil prices) which conditioned the application of economic policy. We would probably have to consider the special nature of the data pertaining to those years by including new parameters, which would certainly do nothing to improve the over-parameterisation problem observed with our model. Indeed, the empirical literature about the recent evolution of fiscal policy in the EMU compared with previous years usually focuses on the period starting in the eighties.

- There is also an important practical reason. We have used all the data provided by the OECD *Economic Outlook* as Galí and Perotti (2003). The two options proposed could reduce our comparability and force us to use a different source.

4. ***Estimated values of the coefficients and principal tests performed:***

Table 4 shows the values of the estimated coefficients of the fiscal policy rule for each country and for the EMU overall, together with the t-statistic.

Although we will later be analysing our results and their possible significance in more detail, we are now in a position to advance some results:

- Before 1992, the coefficients estimated for the output gap are 10% significant in 5 of the 11 countries; after 1992, they are significantly different from zero in 6 countries. It is clearly significant in both periods for the EMU overall.
- The only case in which the estimated coefficient is positive and significant both before and after 1992 is Finland,. In the rest, it is either negative or not significantly different from zero. This appears to indicate that, in the past, discretionary fiscal policy did not systematically play a stabilising role.
- The estimated debt coefficients are significant for 5 EMU countries before 1992 and for 3 afterwards. For the EMU overall, its mean value is very close to zero in both periods.
- Unlike the case of the output gap, when these coefficients are significant, they take on positive values, with the only exception of Belgium before Maastricht.
- Finally, the coefficient of the cyclically-adjusted primary balance lagged one period is clearly significant for all the countries, showing that budgetary decisions are affected by a certain degree of inertia.

Insert Table 4 here

Besides these tests of the individual significance of the parameters, below are the results of the principal statistical tests performed to analyse the evidence available concerning the existence of a structural change in the sample, in order to check whether the estimation obtained meets the required conditions.

4.1. Evidence of structural change:

One of our primary objectives is to test whether the change occurred in the regulatory framework applicable to fiscal policy from 1992 on has altered the systematic behaviour of the fiscal authorities, both in their response to the output gap and in their reaction to changes in indebtedness, and whether this change has been heterogeneous in the different countries.

In order to verify whether there is a structural break in the data in 1992 and, therefore, whether the introduction of a binary variable[14] with which to represent the effects of the Maastricht Treaty was correct, we have performed a series of tests on our model, the results of which are shown in Table 5.

Insert Table 5 here

The first row shows the result of the Chow test, which clearly detects a change in the value of the parameters from 1992 on, so we have estimated the model including a binary variable (AM92t) representing the effect of the change in the fiscal framework on the behaviour of each country's authorities.

[14] With a value of one from 1992 on and zero beforehand.

This change can be included both in the equation's constant and in the response of discretionary policy to the output gap and debt. The model including the structural change would be represented by the equation:

$$CAPB_{it} = \alpha_{0i} + \alpha_{1i} AM_{92it} + \beta_{1i} OG_{it} + \beta_{2i} AM_{92it} OG_{it} + \beta_{3i} PD_{it-1} + \beta_{4i} AM_{92it} PD_{it-1} + \beta_{5i} CAPB_{it-1} + u_{it}$$

We have also compared the estimation resulting from this model with that derived from the same model without structural change, using Akaike and Schwarz information criteria. As the Table shows, this analysis confirms that, although there is an over-parameterisation problem, the model with structural break fits the data better than a model estimated by the same procedure but without contemplating such a break.

Thirdly, to measure the overall goodness of fit of the system, we present a McElroy generalised R2 (1977)[15]. The use of this statistic instead of the traditional R2 is justified, firstly, by the need for a single overall measurement of the system's goodness of fit; and secondly, because in a SURE model like ours the cross-section correlation is used in the method of estimation to gain efficiency in the estimations obtained. The value of this measurement from the data used here is 0.925.

On the fourth row of the Table, we go from a global analysis of the model's fit to a more detailed analysis of each of the parameters showing the effects of the structural change in discretionary fiscal policy (α_{1i}, β_{2i} and β_{4i}). We have therefore tested whether $H_0 : \alpha_{1i} = 0$ or $H_0 : \beta_{1i} = 0$ or $H_0 : \beta_{4i} = 0$, which

[15]The McElroy R2 corresponds to the following expression (see Green (1999), page 585):

$$R_*^2 = 1 - \frac{\hat{\varepsilon}' \hat{V}^{-1} \hat{\varepsilon}}{\sum_{i=1}^{M} \sum_{j=1}^{M} \hat{\sigma}^{ij} \left[\sum_{t=1}^{T} (y_{it} - \bar{y}_i)(y_{jy} - \bar{y}_j) \right]}$$

is more clearly rejected for the constant and the debt coefficient, but also for the output gap.

There is therefore very strong evidence of a structural change. The second part of Table 5 shows other tests performed to verify whether there are significant national differences in the effects of this structural change.

Row 5 presents the results of a test to rule out the effect derived from the application of new fiscal rules from 1992 on being the same for all EMU countries, that is, whether $H_0 : \alpha_{1i} = \alpha_1$ or $H_0 : \beta_{2i} = \beta_2$ or $H_0 : \beta_{4i} = \beta_4$. Once again, the null hypothesis is rejected, which seems to reinforce the need to estimate the model allowing for national differences in the parameters.

