The Impact Of The European Union Fiscal Rules On Economic Growth

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THE IMPACT OF THE EUROPEAN UNION FISCAL RULES ON ECONOMIC GROWTH

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Abstract

This study intends to provide an empirical answer to the question of whether Maastricht and SGP fiscal rules have affected growth of European Union countries. A growth equation augmented with fiscal variables and controlling for the period in which fiscal rules were implemented in Europe is estimated over a panel of 15 EU countries (and 8 OECD countries) for the period 1970-2005 with the purpose of answering this question. The equation is estimated using both a dynamic fixed effects estimator and a recently developed pooled mean group estimator. GMM estimators are also used in a robustness analysis.

Empirical results show that growth of real GDP per capita in the EU was not negatively affected in the period after Maastricht. This is the case when the recent performance of EU countries is compared both with their past performance and with the performance of other developed countries. Results even show that growth is slightly higher in the period in which the fulfilment of the 3% criteria for the deficit started to be officially assessed. Therefore, this study concludes that the institutional changes that occurred in Europe after 1992, especially the implementation of Maastricht and Stability and Growth Pact fiscal rules, should not be blamed for being harmful to growth in Europe.

Keywords: European Union; Economic Growth; Fiscal rules; Pooled mean group estimator.

JEL classification: E62, H6, O47.

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1. Introduction

The impact of Maastricht criteria and Stability and Growth Pact (SGP) fiscal rules on economic growth is an important issue that has generated a lively discussion among economists. This discussion has progressed much further in the theoretical field than in the empirical one.

Arguments for fiscal rules have their foundations in the theory of Optimal Currency Areas, which states that when countries form an Economic and Monetary Union (EMU) they lose their independence over both monetary policy and the exchange rate. Therefore, a significant centralization of the national budgets to accommodate asymmetric shocks in the different countries would be desirable or expected. However, in the European Union (EU) context this did not occur because of the fears that the resulting temporary fiscal transfers might become permanent, which could create political problems among the EU countries and endanger the unity of the EU.

Therefore, the alternative was to leave the fiscal policy in the hands of national governments – to face asymmetric shocks when necessary – and to put in place rules to avoid excessive deficits. Those rules are important because governments' temptation to create budget deficits to absorb negative shocks in an EMU can lead to problems of sustainability of those deficits and to growing government debts. There could also be negative spillovers for other EU states, and the price stability policy of the Central Bank could be undermined. For example, a country that allows its debt-GDP ratio to increase continuously can force the EU interest rate upwards, which will increase the burden of government debts in the other countries and force them to follow more restrictive fiscal polices to stabilize their debt-GDP ratios. This might also compel countries to pressure the European Central Bank (ECB) to relax its monetary stance, which could endanger the stability of prices in the Europe.

These considerations led to the definition in the Maastricht Treaty of budgetary rules that countries have to satisfy in order to take part in EMU: the 3% of GDP deficit rule and the 60% of GDP debt rule. These same rules were later reinforced in the SGP for countries in EMU, in order to avoid the problems mentioned above.

Some politicians and economists have recently argued that, despite the justification for fiscal rules in an EMU without a centralised budget, EU fiscal rules may have undermined economic growth in Europe.[1] Very few empirical contributions exist to sustain or refute such a suggestion. This study tries to contribute to the literature by evaluating empirically the impact of EU fiscal rules on economic growth in the framework of a simple growth model. The results presented in this paper do not support the contention that fiscal rules have damaged growth.

The remainder of this paper is organized as follows. Section 2 presents some motivation for the analysis of the impact of the EU fiscal rules on growth: Maastricht and SGP rules are described and EU economic performance is evaluated; an overview of the literature is presented and some ideas are advanced to fill its gaps. Section 3 specifies the econometric model and the estimation techniques. Section 4 presents the data followed by the estimation of the model and discussion of the empirical results. Finally, section 5 provides a conclusion with the main findings of this paper.

2. Motivation and literature on EU fiscal rules

The aim of this section is to present an overview of the EU fiscal rules complemented with some data analysis and references from the literature that try to assess their implications for the recent EU economic performance.

2.1. From the Maastricht Treaty to the Stability and Growth Pact

The first great step toward the creation of an EMU in Europe was the signature of the Maastricht Treaty by the EU countries in 1991. With this step, EU countries promised to abide by some criteria in order to be accepted as members of the EMU. Those criteria were numerically very simple and clear. To take part in the EMU: (i) a country should have a government budget deficit and debt lower (or not higher) than 3% of GDP and 60% of GDP, respectively; (ii) its inflation rate should be no more than 1.5 percentage points above that of the three best performing member states; (iii) its nominal long-term interest rate should be no more than 2 percentage points above the average rate of the three best performing member states concerning inflation; (iv) and finally, its currency should stay stable in the normal bands of the Exchange Rate Mechanism (ERM) for at least 2 years without devaluations. Having committed to these

[1] See, for example, Thirlwall (2000), Arestis *et al.* (2001), Warin (2005) and Wyplosz (2006), among others.

criteria, the EU countries lost some degree of control over monetary policy and some degree of flexibility at the economic policy level.

By 1999, almost all countries had accomplished most of the criteria, with the exception of Greece which fulfilled none, and Sweden and the United Kingdom which did not have their currencies in the ERM, meaning that 12 of the 15 EU countries could take part in the EMU. Furthermore, Denmark and the United Kingdom decided not to take part, arguing that they were not prepared yet to lose their independence over monetary policy. Thus, Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, Portugal, and Spain were the first countries to take part in EMU, which was created in 1999. Greece joined in 2001.

By taking part in EMU, these countries ceded control over exchange rate and monetary policies to the European Central Bank. The only policy remaining in the hands of EMU member states is fiscal policy, but even this is limited by the requirements of the SGP. The main objective of the SGP is to regulate fiscal policy after the introduction of the Euro in 1999, i.e. to prevent countries from relaxing their convergence efforts or their fiscal policy after they have taken part in EMU. Therefore, the SGP was supposed to guide national fiscal policies in the EMU and persuade countries to achieve balanced deficits in the medium-term, with the aim of producing greater budgetary flexibility when members suffer asymmetric shocks and fall into recession, without disturbing price stability.

Basically, the SGP consists of two parts: a surveillance part and a dissuasive part.[2] The surveillance part or the warning mechanism of the Pact intends to prevent countries from falling into excessive deficits. The Council of the Ministry of Finances (ECOFIN) examines national stability programmes and recommends adjustments if a country's budget deviates from the medium-term objective.

The dissuasive part is activated when surveillance is not efficient in avoiding excessive deficits. In the original version of the SGP an excessive deficit was defined as a deficit higher than 3% of GDP, unless it was considered exceptional, i.e. unless it resulted from an unexpected event (like a natural disaster) or from a severe economic slowdown. The latter was defined as an annual decline of GDP of at least 2%. In such a situation no excessive deficit procedure was activated. If the fall in real GDP was between 0.75% and 2% and the deficit was higher than 3%, the member state could

[2] For more details on the working of these mechanisms see, for example, De Grauwe (2005).

present arguments to justify the excessive deficit and then the Council would decide whether the arguments were valid or not. However, when the decline in real GDP was less than 0.75% no exceptionality could be invoked. So, if a deficit was detected, the Council should issue a recommendation for the member state to correct it. If it was not corrected, sanctions could be imposed: the country in default would have to make a non-interest bearing deposit of 0.2% of GDP plus 0.1% for each point of the deficit above 3% of GDP. The maximum amount of the deposit was set at 0.5% of GDP. If the excessive deficit was not corrected in two years it was turned into a fine; otherwise, it was returned to the country in question.

However, in practice, this process presents some flaws. Because the fines can only be decided upon by a qualified majority of the Council of Ministers of Finance, the original SGP creates a situation in which the judges who have to decide about the sanctions are the same persons (countries) who could be adopting the defence position next time (De Grauwe, 2005). That was probably one of the main reasons why no sanctions were applied to France, Germany, Greece, Italy, and Portugal when they broke the 3% rule several times in this decade. The Commission insisted that those countries should correct their excessive deficits even in the middle of a declining business cycle (2002-2003), but France and Germany, in order to avoid a deeper economic slowdown, preferred not to follow this recommendation. This undermined the SGP power, which boosted the discussion of its reform.