And this result is even stronger when we test the equality of the parameters, both in the model with structural change (row 6) and in the model without (row 7). The null hypothesis in the model with structural change is: $H_0 : \alpha_{0i} + \alpha_{1i} = \alpha$ or $H_0 : \beta_{1i} + \beta_{2i} = \beta_1$ or $H_0 : \beta_{3i} + \beta_{4i} = \beta_3$, and: $H_0 : \alpha_{0i} = \alpha$ or $H_0 : \beta_{1i} = \beta_1$ or $H_0 : \beta_{3i} = \beta_3$ in the model without structural change. It is rejected in both models.

Therefore, this seems to confirm the two initial hypotheses described at the start of this paper: from 1992 on, coinciding with the change in European fiscal rules[16], there is a change in the effects of both the output gap and debt on discretionary fiscal measures; furthermore, these effects are different for each EMU country.

[16] The fact of this coincidence does not imply that the new rules are the only explanation for the different behaviour observed in the fiscal authorities. This institutional change probably encouraged more budgetary discipline in Europe, reducing the weight of the public sector, which has a broader territorial dimension.

4.2. *Diagnosis of the estimated model:*

The evidence derived from the above statistical tests has led us to finally select a model with structural change in which each country's fiscal policy coefficients can be different, but which also considers the interrelation between each of the national equations (simultaneous estimation).

To diagnose our final estimation, we now analyse the existence of autocorrelation in the residuals, their normality and goodness of fit with the original series. As Table 6 shows, the p-values of the Ljung-Box and Breusch-Godfrey tests only show slight evidence of autocorrelation for 1, 2 and 5 lags in some cases, whereas the Jarque Bera test confirms the normality of the residuals.

Finally, we have also calculated the values of the goodness of fit measurements which would have been obtained working individually with each regression and, as we can see, they are lower than that obtained with the global system, which is very high. There is high variability in the fit of each country although, except for Portugal, Holland and Austria, the R2 is relatively high.

Insert Table 6 here

5. ***Interpretation of the results:***

Returning to the values of the estimated fiscal policy rule coefficients for each country and for the EMU as a whole, we can analyse the results of the estimation in more detail. We have centred our analysis on four principal issues: (i) the stabilising role of discretionary fiscal policy, as given by the effect of the

output gap on discretionary decisions, (ii) the effect on these discretionary decisions of the aim of guaranteeing the sustainability of public finance, (iii) the consequences of adopting the new fiscal policy normative framework (Maastricht Treaty and, later, the Stability and Growth Pact) on the two types of behaviour, and (iv) the differences in the coefficients estimated for each country. Following are the results of the joint analysis of these four issues:

1. Before application of the Maastricht Treaty, most EMU countries were characterised by a procyclical discretionary fiscal policy, as can be seen in the negative sign of the β_{1i} parameter (Table 4 and Graph 2). The only exceptions are Finland and Ireland, whereas the countries in which the negative value of the coefficient is greatest are Greece, Germany, Italy, France and Holland.

Insert Graph 2 here

Indeed, the activity, deficit and debt data shows that in an initial phase, from 1984 to 1987, the output gap was negative and contractive discretionary fiscal policies were, nonetheless, applied (there was an increase in the adjusted primary balance in the period, as seen on Graph 3). This behaviour can be justified by the difficult situation of public finances in early eighties, reducing the scope for using fiscal policy as a way of stabilising the economy.

On the other hand, from 1988 to 1991 the European economies experienced an expansive phase, which favoured reduction of the deficit during the period. But this reduction occurred as a result of the application

of automatic stabilisers, since the discretionary fiscal policy was expansive. This can be seen in Graph 3. As you can observe, the output gap increased and the cyclical component of fiscal policy (the effect derived from the automatic stabilisers) therefore generated an improvement in the total budgetary balance. However, since the adjusted balance was diminishing (procyclical) the net effect was only a slight improvement in deficit figures.

Insert Graph 3 here

2. From 1992 on, most countries have experienced a important change in their discretionary fiscal policy; although most of the parameters continue to be negative (procyclical), their absolute values have decreased. We can therefore confirm the result obtained by Galí and Perotti (2003) that discretionary fiscal policy since 1992 has not been more, but less, procyclical. Furthermore, as Graph 2 shows, this change is greatest in precisely those countries in which procyclical behaviour had been more evident up to 1992: Germany, Greece and Italy. On the other hand, the discretionary fiscal policy of Finland remains anti-cyclical.

Here again, however, there are two exceptions. In Belgium and Ireland the change in this coefficient was in the other direction, with its negative value increasing in the former and a positive value becoming negative in the latter.

From 1994 to 1997, the euro-zone economies experienced, in average, a period of negative output gaps in which, nonetheless, restrictive discretionary fiscal measures were applied. This is probably justified by

the budgetary adjustments required in most European countries to comply with the nominal convergence criteria established in the Stability and Growth Pact. Likewise, the high value of the debt-GDP ratio was also significant[17], with the sustainability of public finance objective given priority over stabilisation of the economy, and leaving the latter to the automatic stabilisers. Also, as occurred in the previous expansionary phase, the recovery of growth rates in the late 90's again gave rise to less strict discretionary fiscal policies.