A consensus on the reform of the SGP was achieved in March 2005 and some changes were introduced:[3] (a) the medium-term objective now refers to the cyclically adjusted budgetary position of a country; (b) countries with low debt ratio (and a high growth potential) are allowed to maintain a deficit of 1% over the business cycle; the others have to maintain a balanced budget over the business cycle; (c) the 3% budget deficit ceiling is maintained for all countries and more importance is given to the reduction of the debt ratio to less than 60% of GDP; (d) it is now enough to have a negative growth rate or a "protracted period of very low growth relative to potential growth" for a country to be allowed to (temporarily) exceed the 3% limit; (e) countries are now able to invoke more special circumstances for exceeding the 3% ceiling; for example, investment programmes or pension reforms that increase the debt today while improving the future sustainability of government finances will be accepted as special

[3] On the reform of the SGP, see Artis and Onorante (2006), Buti (2006) and Diebalek *et al.* (2006).

circumstances allowing for a temporary breach of the 3% rule; (f) the adjustment path to the medium-term objective is now defined in conformity with the business cycle: countries have to commit to reinforce consolidation when the economy is growing, but that effort can be reduced in phases of weak economic growth; (g) countries which exceed the 3% ceiling, but have low debt levels, will be allowed to stretch the adjustment over a longer period of time.

With a large number of specificities contemplated in the reformed Pact, which means more flexibility but less simplicity and transparency, it is not surprising that it has also attracted great debate and criticism.

It is evident that both the Maastricht Treaty and the SGP – in both its former and reformed versions – stick to the idea that fiscal policies in a Monetary Union (without a centralised budget) should be subjected to rules, even if those rules can be criticised. Of course, it is easier to criticise them when economic performance is not as expected. The next section analyses EU economic performance under those fiscal rules.

2.2. Economic growth in the EU and in other OECD countries

In this section the evolution of growth of real GDP in the EU countries is compared with growth in a group of industrial non-EU countries. Those countries are the following OECD countries: Australia, Canada, Iceland, Japan, New Zealand, Norway, Switzerland, and the USA. Figure 1 shows the evolution of growth of real GDP in both groups of countries and in its analysis particular attention will be given to the period after Maastricht.

Looking first at the EU countries, we identify a higher synchronisation of countries' economic cycles in the period after Maastricht. This evidence can be interpreted as the natural result of the efforts of integration towards the creation of an EMU in Europe. Besides countries presenting similar growth trends, it is even possible to identify a long lasting episode of sustainable economic growth in the post-Maastricht period: after the recession of 1993 countries grew at rates of around 2% to 4% until 2001 (Ireland and Luxembourg reached even higher rates).

[Insert Figure 1 around here]

That episode of sustainable growth is followed by a slowdown in economic activity in almost all EU countries. As the economic slowdown of 2001-2003 is the first episode of low growth after important institutional changes that have occurred in Europe, economists wonder whether that prolonged period of low growth can be due to those changes. More specifically, as this period is characterized by the implementation of fiscal rules (the SGP rules for the deficit and debt), economists ask whether those rules are influencing overall economic performance in Europe. The aim of this paper is to answer this question, or more precisely, to identify what has been the real impact of the fiscal rules imposed by the Maastricht Treaty, and later reinforced by the SGP, on EU economic growth.

Looking just at Figure 1 and comparing EU economic performance before and after the imposition of fiscal rules in Europe, we do not find a significant difference in economic growth in both periods.[4] Furthermore, there is no substantial difference in growth rates even when we compare average growth in the EU with average growth in the other OECD countries for the period after Maastricht.[5] However, as there are many countries involved in the analysis and non-EU countries present a mixed behaviour, we cannot simply rely in the analysis of these figures. It is necessary to proceed with a more sophisticated and accurate statistical analysis. That work will be done in the empirical part of this paper.

2.3. Literature and its gaps

In the literature we find several studies that try to evaluate the effectiveness of the EU fiscal rules. Some simply raise doubts about the rules themselves and the way

[4] On average, the growth rate of real GDP is not substantially different in both periods. In fact, the results of the simple computation of the annual average growth across the 15 EU countries shows an average rate of about 2.9% for the period before Maastricht (1971-1991) and 2.7% for the period after Maastricht (1992-2005). However, the annual average growth in the period in which the fiscal rules started to be officially assessed (1997-2005) is slightly higher than in the period before: 3.0% in the period 1997-2005 versus 2.5% in the period 1970-1996.

[5] The annual growth rate across the 8 OECD countries for the period 1992-2005 is, on average, approximately 2.8% (and it is 3.1% for the period 1971-1991). These averages are the same when we compare the pre- and post-97 periods. These values are not very different from the ones obtained for the EU countries in the same periods. In fact, a simple (unconditional) differences-in-differences estimation (controlling for fixed and time effects) revealed no significant differences in growth rates between the EU and OECD countries as a result of the imposition of the fiscal rules. The following equation was used in this analysis: $y_{it}=\beta d_{it} + \eta_i + \tau_t + \varepsilon_{it}$, where y_{it} is the growth rate of real GDP, d_{it} is a variable that takes value 1 in the period in which EU countries are affected by the fiscal rules (either after 1992 or after 1997) and 0 both in the other periods and for the unaffected countries (OECD countries), η_i and τ_t are the fixed and time effects, respectively, and ε_{it} is the error term. The estimated coefficient for d is 0.002 (*t*-value = 0.55) when the threshold is 1992 and 0.004 (*t*-value = 1.28) when the threshold is 1997.

they were defined by the European authorities in the SGP. Others analyse, either theoretically or empirically, the impact of those rules on the conduct of fiscal policy by national governments (deficit and debt behaviour) and their impact on public investment and economic growth.

A) EU fiscal rules and the behaviour of fiscal policy

One group of studies analyses the response of fiscal policy to the business cycle. Their results seem to indicate that the improvement of budgetary balances in Europe was mainly the result of a good economic growth rather than active policy adjustments. Nevertheless, the effect of those adjustments on growth itself is not examined.

Gali and Peroti (2003) and Annett (2006) evaluate to what extent the constraints associated with the Maastricht Treaty and the SGP have affected the way national governments have conducted fiscal policy. Their results show that fiscal policy has become more counter-cyclical (or less pro-cyclical) over time: before Maastricht it was pro-cyclical, but after Maastricht it is essentially a-cyclical (although Annett (2006) shows that it seems to have become pro-cyclical again during the SGP period). Marinheiro (2004) also confirms that EU fiscal rules have reinforced the counter-cyclicality of fiscal policy and that this result is even more evident during downswings.

More recently, Artis and Onorante (2006) estimate a set of structural vector autoregression (SVAR) models for each Eurozone country with the purpose of assessing the importance of a set of fiscal rules, in particular the SGP rules in its old and reformed versions. Their results suggest that fiscal policy had a limited smoothing effect on the cycle in the 1990s. They also state that the changes in the rules of the Pact are likely to have very little impact on fiscal policies and conclude that the extra margin to conduct fiscal policies is extremely limited resulting in a negligible effect on growth.

B) EU fiscal rules and public investment

The relation between EU fiscal policy rules and public investment is analysed in another group of papers. Unfortunately, these studies do not proceed to test the subsequent effect of public investment on EU economic growth.

Blanchard and Giavazzi (2004) blame the SGP for putting no pressure on the reduction of current government spending and consider it important to exclude (net) public investment from the definition of the budget deficit. However, this rule for excluding public investment from the computation of the deficit may present some problems like the possibility of “creative accounting”, risk of a growing debt and unequal treatment of expenditure on human and physical capital. According to Balassone and Franco (2000) the idea of creating such a ‘golden rule’ in the EU may not be the best option because it can conflict with the objective of a sound fiscal stance. Verde (2004) suggests a more consensual approach of (temporarily) excluding high quality – or growth promoting – public spending from the computation of the fiscal deficit during periods of economic slowdown.

By applying an empirical analysis, Gali and Peroti (2003) seek to confirm whether Maastricht and SGP rules have a negative effect on investment. Their results show a mildly pro-cyclical behaviour of public investment both before and after Maastricht. However, they conclude that the observed decline in public investment as a percentage of GDP in the last decade among the EU countries is not due to the constraints of either the Maastricht or the SGP. Indeed the decline in public investment started well before Maastricht and other industrial countries have registered an even greater decline. Perée and Välilä (2005) and Välilä and Mehrotra (2005) came to a similar conclusion. They also show that the SGP deficit rule is not responsible for the observed decline in public investment in Europe. For that reason, they are sceptical about the exclusion of public investment from fiscal deficit targets.

C) EU fiscal rules and economic growth

Another group of authors emphasize the need to boost economic performance as a condition for improving a country’s budgetary position in the long run. According to this view, economic growth should receive precedence over a strict application of the fiscal rules. Von Hagen (2003) argues that countries should be encouraged to adopt more growth-friendly policies by restructuring their government tax and expenditure systems. He supports the idea that authorities should pay more attention to the role of economic growth in achieving sustainable public finances. Using simple graphical analysis he observes that an increase in public investment, primary spending cuts, and reduction of direct taxes have a positive impact on GDP growth, which provides a strong foundation for the subsequent sustainable reduction of the deficit and debt. Therefore, he blames the SGP for focusing excessively on annual deficits which keeps governments from adopting important fiscal reforms that might result in larger deficits initially but which would bring the desired positive growth effects in the future.