But, finally, if we consider the deceleration period starting in 2001, European countries have reduced the cyclically adjusted primary balance. In other words, unlike the two restrictive phases considered so far (early eighties and early nineties), anti-cyclical policies were applied on this occasion, as shown by the positive ratio between the change in the CABB and the change in the OG in the 2001-2005 period. As Graph 4 shows, this ratio is only negative – procyclical – in Austria, Spain and, particularly, Greece.

This change in fiscal policy was probably enabled by the improved budgetary situation of European countries, which had more room to manoeuvre in 2001 than at the start of the two previous periods of deceleration. To a large extent, this results from the budgetary discipline imposed by the fiscal rules. It is also true, however, that these expansionary policies were applied even though they meant that six countries failed to comply with the SGP in some of these years, leading to

[17] The highest in the period analysed.

it being reformed in 2005 in order to increase its flexibility so that it could accommodate, for instance, unfavourable cyclical situations.

Insert Graph 4 here

3. In most countries, both before and after application of the Maastricht Treaty, public debt levels helped to generate positive adjusted primary balances. These coefficients are shown on Graph 5, and the only exceptions are Austria, Belgium and Holland (before 1992) and Germany after 1992.

On the other hand, it is important to note that the change towards a more anti-cyclical discretionary fiscal policy did not represent an important change in reaction to debt in most European countries. This result is consistent with that obtained by Galí and Perotti (2003).

Insert Graph 5 here

4. From the estimated rule, a test can also be applied to weight the long-term sustainability of public finance[18]. The sufficient condition to guarantee solvency is for the estimation of the parameter representing the effect of the debt-GDP ratio on the adjusted primary balance (β_{3i} before application of the Maastricht Treaty and $\beta_{3i}+\beta_{4i}$, afterwards) to be positive. As Table 3 and Graph 6 shows, this condition is met in most cases so that, except for Belgium[19], the public finance of EMU countries is sustainable after application of the Maastricht Treaty.

[18] See Bohn (1998) and Ballabriga and Martínez-Mongay (2005).
[19] However, since this is only a sufficient condition, we cannot confirm with this test that it is unsustainable in Belgium.

5. With regards to the role established by the Stability and Growth Pact for discretionary measures and automatic stabilisers in the fiscal policy stabilising function[20], we can affirm the following. During its first few years of application, the need to adapt to stricter budgetary discipline requirements led to discretionary fiscal measures partly compensating for the effect induced by automatic stabilisers. However, in more recent years, economic stagnation and previous fiscal adjustment led the fiscal authorities to adopt expansive discretionary measures to stabilise their economies, failing to strictly comply with the Pact's philosophy, with some countries even failing to comply with the Pact itself. However, as we saw in the previous point, a small adjustment (positive) to the adjusted primary balance in response to accumulated debt is sufficient for public accounts to be sustainable, so SGP requirements would appear to be too strict, and the introduction of greater flexibility in the 2005 reform would be justified.

Finally, by introducing the cyclically adjusted primary balance delayed one period as one of the regressors of the fiscal policy rule, we have estimated a dynamic model. One of the most significant features of these models is that they

[20]The SGP does not literally establish that discretionary measures cannot be applied to stabilise the economy, but it is implicit in its philosophy when it states that governments must maintain equilibrium or a superavit position in the medium term. This approach is defended, for example, in European Central Bank (2004), and in relation to the relative role of discretionary measures and automatic stabilisers, Buti and Van der Noord (2004) say that: "While the potential usefulness of fiscal stabilisation is being re-considered, the "heritage" of the debate in the 1980s casts a strong scepticism over the use of discretionary fiscal action to fine tune the economy. (...) The use of discretionary fiscal policy for stabilising purposes should be confined only to exceptional situations".

enable us to distinguish between the short and long-term response of the dependent variable to variations in one of the explanatory variables.

The short-term effects are given by the coefficients estimated in the model, which we have analysed in the above section. With regards to the long-term effects, they are obtained by considering that the impact of each explanatory variable on discretionary fiscal policy at time t is not only due to the contemporary value of the variable *(at time t)* but also to the effect of the evolution of the same variable in previous periods *(t-1, t-2…)*. This long-term effect can be identified in the response functions to the output gap and debt level, also considering the possible changes to the effects of the two variables from 1992 on.

Table 7 shows the short-term effects of the output gap and debt *(before Maastricht, β_{1i}, β_{3i} and after Maastricht, $\beta_{1i}+\beta_{2i}$, $\beta_{3i}+\beta_{4i}$, respectively)*, and the accumulated effects from their impact[21]. The long-term effect is evidently greater, so we should consider that the response of the authorities is more active than initially assumed given the short-term expect, since the β_{5i} parameter is always positive. Our conclusions concerning the procyclical or anticyclical nature of discretionary fiscal action, however, remain unaltered.

Insert Table 7 here

[21]These effects will be significantly different from zero whenever the coefficients are. Since the accumulated effect is $\beta_{ji}/(1- \beta_{5i})$, when the test is performed, the null hypothesis (the estimated coefficient is zero) will only be accepted when the same hypothesis, but considered with the numerator coefficient, is not rejected.

6. Conclusions:

In this paper, we have used a SURE model to simultaneously estimate the rule characterising the behaviour of the fiscal authorities in each EMU country in the 1983-2005 period. This estimation procedure has enabled us to identify the impact of common factors such as the new fiscal framework, but also to obtain the differences in the national values of the coefficients of the rule, contemplating other aspects (institutional, political or economic) specific to each country. In our opinion, this is an important contribution to the empirical literature related to fiscal policy in the EMU.

Our estimated fiscal policy rule pays special attention to the reaction of the discretionary component of fiscal policy versus variations in the economy's cyclical conditions – measured by the output gap- and in the level of public debt. We also analyse whether there was a change in this reaction after the Maastricht Treaty came into force in 1992.

In this respect, one of the most solid results obtained from the estimation is that there is clear evidence of a structural break after the introduction of a new fiscal framework. This change is seen in a reduction in the procyclical nature of previous fiscal policies, even though there was no significant reduction in the authorities' reactions to increased debt in the form of increases in the cyclically adjusted primary balance. On the other hand, this reaction appears to be sufficient to guarantee the long-term sustainability of public debt.

These results support those previously obtained in the literature and, in particular, are generally consistent with those obtained by Galí and Perotti (2003), our reference for this paper. However, we have also obtained clear evidence in

favour of the need to distinguish between the fiscal rules for each country, estimating them with a SURE model to collect all the cross correlations, because all our tests have rejected the hypothesis of equality in the national coefficients, a constraint which was applied to prior studies. There is, for example, a large difference between Finland – the only country in which discretionary policy was clearly anti-cyclical during the two periods considered – and Greece – the country with the clearest procyclical activity in both periods. We believe that this result shows a need to continue our analysis with a specific study of the national factors behind these differences.

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Tables and Graphs:

TABLE 1: REGRESSION COEFFICIENTES FOR EACH COUNTRY:

α_{0i} : Constant before 1992.
$\alpha_{0i} + \alpha_{1i}$: Constant from 1992 on.
β_{1i} : Effect of economic evolution on the discretionary nature of fiscal policy before 1992. For each percentage point that the output gap changes, a structural primary balance of β_{1i} percentage points is generated in the same period.
$\beta_{1i} + \beta_{2i}$: Effect of economic evolution on the discretionary nature of fiscal policy from 1992 on. For each percentage point that the output gap changes, a structural primary balance of $\beta_{1i} + \beta_{2i}$ percentage points is generated in the same period.
β_{3i} : Effect that the level of debt in the previous period has on the discretionary nature of fiscal policy before 1992. For each percentage point of debt in the previous period, a structural primary balance of β_{3i} percentage points is generated in the same period.
$\beta_{3i} + \beta_{4i}$: Effect that the level of debt in the previous period has on the discretionary nature of fiscal policy from 1992 on. For each percentage point of debt accumulated up to the previous period, a structural primary balance of $\beta_{3i} + \beta_{4i}$ percentage points is generated in the same period.
β_{5i} : It represents the inertia of the structural primary balance, determining how the past of the dependent variable influences its future evolution.

TABLE 2: HETEROSCEDASTICITY TEST BETWEEN GROUPS AND CROSS-SECTION CORRELATION:

STATISTIC*	P-VALUE
$\lambda_{LR} = (n*T)*\left(\log\left(\frac{e'*e}{n*T}\right) - T*\log(\lvert\Sigma\rvert)\right) = 1629{,}3$	0.0000

**The asymptotic distribution is* χ^2 *with* $\frac{n*(n+1)}{2} - 1$ *degrees of freedom.*

Source: the authors, from the results of the estimations.

TABLE 3: CONTEMPORANEOUS RESIDUAL CORRELATIONS ESTIMATED BY GLS:

	AU	BE	FI	FR	GE	GR	IR	IT	HO	PO	SP
AU	1.0000	0.0811	-0.0222	0.1337	0.1667	-0.1961	-0.1543	0.4784	-0.2417	0.1671	0.1657
BE	0.0811	1.0000	-0.0165	0.3240	-0.0011	-0.0943	0.0043	-0.1399	-0.2390	-0.3701	-0.0575
FI	-0.0222	-0.0165	1.0000	-0.1607	0.3831	0.2619	0.0392	0.1449	-0.0103	-0.0785	-0.6381
FR	0.1337	0.3240	-0.1607	1.0000	0.3587	0.4203	0.2852	0.0401	0.2764	-0.3333	0.4673
GE	0.1667	-0.0011	0.3831	0.3587	1.0000	0.4855	0.5886	0.3026	0.3142	-0.0198	-0.1539
GR	-0.1961	-0.0943	0.2619	0.4203	0.4855	1.0000	0.4273	-0.2819	0.3522	-0.1859	0.1422
IR	-0.543	0.0043	0.0392	0.2852	0.5886	0.4273	1.0000	0.2056	0.4808	0.1493	-0.0221
IT	0.4784	-0.1399	0.1449	0.0401	0.3026	-0.2819	0.2056	1.0000	-0.2127	0.6027	0.0342
HO	-0.2417	-0.2390	-0.0103	0.2764	0.3142	0.3522	0.4808	-0.2127	1.0000	-0.5234	-0.1187
PO	0.1671	-0.3701	-0.0785	-0.3333	-0.0198	-0.1859	0.1493	0.6027	-0.5234	1.0000	0.2139
SP	0.1657	-0.0575	-0.6381	0.4673	-0.1539	0.1422	-0.0221	0.0342	-0.1187	0.2139	1.0000

Source: the authors, from the results of the estimations.