A detailed examination of the extent to which the quality of the consolidation efforts during the 1990s affected macroeconomic performance in the EU is provided by Fatás *et al.* (2003). Their evidence indicates that fiscal adjustments based on the reduction of primary expenditures (wages and transfers in particular) are more persistent and successful in terms of debt reduction and are less damaging to growth than revenue-driven consolidations. They show that the growth rates remained persistently above the EU average after expenditure-driven consolidations, while the difference vanishes quickly after revenue-driven consolidations. Thus, they conclude that tax-driven consolidations have been less favourable to growth than expenditure-led consolidations.

Few empirical studies have intended to demonstrate how economic behaviour in Europe has been affected by Maastricht and SGP rules. Furthermore, there are some methodological flaws in these works and the results are unsatisfactory or do not provide a clear answer. For example, Hein and Truger (2005) examine the effects of EMU monetary and fiscal policies on growth and on convergence across the Euro-area. They observe that, despite a significant convergence of nominal variables (interest rate, inflation rate, deficit/GDP, debt/GDP), there was no convergence in terms of GDP growth, labour productivity and unemployment rates. Using simple pooled least squares regressions for 11 EU countries (1981-2001) they show that EMU macroeconomic policy institutions (ECB policy stance and SGP rules) have restrictive effects on growth. More specifically, they show that an increase in interest rates and a reduction in the structural primary government deficit have a negative effect on growth. Therefore, they conclude that the years before and after the introduction of the euro were characterized by a restrictive policy mix that has not been conducive to aggregate growth or to real convergence.

However, the work of Hein and Trugger (2005) presents some flaws that may undermine their results. First, the conclusion that EMU macroeconomic policy institutions have restrictive effects on growth seems too strong, in the sense that in their model they are analysing the whole period 1981-2001 without distinguishing the periods before and after the institutional cooperation has become stronger. They could, for example, use a dummy for the period after 1992 or proceed to a separate analysis for the periods before and after Maastricht. Second, they use an *ad hoc* model specification without taking into account the economic growth literature. Hence, their specification can be criticised for lack of important variables. Finally, they ignore the reciprocal causality between GDP growth and public deficit.

A more consistent analysis can be found in Savona and Viviani (2003) and Soukiazis and Castro (2005). Despite some flaws, their approaches are more in conformity with the growth theory. However, a more adequate specification could be used, including, for example, physical and human capital and short-term dynamics in the model, since both studies use annual data.

Savona and Viviani (2003) perform econometric tests in a fixed effects panel data model for a group of 12 EU countries for the period 1987-2002 and find evidence of a negative effect of current public spending on output growth and a positive impact of public capital spending on growth. According to their results, they argue for the modification of the rules of the Pact: it should exempt public investment from its constraints, but the automatic checks on current public spending should be maintained.

Like Hein and Truger (2005), Savona and Viviani (2003) do not analyse the pre and post Maastricht (or SGP) periods separately nor the direct impact of Maastricht criteria and SGP rules on growth. Soukiazis and Castro (2003, 2005) make that direct analysis by using panel data estimations for the 15 EU countries for the period 1980-2001. They observe that the greater fiscal discipline after Maastricht was harmful to both growth of real output and convergence in per capita income in the EU. But the evidence behind this conclusion is not strong enough because, although they find a lower rate of convergence in per capita output after Maastricht, their dummy for the period after Maastricht is not statistically significant. Moreover, they do not proceed in separately estimating the effects of the components of the deficit (current spending, public investment, tax revenues) on growth and they do not include human capital in their regressions. The inclusion of those variables would make the analysis more interesting and more in line with recent economic growth theory. Finally, the reverse causality of the deficit on the output is not taken into account in their study.

2.4. Aims and contributions of this study

Using the existing literature as starting point, this study intends to provide a clear empirical answer to the question of whether the Maastricht and SGP fiscal rules have affected growth in Europe. The analysis of this issue will be based on the estimation of a growth equation augmented with fiscal and economic variables.

This paper also tries to contribute to the literature with some improvements relative to the previous empirical works on the impact of EU institutional changes on growth. First, in this study the econometric analysis of the economic phenomenon is built around a formal growth model, contrary to the existing approaches that rely on *ad-hoc* growth specifications.

Second, short-run dynamics of output are controlled for by using both short-run regressors in the growth equations for annual data and a five-year time spans analysis. These procedures are not used in the previous empirical studies in this area of research.

Third, a recently developed estimator is implemented in this analysis: a pooled mean group estimator. In fact, as this estimator allows for heterogeneity not only on the intercepts but also on other coefficients, it has some advantages over a simple fixed effects estimator in the estimation of a growth equation using annual data.

Fourth, a new time dummy for the period in which fiscal rules started to be officially assessed is now used, instead of just a dummy for the period after Maastricht. This new dummy seems to be more appropriate because it covers the period of effective enforcement of the fiscal rules. Additionally, an indicator to control for the constraints that result from the implementation of the fiscal rules is developed: the margin of manoeuvre indicator.

Finally, this study goes even further in the analysis and provides an original comparison between the economic performances of the EU countries and a group of industrial non-EU countries for the period after Maastricht.

3. Specification of the model

A growth equation augmented with fiscal and economic variables will be used in the analysis of the impact of EU fiscal policy rules on economic growth. The aim of this section is to derive the growth equation to be estimated and to define the adequate econometric estimation techniques.

3.1. Specification of the growth equation

Following the works of Mankiw *et al.* (1992), Islam (1995) and Bassanini and Scarpetta (2001), a policy-augmented growth equation can be derived from a traditional constant-returns-to-scale growth model. The standard neo-classical growth model is derived from a constant-returns-to-scale Cobb-Douglas production function of the type:

$$Y(t) = K(t)^{\alpha} H(t)^{\beta} \left[A(t)L(t)\right]^{1-\alpha-\beta} \tag{1}$$

where the level of output at time *t* (*Y(t)*) is a function of physical capital (*K(t)*), human capital (*H(t)*), labour (*L(t)*) and the level of technological and economic efficiency (*A(t)*). The partial elasticities of output with respect to physical and human capital are represented by α and β, respectively. Labour is assumed to grow at a rate *n(t)*: $\dot{L}(t) = n(t)L(t)$.

Next, according to Bassanini and Scarpetta (2001), it is assumed that *A(t)* can be divided in its two components: economic efficiency (*E(t)*), which will depend on economic policy and institutions; and level of technological progress (*T(t)*), which is assumed to grow at a constant rate *g*: $\dot{T}(t) = gT(t)$ Therefore, we have:

$$\ln A(t) = \ln T(t) + \ln E(t) = \ln T(t) + q_0 + \sum_j q_j \ln X_j(t) \tag{2}$$

where $X_j(t)$ is a vector of variables affecting economic efficiency.

The remaining two time paths of the right hand-side variables of equation *(1)* are described as follows:

$$\dot{k}(t) = s_k(t)A(t)^{1-\alpha-\beta} k(t)^{\alpha} h(t)^{\beta} - [n(t)+d]k(t) \tag{3.1}$$

$$\dot{h}(t) = s_h(t)A(t)^{1-\alpha-\beta} k(t)^{\alpha} h(t)^{\beta} - [n(t)+d]h(t) \tag{3.2}$$

where, *k=K/L*, *h=H/L*, s_k and s_h are the investment rates in physical and human capital, respectively, and *d* denotes the constant depreciation rate of both types of capital.

Under the assumption that $\alpha + \beta < 1$ (i.e. under the assumption of decreasing returns of physical and human capital), the system of time path equations can be solved to obtain the steady-state values of *k* and *h*.[6] Thus, after taking logs, we get:

$$\ln k^*(t) = \ln A(t) + \frac{1-\beta}{1-\alpha-\beta}\ln s_k(t) + \frac{\beta}{1-\alpha-\beta}\ln s_h(t) - \frac{1}{1-\alpha-\beta}\ln\left[n(t)+g+d\right] \tag{4.1}$$

$$\ln h^*(t) = \ln A(t) + \frac{\alpha}{1-\alpha-\beta}\ln s_k(t) + \frac{1-\alpha}{1-\alpha-\beta}\ln s_h(t) - \frac{1}{1-\alpha-\beta}\ln\left[n(t)+g+d\right] \tag{4.2}$$

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[6] This system of equations includes equations *(2)*, *(3.1)*, *(3.2)* and the time paths for labour and technological progress. For more details on this derivation, see Mankiw et al. (1992) and Bassanini and Scarpetta (2001).

where * denotes steady-state values. Taking logs in the production function and substituting these two equations there, we obtain the expression for the steady-state path of output in intensive form:

$$\ln y^*(t) = \ln A(t) + \frac{\alpha}{1-\alpha}\ln s_k(t) + \frac{\beta}{1-\alpha}\ln h^*(t) - \frac{\alpha}{1-\alpha}\ln\left[n(t)+g+d\right] \qquad (5)$$