TABLE 4: ESTIMATION OF DISCRETIONARY FISCAL POLICY IN EMU-11:

COUNTRY	CONSTANT		OUTPUT GAP		DEBT		$CABB_{-1}$	TOTAL AFTER MAASTRICHT		
	α_0	α_1	β_1	β_2	β_3	β_4	β_5	$\alpha_0+\alpha_1$	$\beta_1+\beta_2$	$\beta_3+\beta_4$
AUSTRIA	3.44	-12.58	-0.04	0.04	-0.06	0.21	0.47	-9.14	0.00	0.14
	(0.75)	(-2.17)	(-0.18)	(0.13)	(-0.79)	(2.13)	(2.90)	(-2.56)	(-0.02)	(2.64)
BELGIUM	12.36	-14.09	-0.03	-0.50	-0.10	0.11	0.83	-1.73	-0.52	0.02
	(1.94)	(-1.96)	(-0.18)	(-2.26)	(-1.78)	(2.00)	(7.90)	(-1.00)	(-3.33)	(1.55)
FINLAND	-10.23	8.70	0.21	0.07	0.61	-0.53	0.34	-1.54	0.27	0.08
	(-1.37)	(1.15)	(1.28)	(0.35)	(1.48)	(-1.28)	(1.78)	(-0.70)	(2.07)	(2.21)
FRANCE	-1.07	-1.78	-0.26	-0.07	0.02	0.01	0.59	-2.84	-0.33	0.04
	(-0.19)	(-0.33)	(-1.77)	(-0.32)	(0.17)	(0.10)	(4.42)	(-2.73)	(-2.19)	(2.19)
GERMANY	-42.91	43.85	-0.80	0.36	1.05	-1.07	0.54	0.94	-0.44	-0.02
	(-3.37)	(3.43)	(-6.05)	(1.91)	(3.38)	(-3.43)	(5.05)	(0.83)	(-3.48)	(-0.93)
GREECE	-8.88	5.75	-1.46	0.55	0.09	-0.06	0.27	-3.13	-0.91	0.03
	(-4.82)	(1.20)	(-4.75)	(1.42)	(3.07)	(-1.31)	(2.17)	(-0.69)	(-3.83)	(0.79)
IRELAND	-15.87	16.75	0.21	-0.48	0.17	-0.16	0.42	0.88	-0.27	0.01
	(-3.16)	(3.33)	(0.94)	(-1.95)	(3.30)	(-3.12)	(2.66)	(0.58)	(-1.62)	(0.26)
ITALY	-17.90	9.47	-0.76	0.36	0.18	-0.10	0.58	-8.43	-0.40	0.08
	(-3.49)	(1.07)	(-2.61)	(1.10)	(3.34)	(-1.21)	(2.95)	(-1.09)	(-2.72)	(1.15)
HOLLAND	10.02	-11.24	-0.32	0.14	-0.12	0.15	0.42	-1.22	-0.18	0.03
	(0.65)	(-0.72)	(-1.10)	(0.38)	(-0.66)	(0.81)	(2.49)	(-0.65)	(-0.98)	(1.23)
PORTUGAL	-0.68	-0.95	-0.12	0.09	0.03	0.00	0.34	-1.63	-0.03	0.03
	(-0.11)	(-0.13)	(-1.43)	(0.58)	(0.24)	(0.02)	(2.05)	(-0.50)	(-0.26)	(0.54)
SPAIN	-4.51	4.96	-0.20	0.21	0.09	-0.09	0.74	0.45	0.01	0.00
	(-1.38)	(1.39)	(-1.79)	(1.13)	(1.26)	(-1.14)	(6.13)	(0.31)	(0.07)	(0.14)
EMU	-0.72	0.09	-0.15	-0.01	0.01	0.00	0.82	-0.63	-0.17	0.01
	(-3.24)	(0.26)	(-5.50)	(-0.32)	(4.11)	(0.38)	(31.09)	(-2.61)	(-4.68)	(4.25)

The brackets contain the value of the t-statistic of the parameter significance test.
Source: the authors, from the results of the estimations.

TABLE 5: EVIDENCE OF A STRUCTURAL CHANGE FROM 1992 ON:

No.	TEST	MODEL		α_1	β_2	β_4
1	CHOW TEST	0.02348				
2	INFORMATION CRITERIA	MODEL WITH BREAK	MODEL WITHOUT BREAK			
	- AIC	-172.638	-113.61			
	- SC	-171.528	-112.976			
3	R2 (McElroy)	0.925				
4	STRUCTURAL CHANGE BY PARAMETER			4.24E-06	6.41E-02	8.16E-06
5	EQUAL MAASTRICHT EFFECT ACROSS COUNTRIES			2.79E-06	4.72E-02	4.40E-06
6	EQUAL PARAMETERS ACROSS COUNTRIES (WITH STRUCTURAL CHANGE)			3.53E-07	5.19E-11	3.06E-06
7	EQUAL PARAMETERS ACROSS COUNTRIES (WITHOUT STRUCTURAL CHANGE)			0.000000	0.,000000	1.78E-15

The information provided about test results refers to p-value.
Source: the authors, from the results of the estimations.

TABLE 6: MODEL DIAGNOSIS STATISTICS:

COUNTRY	AUTOCORRELATION*			R2	NORMALITY
	1 lag	2 lags	5 lags		Jarque Bera
Austria	0.93	0.65	0.80	0.517	0.84
	0.51	0.08	0.02		
Belgium	0.50	0.83	0.75	0.908	0.38
	0.15	0.07	0.17		
Finland	0.74	1.00	0.77	0.686	0.67
	0.05	0.12	0.08		
France	0.81	0.77	0.47	0.806	0.51
	0.04	0.09	0.12		
Germany	0.52	0.99	0.56	0.768	0.57
	0.10	0.07	0.02		
Greece	0.89	0.85	0.55	0.897	0.65
	0.04	0.11	0.15		
Ireland	0.83	0.73	0.65	0.763	0.93
	0.04	0.05	0.04		
Italy	0.91	1.00	0.49	0.924	0.41
	0.10	0.23	0.38		
Holland	0.73	0.48	0.58	0.598	0.62
	0.04	0.03	0.00		
Portugal	0.74	0.73	0.79	0.360	0.96
	0.27	0.13	0.22		
Spain	0.50	0.67	0.59	0.864	0.81
	0.06	0.13	0.03		
Global				0.925	

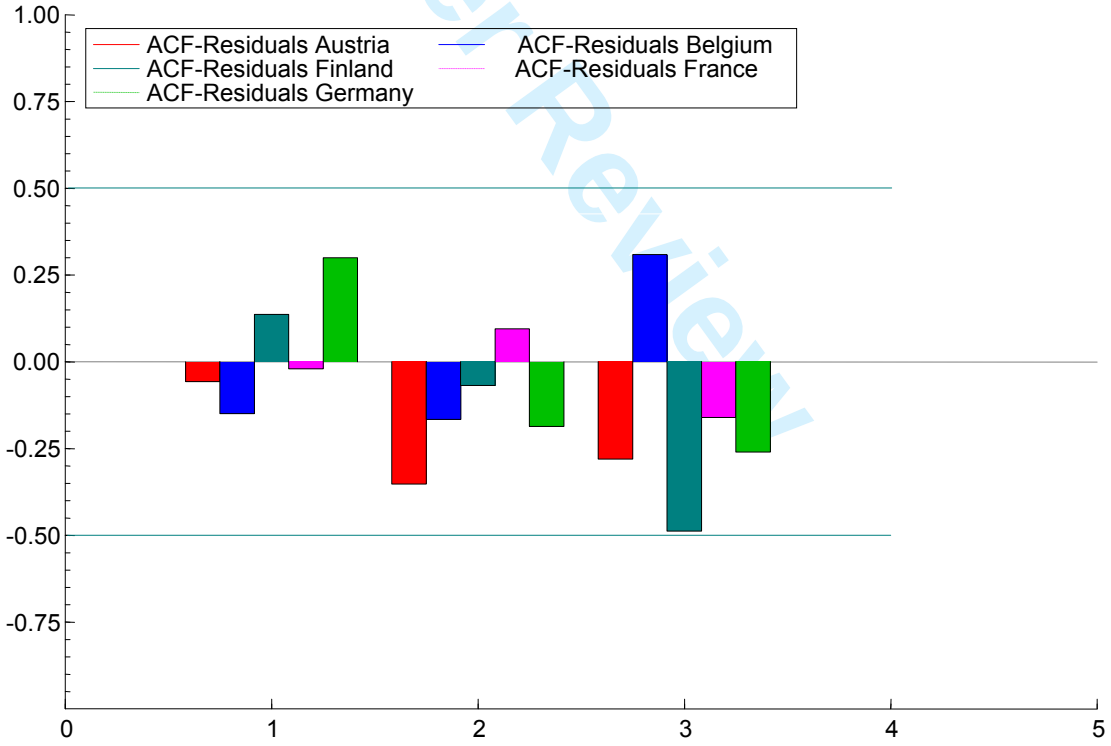
**For each country, the first row corresponds to the Ljung-Box Q test and the second to the Breusch-Godfrey test.*
The information provided about the test results refers to the p-value.
Source: the authors, from the results of the estimations.

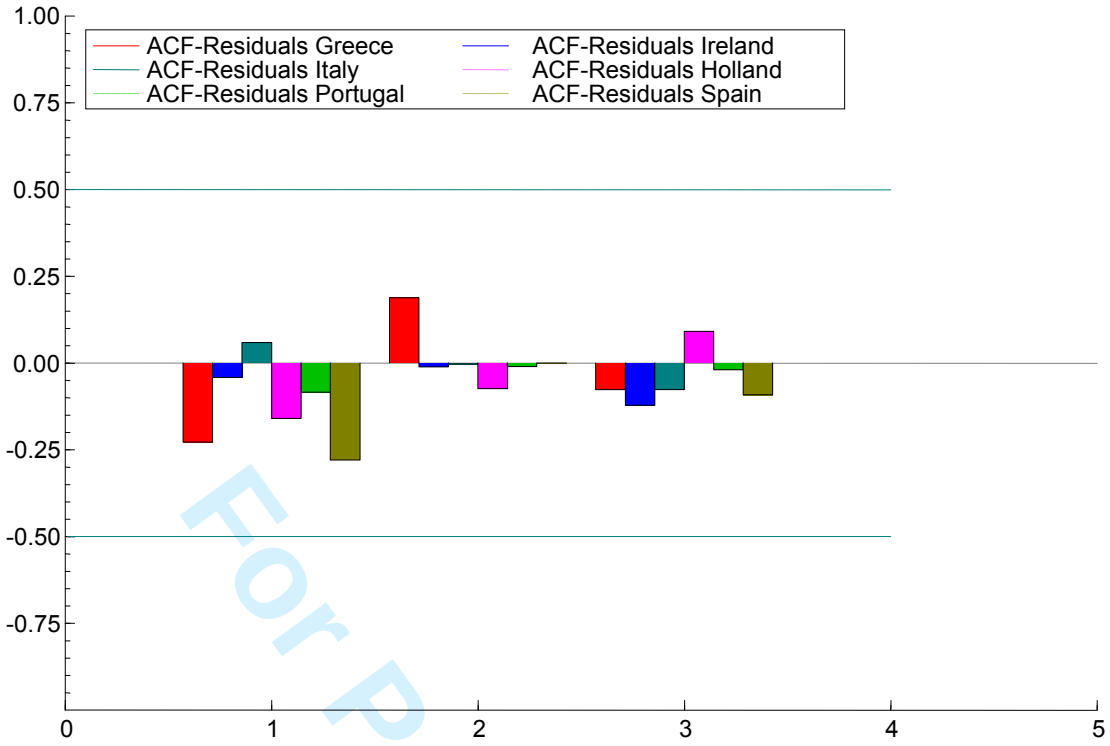
TABLE 7: SHORT-TERM AND LONG-TERM EFFECTS OF OUTPUT GAP AND DEBT BEFORE AND AFTER MAASTRICHT TREATY.