The steady-state value of output per capita, y^*, is represented as a function of the steady-state stock of human capital (h^*) instead of a function of investment in human capital (s_h) because: (i) data available to represent human capital (h) is the 'stock' of years of schooling of the (working-age) population from 25 to 64 years of age; and (ii) it can be shown that the unobserved h^* is a function of actual human capital (h):

$$\ln h^*(t) = \ln h(t) + \varphi\Delta\ln\left[\frac{h(t)}{A(t)}\right] \qquad (6)$$

Assuming that observed growth rates include out-of-steady-state dynamics, then a linear approximation of the transitional dynamics can be expressed as follows (Mankiw et al., 1992):[7]

$$\begin{aligned}\Delta\ln y(t) = &-\phi(\lambda)\ln y(t-1) + \phi(\lambda)\frac{\alpha}{1-\alpha}\ln s_k(t) + \phi(\lambda)\frac{\beta}{1-\alpha}\ln h(t) \\ &- \phi(\lambda)\frac{\alpha}{1-\alpha}\ln\left[n(t)+g+d\right] + \sum_j q_j\phi(\lambda)\ln X_j(t) + \varphi\frac{\beta}{1-\alpha}\Delta\ln h(t) \\ &+ \left[1-\phi(\lambda)(1+\varphi)\right]g + \phi(\lambda)\left[q_0 + \ln T(0)\right] + \left[\phi(\lambda)g\right]t\end{aligned} \qquad (7)$$

where $\phi(\lambda)$ represents the convergence factor as a function of the speed of convergence to the steady-state ($\lambda=(1-\alpha-\beta)[n(t)+g+d]$, $-1<\lambda<0$). Adding short-term dynamics to equation *(7)* in order to capture the short-run components of the dependent variable, we obtain the basic functional form that is empirically estimated in this study:

$$\begin{aligned}\Delta\ln y(t) = &\, a_0 - \phi\ln y(t-1) + a_1\ln s_k(t) + a_2\ln h(t) - a_3\ln\left[n(t)+g+d\right] + a_4 t \\ &+ \sum_j a_{j+4}\ln X_j + b_1\Delta\ln s_k(t) + b_2\Delta\ln h(t) + b_3\Delta\ln\left[n(t)+g+d\right] \\ &+ \sum_j b_{j+3}\Delta\ln X_j + \varepsilon(t)\end{aligned} \qquad (8)$$

[7] This equation is obtained substituting equations *(2)* and *(6)* into *(5)* and proceeding to the subsequent linear approximation around the steady-state.

Using the estimated coefficients from this equation and comparing it with equation *(7)*, we can obtain estimates of the steady-state coefficients and the parameters of the production function. The estimated speed of convergence to the steady-state ($\hat{\lambda}$) can be derived from the estimated convergence parameter ($\hat{\phi}$) as follows: $\hat{\lambda} = -\ln(1-\hat{\phi})$; the time to cover half way to convergence (*hwtc*) can be computed as: $hwtc = \ln(0.5)/\ln(1-\hat{\phi})$; the estimated long-run effects or coefficients on the investment rate, human capital and population growth on output (or the estimate of the respective elasticities) are given by $\hat{a}_1/\hat{\phi}$, $\hat{a}_2/\hat{\phi}$ and $\hat{a}_3/\hat{\phi}$, respectively; a similar deduction can be done to get the long-run coefficients on the other variables: $\hat{a}_{j+4}/\hat{\phi}$; finally, an estimate of the share of physical and human capital in output (α and β) can be obtained, respectively, as follows: $\hat{\alpha} = \hat{a}_1/(\hat{\phi}+\hat{a}_1)$ and $\hat{\beta} = \hat{a}_2(1-\hat{\alpha})/\hat{\phi} = \hat{a}_2/(\hat{\phi}+\hat{a}_1)$.

3.2. Econometric estimation techniques

In this model the observed growth of GDP per capita is the result of technological progress, the convergence process to each individual-specific steady-state and the shifts in the steady-state that may arise from changes in policy, institutions, investment rates and changes in population growth rate (Bassanini and Scarpetta, 2001).

Annual data are used to estimate the growth equation – in line with the works by Cellini (1997) and Bassanini and Scarpetta (2001) – instead of averages over time (twenty or five-year time spans) as in the works by Mankiw *et al.* (1992) and Islam (1995). Data with annual frequency is preferred because large time spans can involve the loss of important information. Moreover, according to Cellini (1997), the use of annual data produces more plausible values for the elasticity of output to the exogenous variables than the estimates reported by lower frequency regressions.

However, annual variations in output contain cyclical components. Thus, it is necessary to consider a specification that takes into account those short-run dynamics. A way of controlling for those business cycle fluctuations is by including first-differences of the determinants of growth as short-run regressors in the equations.[8] As a result, the general form of the growth equation can be written as an error correction model:

$$\Delta \ln y_{i,t} = -\phi\left[\ln y_{i,t-1} - \theta_1 \ln sk_{i,t} - \theta_2 \ln h_{i,t} + \theta_3 \ln(n_{i,t} + g + d) - \theta_4 t - \theta_{0,i} - \sum_{j=5}^{m} \theta_j \ln X_{i,t}^{j}\right] + b_1 \Delta \ln sk_{i,t} + b_2 \Delta \ln h_{i,t} + b_3 \Delta \ln(n_{i,t} + g + d) + \sum_{j=4}^{m} b_j \Delta \ln X_{i,t}^{j} + \varepsilon_{i,t} \qquad (9)$$

where ε symbolizes the error term and θ_s represents the long-run coefficients. As usual in growth literature, a value of 0.05 is assigned to the constant $g+d$.[9]

The model will be estimated by using pooled cross-country time-series data for 15 EU countries, controlling for country-specific effects. In some particular regressions 8 additional industrial countries (OECD countries) will be included for comparative purposes. Equation *(8)* will be the basis for these estimations and then long-run coefficients (θ_s) will be obtained as indicated in Section 3.1.

Fixed effects are preferred to random effects because the population of the 15 EU countries is entirely represented in the sample for the period under analysis. Thus, according to Marinheiro (2004), in a case like this it makes no sense to use a random effects estimator. A similar argument can be used for the estimations with the 23 OECD countries. The use of fixed effects will allow controlling for and capturing the actual specific characteristics of each country in the sample.

However, this may not be the most adequate method to employ in this analysis. The fixed effects estimator allows intercepts to differ across countries while the other coefficients are constrained to be the same. Indeed, there is no reason to assume that the speed of convergence to the steady-state should be the same across countries (Bassanini and Scarpeta (2001)). Although there are reasons to believe in common long-run coefficients across EU countries – given they have access to common technologies and have intense trade relations – short-run dynamics and the speed of convergence may not be the same across them. In order to control for that case a pooled mean group (PMG) estimator is employed in a second phase of this study. This estimator, developed by

[8] Another way of controlling for those annual fluctuations on output is by using larger time spans. Despite the already mentioned loss of important information, a specification for a larger time span (five-year time spans) will be considered latter in this work with the aim of comparing results.
[9] For details see, for example, Mankiw *et al.* (1992) and Cellini (1997).

Pesaran, Shin and Smith (1999), allows the intercepts, speed of convergence, short run coefficients, and error variances to differ freely across groups, but imposes homogeneity on long long-run coefficients. Thus, with the PMG procedure, we are able to estimate directly the following error correction version of the growth equation:[10]

$$\begin{aligned}\Delta \ln y_{i,t} = -\phi_i \Big[& \ln y_{i,t-1} - \theta_1 \ln sk_{i,t} - \theta_2 \ln h_{i,t} + \theta_3 \ln(n_{i,t} + g + d) - \theta_4 t - \theta_{0,i} \\ & - \sum_{j=5}^{m} \theta_j \ln X_{i,t}^{j} \Big] + b_{1,i} \Delta \ln sk_{i,t} + b_{2,i} \Delta \ln h_{i,t} + b_{3,i} \Delta \ln(n_{i,t} + g + d) \\ & + \sum_{j=4}^{m} b_{j,i} \Delta \ln X_{i,t}^{j} + \varepsilon_{i,t}\end{aligned} \qquad (10)$$

and the long-run homogeneity hypothesis permits the direct identification of the parameters that affect the steady-state path of output per capita ($\theta_s = a_{s,i} / \phi_i$).

This method requires a *T* large enough such that we can estimate the model for each group separately. Therefore, when the data allow, this method will be used and its results compared to the results obtained with the dynamic fixed effects estimator.

4. Empirical work

This section starts by describing the data and variables used in the estimation of the growth equation. Then, the empirical results obtained from both the dynamic fixed effects estimator and the pooled mean group estimator will be presented and analysed. In the final part of this section those results will be compared with the results from the estimation of a growth equation using data for five-year time intervals instead of annual intervals.[11]

4.1. Data and description of the variables

Annual data used to estimate the growth equation derived in the previous section were mainly collected from the OECD *Statistical Compendium* (2006) for 23 OECD countries over the period 1970-2005. Besides the 15 EU countries, Australia, Canada,

[10] Note that both this equation and equation *(9)* rely on the assumption that regressors are cointegrated.
[11] All growth equations were estimated by using the statistical software STATA 9.0.

Iceland, Japan, New Zealand, Norway, Switzerland, and the USA are also included in the sample. These countries are included in the sample to permit a comparison of their economic performance with the performance of the EU countries in the period after Maastricht, i.e. to determine whether economic growth was significantly higher or lower in the EU than in other developed countries in the period in which fiscal rules were imposed in the EU.

A detailed description of the variables used in this study and respective sources can be found in Table 1. The dependent variable is simply defined as the growth rate of real GDP per capita ($\Delta \ln gdppc$).

[Insert Table 1 around here]

Traditional economic growth literature considers that the rate of accumulation of physical capital, the accumulation of human capital and population growth are the most important factors in determining the level of real output per capita.[12] Indeed, significant differences in the investment rate over time and across countries are seen as a source of cross-country differences in output per capita. Studies on growth also assume that labour force skills and experience can represent a form of capital: human capital (Mankiw *et al.*, 1992). The variables used to collect the effects of the physical and human capital are the ratio of real private fixed capital formation to real GDP ($\ln pfcf$) and the average number of years of schooling of the working-age population ($\ln hk$), respectively. Population growth is another important variable to be considered in the growth equation.

Like several other works on economic growth, Bassanini and Scarpetta (2001) verify that some macroeconomic issues must also be considered in a growth analysis, namely the impact of fiscal policy, the benefits of having low and stable inflation and the benefits of exploiting comparative advantages of trade. According to their analysis, fiscal policy can affect output and growth in the medium-term and over the business cycle. Those effects may come from the financing and composition of public expenditure. More than the overall deficit, it is the composition of public spending that is relevant for economic growth. Negative effects on growth arise when government relies more on direct (or distortionary) taxes and when its expenditure focuses on

[12] See, for example, Barro (1991), Barro and Sala-i-Martin (1992), Mankiw *et al.* (1992) and Islam (1995).

unproductive activities. Hence, the impact of fiscal policy should be evaluated by looking at the components of government revenue (direct and indirect taxes) and expenditure (consumption and public investment).

Finally, a low and stable inflation can have a positive effect on the level of capital accumulation and consequently on growth because investment decisions are usually made with a long-run perspective. On the other hand, higher volatility in inflation brings uncertainty which discourages firms from investing in some interesting projects. Additionally, gains from trade and exposure to external competition must be also taken into account because of their potential positive effect on growth.

Besides the traditional determinants of economic growth described above, some dummies or qualitative variables to control for the period in which fiscal rules were imposed in Europe are included in the growth equation. Particular attention is given to the results from those variables because they will allow us to get an answer to the question of whether EU fiscal rules have affected real economic growth in Europe and, if so, whether that impact has been positive or negative.

A dummy variable, similar to the one used by Soukiazis and Castro (2005), was built to control for the period after Maastricht. This dummy is named *d92eu* and is equal to 1 when we are observing an EU country for the period 1992-2005, and 0 over the period 1970-1991. It will take value 0 over the entire period 1970-2005 for the other OECD countries. As an alternative, a second dummy is built and used for the period in which the fulfilment of the 3% criteria for the deficit is to be officially assessed. This period started in 1997 with the assessment of the countries that would take part in EMU.[13] This second dummy is called *d97eu* and assumes value 1 for EU countries in the period 1997-2005 and 0 otherwise. In practice, *d97eu* can be seen as a dummy that will account for the impact of the SGP rules since they really come into effect, i.e. since the 3% fiscal rule has to be really accomplished, otherwise sanctions can be imposed.

To avoid the fact that these dummies might be collecting the effect of several other factors and not exclusively the effect of the EU fiscal and institutional changes, the other 8 non-EU countries will also be included in the sample to control for common macroeconomic effects. Both the EU and the non-EU countries are industrialised countries with similar characteristics, intense economic relations, access to common technologies and linked economic cycles, which means that they are more or less

[13] Before 1997 countries had just to make efforts to converge; there was no particular sanction if convergence criteria were not accomplished in a particular year between 1992 and 1996.

similarly affected by economic shocks (like the recession after September 11th 2001, the effect of an increase in oil prices, the slowdown of the US economy, etc). The dummies will, in this case, capture and reflect with more accuracy the particular effect of the EU fiscal rules and not the effects of other specific factors that affected growth in both groups of countries. Assuming that those other effects will affect both groups in a similar way, the main differences will come from the specificities of the institutional changes in the EU economy, where the fiscal rules assume an important role.

This analysis can be done either for the period after Maastricht (1992-2005) or just for the period in which rules were officially assessed (1997-2005). In this case, as dummies *d92eu* and *d97eu* take value 1 for EU countries and 0 for non-EU countries, they can be used as the indicator to compare the performance of both groups of countries in those periods. Therefore, these dummies are now controlling for specific effects on the EU economy in the period post-Maastricht. Considering that the fiscal rules established by the Maastricht Treaty and SGP are a very important specific characteristic of the EU economy during the period 1992-2005, this will mean that the coefficients on both dummies will allow us to conclude whether those rules have had a particular impact on the EU economic growth. This approach constitutes an original contribution to the analysis of the impact of the EU fiscal rules on growth.

In sum, according to the alternatives mentioned above, we may have either a time comparison (panel of EU countries over the period 1970-2005) or a cross-country comparison (panel of EU and non-EU countries over the post-Maastricht period) of the impact of the EU institutional changes on economic growth (or even both).

A third alternative is to estimate a regression for the 15 EU countries using an indicator for the margin of manoeuvre of fiscal policy (*mg_mnvr* – see Table 1). The expectation is that the greater the margin of manoeuvre in this period, the stronger economic growth in the next period, because it is assumed that countries can use fiscal policy to boost the economy in "bad times". As Maastricht and SGP rules reduce the margin of manoeuvre of fiscal policy in most EU countries, this means that if the coefficient on this variable is significantly positive then it can be concluded that the impact of those rules on EU economic growth was negative.

Regression results for growth equations taking into account those alternatives are provided in the next section. In practice, the growth equations to be empirically estimated are equal to equations *(9)* or *(10)* – depending on which estimator is used –

plus the term $\gamma d_{i,t}$, where $d_{i,t}$ represents one of those qualitative variables that control for the period in which EU fiscal rules were imposed in the EU (*d92eu*, *d97eu* or *mg_mnvr*).

4.2. Regressions and interpretation of the main results

Based on the theoretical approach and data presented above, this work will proceed with the empirical analysis to determine whether fiscal rules imposed in Europe in the period after Maastricht have had a significant effect on growth in the EU countries. First, we will present and analyse the results from the dynamic fixed effects (DFE) estimator and then the results from a pooled mean group (PMG) estimator. Additionally, some robustness checks and sensitivity analyses will be provided.

However, before proceeding to the estimation of the error correction models, using either the DFE estimator or the PMG estimator, it is convenient to analyse whether the regressors are *I(0)* or *I(1)*, i.e. whether they are stationary or not. Pesaran, Shin and Smith (1999) show that the same algorithm can be used to compute the PMG estimators whether regressors are *I(0)* or *I(1)*, but their asymptotic distributions are slightly different. If the regressors are not stationary but are *I(1)*, then it is convenient that they are cointegrated. This would make the error term a stationary process for all countries. Therefore, the order of integration of the regressors is established in first place and then – if they are non-stationary or *I(1)* – cointegration tests are performed.

Panel unit root tests for each variable are presented in Table 2. Statistics were obtained by applying Im, Pesaran and Shin (2003) unit root test. This test assumes that all series are non-stationary under the null hypothesis. Results provide evidence that most of the regressors can be considered non-stationary (or *I(1)*) at a significance level of 5%: only *sdinfl* and *ln(n+g+d)* seem to be clearly stationary; the other regressors are either non-stationary or borderline, so we proceed treating them as non-stationary.

[Insert Table 2 around here]

Having concluded that series are essentially integrated of order 1, some cointegration tests were performed by using Pedroni (1999) tests. Pedroni's panel tests for cointegration are also reported in Table 2. Results show that 4 of the 7 tests reject the null hypothesis of no-cointegration (panel υ, pp, ADF and group pp tests). Although not all tests reject the null hypothesis, the majority do. This fact provides some evidence of cointegration among the variables, which permits us to proceed with the estimation of the growth model presented above using either a DFE estimator or a PMG estimator in the context of an error correction mechanism.