Country	Before Maastricht				After Maastricht			
	β_1	Accumulated response	β_3	Accumulated response	$\beta_1+\beta_2$	Accumulated response	$\beta_3+\beta_4$	Accumulated response
Austria	-0,039	-0,075	-0,064	-0,122	-0,003	-0,007	0,142	0,270
Belgium	-0,028	-0,161	-0,095	-0,545	-0,524	-3,003	0,019	0,107
Finland	0,206	0,311	0,608	0,916	0,273	0,412	0,078	0,118
France	-0,262	-0,637	0,025	0,060	-0,335	-0,814	0,039	0,095
Germany	-0,801	-1,748	1,049	2,291	-0,445	-0,971	-0,018	-0,039
Greece	-1,458	-1,998	0,094	0,128	-0,905	-1,241	0,030	0,040
Ireland	0,207	0,359	0,168	0,291	-0,269	-0,466	0,007	0,012
Italy	-0,757	-1,806	0,181	0,431	-0,399	-0,952	0,077	0,184
Holland	-0,320	-0,550	-0,125	-0,215	-0,177	-0,305	0,030	0,051
Portugal	-0,118	-0,179	0,026	0,040	-0,032	-0,049	0,028	0,043
Spain	-0,199	-0,764	0,089	0,342	0,012	0,045	0,003	0,013
Euro area	-0,151	-0,834	0,011	0,061	-0,165	-0,912	0,012	0,066

Source: the authors, from the results of the estimations.

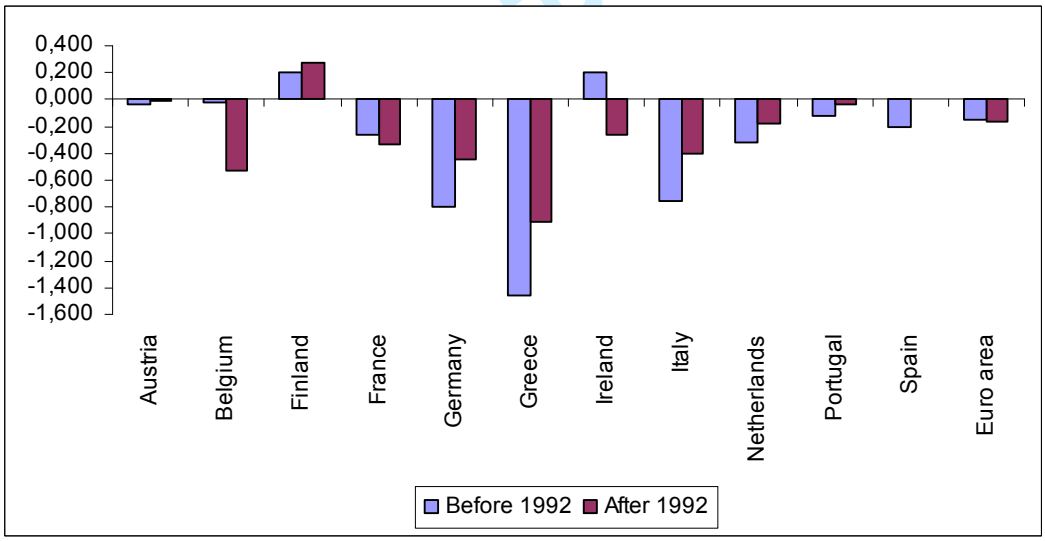
GRAPH 1: AUTOCORRELATION FUNCTION OF THE RESIDUALS ESTIMATED BY GLS:





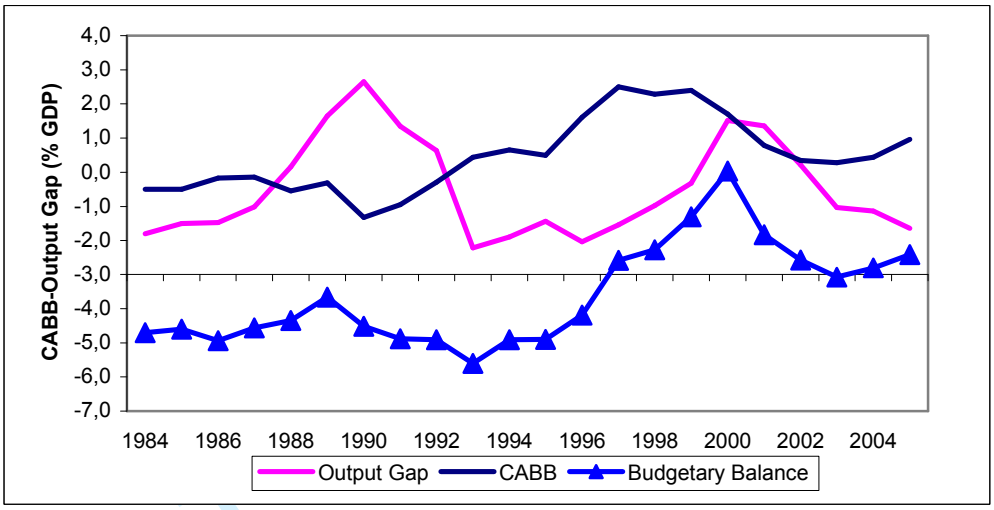
Source: the authors, from the results of the estimations.

GRAPH 2: ESTIMATED COEFFICIENTS FOR THE OG:



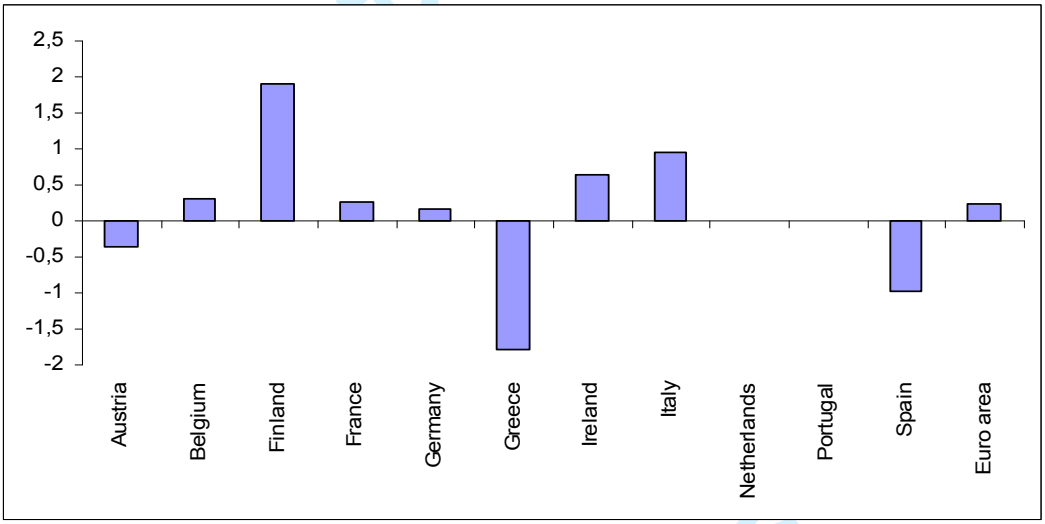
Source: the authors, from the results of the estimations.

GRAPH 3: FISCAL POLICY IN EMU, 1984-2005.



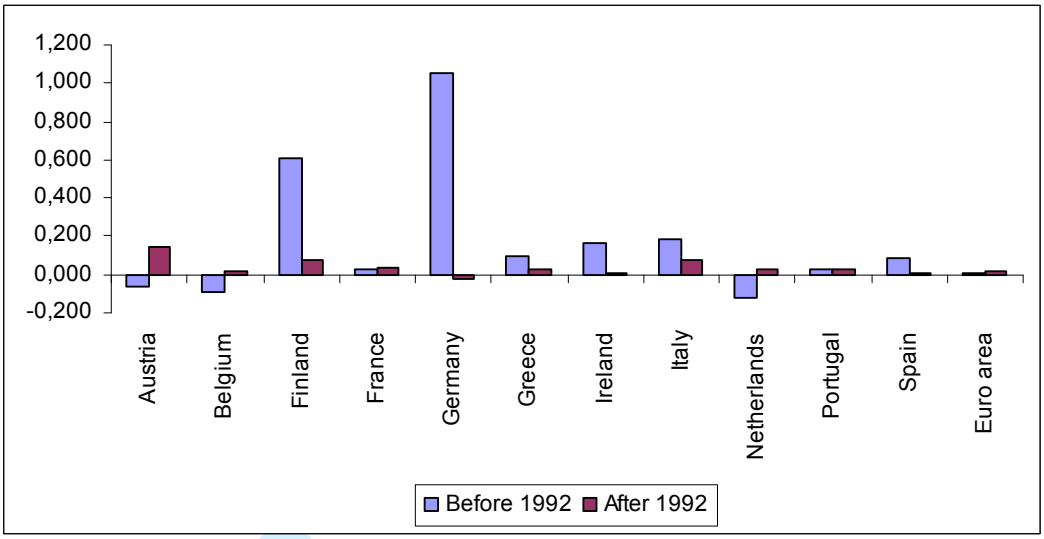
Source: OECD Economic Outlook.

GRAPH 4: CHANGE IN CABB/CHANGE IN OG, 2005-2000



Source: OECD Economic Outlook.

GRAPH 5: ESTIMATED COEFFICIENTS FOR THE PUBLIC DEBT:



Source: the authors, from the results of the estimations.