I) Dynamic fixed effects panel data estimation

The results from a dynamic panel data estimation controlling for fixed effects are presented in Table 3. The presence of any pattern of heteroscedasticity and autocorrelation is controlled for by using robust standard errors. Economic policy variables are lagged one period in all estimations in order to better identify their long-run impact on output and to account for the usual delays in reporting of economic data. The time trend was not included in these regressions to avoid the loss of more degrees of freedom, because, when included, it was never statistically significant. Columns 1, 2 and 3 of Table 3 present results just for EU countries over the period 1972-2004. In the remaining estimations the non-EU countries are included with the intention of doing a comparative analysis.

[Insert Table 3 around here]

Results for the traditional determinants of economic growth are as expected. The convergence coefficient is statistically significant in all of the regressions presented in Table 3. Estimations show that convergence in output per capita in the EU countries runs at an annual rate of about 3.5%, which means that each year an economy's GDP covers about 3.5% of its distance from the steady state.[14] This suggests that it takes about 19 years to reduce by half the differences in output per capita among EU countries.[15]

The coefficients on physical and human capital and population growth have the expected signs and are highly significant in almost all specifications. Thus, an increase in private investment and years of schooling and a decrease in population growth have a

[14] Although, rather low, this value is in accordance with some seminal empirical contributions to the growth literature. Barro (1991), Barro and Sala-i-Martin (1992), Mankiw *et al.* (1992), among others, show that countries converge to their steady-state level of output per capita at a slow rate of approximately 2% or 3% per year.

[15] This seems quite a long time, but in Table 4 it is possible to verify that for the period 1997-2004 that time was reduced to about 7 years (see column 6). This means that EU countries have been converging in real terms over the last years at a good pace.

positive impact on output per capita. It is important to notice that in this analysis more attention is given to the long-run coefficients because short-run dynamics are just used to control for cyclical fluctuations.

As expected, government investment (ln*gvfcf*) has a positive and significant impact on real output per capita while government final consumption expenditure (ln*gvcns*) affects it negatively. These results support the view of EU authorities that cuts in current expenditures to control the deficit may have positive effects on output in the long-run, but they also enhance the relevance given by some authors to public investment (Savona and Viviani (2003), Blanchard and Giavazzi (2004) and Verde (2004)). In fact, EU authorities should take into account not only the importance of controlling excessive deficits but also the benefits of 'productive' public investment in the definition and application of the fiscal rules to countries in the EMU.

It was also expected that a shift from taxing factor incomes to taxing consumption would have positive growth effects. Nevertheless, this study does not identify those positive effects in the EU context. The long-run coefficient on the variable ln*gvtxr* is not statistically significant in any of the regressions.

The variability of inflation (*sdinfl*) has a negative impact on output per capita, which is in accord with the findings of Bassanini and Scarpetta (2001). Inflation itself was also used as an alternative, but results were quite similar (they are not presented here). As inflation shows a high correlation with the convergence variable and human capital, the variability of inflation is used instead.[16] The results also suggest significant gains from trade and exposure to external competition in the EU context. The sign of the coefficient on ln*xmr* means that the higher the proportion of exports over imports the higher the output per capita.

However, the results of most interest in this analysis come from the dummy variables for the post-Maastricht period. In the first regression presented in Table 3, the dummy *d92eu* was used to control for the growth effects in the EU-15 in the period after Maastricht. The coefficient on this variable is not significant. A similar result was obtained by Soukiazis and Castro (2005) in their analysis of output per capita convergence. This result may indicate that the institutional changes that took place in Europe after Maastricht do not seem to be harmful to output growth. Indeed, when a

[16] Theoretically, it makes more sense to use the variability of inflation than its level, because the variability of inflation affects much more the decisions of consumption and investment (and economic growth) in the medium and long-term than its level.

dummy just for the period in which the fiscal rules started to be assessed (*d97eu*) is considered, it is even possible to conclude that growth of real GDP per capita is significantly higher than before: results show that after 1997 growth of real GDP per capita is, on average, about 0.5 percentage points higher than before. Therefore, these results allow us to conclude that economic growth in the EU was not negatively affected by those rules, contrarily to what some authors argue.[17]

The third regression includes the indicator for the margin of manoeuvre lagged one period, but results show an insignificant coefficient. One interesting conclusion can be retrieved from this result: the reduction of the margin of manoeuvre of fiscal policy in the period after Maastricht did not have the expected negative impact on growth, meaning once again that fiscal rules were not as harmful to growth of real GDP per capita as one might imagine. This variable was also included in the other regressions presented here instead of the dummies, but it remained insignificant (results not reported here).[18]

Next, other OECD developed countries were included in the sample for the period 1972-2004. Column 4 of Table 3 presents the results for the whole period. The dummy *d97eu* remains significant. In this case, that means that growth of GDP per capita in EU was not only higher than before 1997 but, at the same time, higher than in the other non-EU countries.[19] To separate the temporal effect from the cross-country effects, estimations were performed just for the period after Maastricht. In column 5, the results for the period after 1992 are reported. In this case, the dummy *d92eu* is directly comparing the difference in growth between EU countries and non-EU countries. Results for the dummy do not show a significant difference in growth of GDP per capita: the estimated coefficient on the dummy is positive but insignificant. However, when we consider just the period after 1997, and *d97eu* is included instead, it is possible to observe significantly higher growth in the group of the EU countries than in the

[17] If the coefficients associated to those dummies were significantly negative, it would not be clear whether the low economic growth was essentially caused by the fiscal constraints or by other factors. But as the coefficient on *d97eu* is significantly positive and *d92eu* is not significant, we have evidence to say that growth was not lower in the period in which fiscal rules were imposed in Europe than before. In reality, evidence shows a higher growth after 1997 (on average), but this is also not enough to say that that fact was a direct outcome of the fiscal rules, because other factors can be involved.

[18] This variable was also included as regressor in a simple government investment equation, similar to the one used by Perée and Välilä (2005), to test if it might affect growth indirectly via a potential effect on public investment. Nevertheless, even in that case, the coefficient on this variable was not significant.

[19] In the unconditional differences-in-differences estimation no significant differences were found between EU and non-EU countries' growth rates (although the estimated coefficient on the dummy was positive), but when control variables are included in the equation, results show a significantly higher growth in the EU countries than in the OECD countries in the period after 1997.

others. In this case, a random effects estimator was used because the dummy *d97eu* was dropped in the fixed effects estimation due to lack of variability. In order to overcome that problem, an estimation for the period 1992-2004 was performed (column 7) using the dummy *d97eu*. The significance of the coefficients improves and the dummy remains highly significant. In fact, it is strengthening the idea that growth in the EU countries in the period after 1997 was not negatively affected by the fiscal rules. Indeed, if we gather the results of columns 6 and 7, there is evidence that growth was not lower in the EU than in the other non-EU countries.

II) Pooled mean group panel data estimation

Results of the PMG estimations and some robustness analyses are presented in Table 4. Only long-run and dummy coefficients are reported, but all equations were estimated including short-run dynamics and a constant. In the first 3 columns of Table 4 we have the results of the PMG estimations for the EU countries over the period 1972-2004.[20] The results of some robustness checks are shown in the remaining part of the table.

In the fixed effects estimations it was considered that intercepts could differ across groups but the other coefficients were constrained to be the same. Although the fact that the EU countries have access to common technologies and intense economic relations may justify the presence of common long-run coefficients, the speed of convergence to the steady-state and the short-run dynamics may not be the same across countries. Indeed, each country can follow a different path to the steady-state. Therefore, the PMG estimator developed by Pesaran, Shin and Smith (1999) seems to be a suitable instrument to control for these specificities.

This method improves the significance of most estimates and generates a higher convergence coefficient. These results are a consequence of the improvements made on the assumptions of the model and are in line with the examples presented by Pesaran, Shin and Smith (1999). Now results suggest that it takes about 10 years to reduce by half the differences in output per capita among EU countries. Indeed, this result seems to be more adequate for industrial countries that have been increasing their efforts of integration over the last decades.

[20] The author wishes to thank Ed Blackburne for providing the STATA code to perform the PMG estimations.

[Insert Table 4 around here]

Estimated coefficients on physical and human capital and population growth have the expected signs and remain highly significant. Evidence on fiscal variables is also consistent with the previous findings: there is evidence favouring both the positive impact of public investment and the negative effect of public consumption on GDP per capita; and, once again, the positive effect of shifting taxes from factor incomes to consumption is not evident in the data. Finally, results confirm the negative impact of inflation on output and the expected gains from trade.

The most important findings are provided by the time dummies and by the margin of manoeuvre indicator. The coefficient on the dummy for the period after Maastricht remains insignificant. Considering the dummy for the period in which the fiscal rules started to be officially assessed (*d97eu*), we get evidence that supports the previous finding that real growth of GDP per capita was slightly higher during that period than before. In this case, results show that after 1997 growth of real GDP per capita is, on average, about 0.9 percentage points higher than before. Finally, when the indicator for the margin of manoeuvre is included instead of the dummies, results confirm the insignificance of its coefficient.

Thus, evidence from the fixed effects estimator is now corroborated by the PMG estimator or, more precisely, results from the PMG estimations reinforce the conclusion that in the period in which fiscal rules were implemented in Europe economic growth was not negatively affected by them, contrarily to what some authors claim.

Results of a robustness analysis are presented in columns 4 to 7 of Table 4.[21] Those robustness checks are performed with the purpose of confirming if the results obtained so far are statistically solid. Column 4 presents results of an identical specification to columns 6 of Table 3, but using a different estimation method, which is more adequate to cases like this where the number of time periods is substantially smaller than the number of individuals (T small, N large). This specification is based on the application of Arellano and Bond (1991) GMM estimator. In this case, the

[21] The intention was to proceed with a comparison of economic performances of the EU and non-EU countries using the PMG estimator, but PMG estimation becomes impossible in these cases because of the lack of variability of the dummy variables when the model is being estimated for each country separately before retrieving the PMG estimates. Moreover, PMG estimator requires a *T* large enough such that the model can be estimated for each country individually. This means that it is not viable to proceed with a comparative analysis of our model for the periods before and after Maastricht either. Due to the very low number of degrees of freedom it is not possible to get estimates for the convergence coefficient for some countries in the sample. Therefore, in this case, a fixed effects estimator is used.

regression equation is written in the form of a dynamic model using ln*gdppc* as dependent variable and subsequently transformed for reasons of comparability with the other equations. Time-invariant country specific effects are removed by taking first-differences in the estimation. Then the right-hand-side variables in the first-differenced equation are instrumented.[22] This method improves the statistical significance of the results and allows us to conclude that after 1997 growth of GDP per capita in the EU countries is, on average, higher than growth in other industrial OECD countries; when the threshold is 1992 no significant differences are found (in this case only the results for the convergence coefficient and the dummy are reported).

In columns 5 and 6, the economic performance of the EU countries before and after 1997 is compared (the same is done for the periods before and after 1992, but only the convergence coefficient is reported). Instead of using dummies, a separate regression for each period is estimated. The focus of this analysis will be in comparing the convergence coefficient of each regression. The convergence coefficient for the period before 1997 is considerably lower (in absolute value) than the one for the period after 1997, meaning that the speed of convergence to the steady-state is higher in the period in which fiscal rules are officially enforced than before. This evidence confirms the result given by *d97eu* above. When the pre and post Maastricht periods are compared separately no substantial differences are found, confirming once again the results obtained before for the case where *d92eu* was used.

The last column reports estimates to compare the performance of the non-EU countries (column 7) with the performance of the EU countries (column 6) in the period after 1997 (and 1992). Despite the problems of significance due to the low number of observations in the regression for non-EU countries, results show that the speed of convergence in the EU countries is not substantially different from the other OECD countries, whichever period is considered. This reinforces the idea that EU fiscal rules may have not indeed affected economic growth in Europe.

Thus, from this simple analysis it is possible to conclude that output growth was not negatively affected in the period after Maastricht in the EU. Therefore, Maastricht and SGP fiscal rules for the deficit and debt should not be blamed for being harmful to growth of real GDP per capita in the EU countries. On the contrary, evidence shows that, on average, growth is statistically higher in the period in which the fulfilment of

[22] In the regression of column 4, the log of real GDP per capita is instrumented with its second and subsequent lags and the other variables are instrumented with their own values.

the 3% criteria for the deficit started to be officially assessed… And this is true either comparing with the past performance of the EU countries or even with the performance of other developed countries.

III) Sensitivity analysis

In addition to the robustness checks presented above, other estimations were performed to verify whether the main results are sensitive to the exclusion or inclusion of some variables in the model. Some of the results of that sensitivity analysis are reported in Table 5 and Table 6. Those results were obtained by using a PMG estimator and regressions were performed including either a dummy for the period after Maastricht (*d92eu*) or for the period in which fiscal rules are officially assessed (*d97eu*).

As the variable used to control for the revenue side of the government budget (ln*gvtxr*) was never statistically significant, a new variable was included in the model: the log of the total government tax and non-tax receipts divided by GDP (ln*gvrcp*). Nevertheless, it is also insignificant and the main results are not affected (see Table 5, column 1). The same happened when a similar variable considering just tax revenues was included as an alternative (results not reported).

[Insert Table 5 around here]

Despite the justifications advanced before to use the volatility of inflation instead of its level, the results of a regression including the level of inflation (*infl*) are reported in column 2 of Table 5. They show a significant negative effect of a higher level of inflation, but its inclusion in the model does not change the main conclusions of this study. Those conclusions remain valid even when both ln*gvtxr* and *sdinfl* are excluded from the model (column 3), or when a simple growth specification *à la* Mankiw *et al.* (1992) is considered (column 4).

Some other variables were included in the model to control for the omission of other potential factors that might affect output, like the OECD crude oil import price (ln*oilp*), the average growth in the OECD countries (*gwgdp*) and the deviation from the Taylor rule (*devtr*).[23] Empirical evidence shows that oil price has a negative impact on

[23] The deviation from the Taylor rule was computed as follows: *devtr = short-term interest rate - Taylor rule*, where *Taylor rule = inflation + 0.5*output gap + 0.5*(inflation - 2) + 2*. See Taylor (1993). This variable is included in the model to, somehow, control for the effects of the conduct of monetary policy.

output per capita, whilst a better economic environment in the group of OECD countries has a positive spillover affect on convergence in output per capita in the EU. Additionally, the output is negatively affected when the short-term interest rate exceeds the Taylor rule, but this effect is not always statistically significant. Nevertheless, the most important point to emphasize here is the fact that the other results are not substantially affected by the inclusion of those control variables.

Theoretically, we would expect that a higher level of public debt had a negative impact on output (Saint-Paul, 1992). Estimations presented in column 1 of Table 5 and column 1 of Table 6 show that, in the case of the EU countries, it is not the level of the debt (*debt*) but the accumulation of more and more debt (*Δdebt*) that has a negative impact on output per capita. This evidence supports the concern of the EU authorities in avoiding growing debts and, somehow, justifies the rule for the public debt.

[Insert Table 6 around here]

Results also support the rule for the deficit. When the government budget surplus (*gbs*) is included instead of the other fiscal variables (column 2), we observe that output decreases as the deficit increases. However, the results of this estimation can be criticised due to a bias coming from the reciprocal causality between the government budget surplus and the dependent variable. A way of attenuating that problem and, at the same time, taking into account the rule for the deficit in the model more directly is to include a dummy that takes value 1 when the deficit is lower than 3% of GDP (*def_rule*). The lag of this variable is included in the regression presented in column 3 of Table 6. Results show that when countries have deficits lower than 3% of GDP, they present a higher growth of real GDP per capita, on average. This result can be interpreted as some evidence in favour of the EU rule for the deficit.

Thus, as the significance of the other variables, especially the dummies, is not affected by the inclusion of those fiscal variables, we have evidence to reinforce the idea that fiscal rules were not harmful to growth in the EU; furthermore, evidence is even supporting those rules.

The margin of manoeuvre was also included in all the specifications reported before instead of the dummies, but it remained insignificant (results are not reported here). Some attempts were made to improve this indicator. In a first attempt, the values for the deficit (or GBS) were estimated from a rolling regression of the GBS on the time trend to control for the time effects on the deficit and to make the deficit endogenously determined. Then the margin of manoeuvre was computed as the linear relation indicated in Table 1. However, when included in the growth specification, the coefficient associated with this variable is not significant (see column 4 of Table 6). This variable remains insignificant even when estimated directly from a rolling regression of the (original) marginal of manoeuvre variable on the time trend. In another attempt, the following non-linear relation was considered in the computation of the margin of manoeuvre: *mg_mnvr* is equal to the exponential of *GBS* if GBS<0 and year>1991; and equal to 1, otherwise. This indicator allows some (little) margin of manoeuvre even when the deficit is higher than 3% of GDP. The idea is to capture the implicit margin of manoeuvre that the countries that broke the rule in this decade seem to have enjoyed without being sanctioned. But, once again, no effect on output comes from this variable (see column 5). The same happened when the square of the (original) margin of manoeuvre was used and when a different relation was considered to compute this variable for large and small countries in the period after Maastricht (results are not reported here).[24] Thus, this evidence seems to give more support to the argument that the reduction of the margin of manoeuvre over fiscal policy in some countries in the period after Maastricht did not have a negative impact on growth of real GDP per capita.

Another interesting aspect to clarify is whether growth in the group of countries that have had problems in accomplishing the 3% rule for the deficit (France, Germany, Greece, Italy, Portugal and UK) was indeed affected in the periods after Maastricht and after 1997. Results presented in column 6 confirm the findings obtained with the panel of all EU countries: growth of GDP per capita is not significantly different in the periods before and after Maastricht but it is higher, on average, in the period after 1997. The same happens when we consider a regression with the other 8 EU countries that have been accomplishing the rule (see column 7).[25] One interesting finding comes from the results for the fiscal variables: cuts in government spending have a positive and significant effect on growth of GDP per capita in the group of countries that have had

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[24] A relation that allows a larger margin of manoeuvre for large countries (France, Germany, Italy, Spain, UK) than for the others was considered in this last case.

[25] This can mean that the first group of countries did not take advantage of the 'good years' after 1997 to stabilize their public accounts in order to have enough budgetary margin of manoeuvre to avoid breaking the rule in the 'bad years'. This does not seem to be the case in the other 8 EU countries that have been accomplishing the rule. They also present a higher growth after 1997, but they seem to have taken advantage of it to stabilize their accounts.

problems in accomplishing the 3% rule for the deficit. These cuts are important because they promote not only a higher growth but also the necessary reduction of their deficits (directly, via the cuts, and indirectly, via a higher growth). Hence, this group of countries should promote measures to reduce their public spending. On contrary, in the group of countries that has achieved a stable budgetary position, it is not the spending cuts but the government investment that has a significant impact on growth.

A final analysis assesses whether growth was higher in the non-EU countries after 1997, like it was in the EU countries. If so, the higher growth in the EU in the period in which fiscal rules started to be officially assessed can be due to international spillovers that may help to cover eventual negative effects of the rules. Nevertheless, results show that, on average, growth was not significantly higher in the other OECD countries after 1997 (or even after 1992 – see column 8).[26] Therefore, this gives more support to the idea advanced in this study that EU economic growth was not negatively affected by the fiscal rules.

Other regressions were performed including some political and institutional variables, like the timing of elections, ideological orientation of the government and constraints on the executive or on the political power, and even including variables controlling for the iteration of the exogenous variables with the dummies. However, the coefficients associated with those variables were not significant in any of the experiments, providing no additional explanation for the understanding of the behaviour of economic growth in the EU. Moreover, the results of this study were not significantly affected by the inclusion of those variables. The results and conclusions of this work are also robust to the exclusion of one EU country at a time from the sample and to the exclusion of the 3 EU countries that did not take part in the EMU (Denmark, Sweden and UK).[27]

In sum, the main conclusions of this paper remain valid even when some variables are excluded from or included in the model: growth was not negatively affected in the period after Maastricht; and in the period in which fiscal rules are officially assessed we have (on average) a higher growth of GDP per capita in the EU. Additionally, the results of the sensitivity analysis for the fiscal variables give support

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[26] In this case, we consider just a basic specification of the model to avoid the loss of more degrees of freedom, once we consider just a small sample of countries in this PMG estimation. In reality, the PMG estimator does not converge and cannot retrieve the estimates when the other variables are included. The same problem affected regressions 6 and 7, but it was solved excluding just ln*gvtxr*.

[27] These results are not presented here, but they are available upon request.

to the rules for the deficit and debt and call attention to the importance of government spending cuts in the group of countries that have failed in accomplishing the fiscal rule for the deficit.

4.3. Estimations using five-year time intervals

In the empirical work done so far, annual data has been used to estimate the growth equation. Yearly time spans are used to avoid the loss of important information that might result from the use of larger time spans. The justification for the choice of annual data becomes more evident when economic performance of the EU and non-EU countries is compared and when a separate comparative analysis for the periods before and after Maastricht (or SGP) is made. Nevertheless, this choice implied the inclusion of short-run dynamics in the equation to control for cyclical fluctuations of output.

Another way of avoiding the problem of the short-run business cycle fluctuations of output is precisely by using data from larger time intervals. Therefore, despite the mentioned loss of information that may result from the use of these larger time spans, we will proceed with the estimation of some growth equations using data from five-year time intervals in line with the works by Islam (1995), Caselli *et al.* (1996), Bond *et al.* (2001) and Ederveen *et al.* (2006). The objective of this final analysis is basically to evaluate the robustness of the results to a change in the time spans and assess whether the main conclusions are affected or not by that change.

As a result of the use of five-year time intervals, the general form of the growth equation can simply be written as:

$$\Delta \ln y_{i,t} = \alpha_{0,i} + \phi \ln y_{i,t-1} + \beta_1 \ln sk_{i,t} + \beta_2 \ln h_{i,t} + \beta_3 \ln(n_{i,t} + 0.05) + x'_{i,t}\delta + \gamma d_{i,t} + \varepsilon_{i,t} \quad (11)$$

for $i = 1,...,N$ and $t = 2,...,T$, where $\Delta \ln y_{i,t}$ is the log difference in output per capita over a five-year period, $\ln y_{i,t-1}$ is the logarithm of output per capita at the start of that period and $x_{i,t}$ is a vector of additional variables to be included in the basic growth equation. These variables and the other explanatory variables (ln*sk*, ln*h*, ln(*n+0.05*)) are measured as the average over each five-year period. A dummy or qualitative variable ($d_{i,t}$) is added to the equation to control for the period in which EU fiscal rules were imposed in the EU, similarly to the case in which annual data is used instead.

Considering the same data and time period used in the annual analysis (1970-2005), 7 five-year time spans are constructed for the 15 EU countries. These data are then used in the estimation of equation *(11)*. Different estimators have been used in the literature to estimate this kind of dynamic panel data model. In this analysis, fixed effects (FE) and generalized method of moments (GMM) estimators will be employed.

Fixed effects are widely employed in several growth studies. However, Caselli *et al.* (1996) argue that this estimator may lead to inconsistent estimates in the context of a dynamic panel data model because it does not take into account the fact that some of the explanatory variables can be endogenous and measured with error. Additionally, the incorrect treatment of country-specific effects may lead to omitted variable bias. A way of addressing this problem is using a first-differenced GMM estimator (DIF-GMM). This estimator was developed by Arellano and Bond (1991) and introduced in the growth literature by Caselli *et al.* (1996). The idea is to take first-differences of the regression equation, written in the form of a dynamic model, to remove unobservable time-invariant country-specific effects. Then the right-hand-side variables in the first-differenced equation can be instrumented. This procedure will solve the problem of omitted variable bias that is constant over time; parameters are estimated consistently despite the endogeneity of right-hand-side variables; and the use of instruments allows for consistent estimation even in the presence of measurement errors.

However, Bond *et al.* (2001) show that this method may present a serious problem when the empirical growth models are based on five-year averages to avoid the high persistence of the output series. This procedure reduces the number of time periods considered in the analysis to a small number and the first-differenced GMM estimator has been found to have poor finite sample properties, in terms of bias and imprecision. In fact, under these conditions, lagged levels of the variables are only weak instruments for the first-differences (see Blundell and Bond, 1998). Therefore, the results of this estimator must be analysed with caution.

A refinement to this estimator that tries to solve the problem of the small sample bias was developed by Blundell and Bond (1998) and then introduced in the growth literature by Bond *et al.* (2001). These authors demonstrate that more reliable results can be obtained by using a system GMM estimator (SYS-GMM). The idea is to estimate a system of equations for both first-differences and levels, where the additional instruments used in the levels equations are lagged first-differences of the series. Since

Bond *et al.* (2001) consider that this estimator may have superior finite sample properties, they recommend the system GMM estimator for empirical growth research.

The results of the estimation of the growth equation using these estimators for five-year time spans are reported in Table 7. Growth regressions were essentially estimated including the same variables used in the annual analysis and incorporating a dummy either for the period after Maastricht or for the period in which fiscal rules started to be assessed.[28] The indicator for the margin of manoeuvre (*mg_mnvr*) was also included in some regressions.

[Insert Table 7 around here]

The estimates presented in column 1 and 2 were obtained by using a FE estimator. The convergence coefficient has the correct sign and is statistically significant in any of the estimations (including *d91eu*, *d96eu* or *mg_mnvr*), showing that convergence in output per capita runs at an annual rate of about 8%.[29] The coefficients on physical and human capital and population growth have the expected signs, according to the growth literature, and are significant. The additional variables do not present robust results: only the government consumption (ln*gvcns*) and the log of the ratio of exports over imports (ln*xmr*) have the expected signs and are significant; a shift from taxing factor incomes to taxing consumption has a negative effect on output, contrarily to the expected; and the other variables are not significant. Moreover, neither of the dummies nor the margin of manoeuvre are significant, which can be interpreted as an additional empirical support to the idea advanced in this study that institutional changes that took place in Europe after Maastricht were not harmful to growth.

However, as the fixed effects estimator may lead to inconsistent estimates in the context of empirical growth models by the reasons indicated before, results from GMM estimators are reported in columns 3 to 6. The instruments used for DIF-GMM are the second and third lags of the log of output per capita. All other right-hand-side variables are assumed exogenous and are instrumented with just their own values in order to avoid the problem of too many instruments. The additional instrument used in the SYS-

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[28] As we are considering five-year time intervals it is not possible to use dummies covering exactly those periods. The best we can do is to use a dummy that takes value 1 from the time interval 1991-1995 onwards (*d91eu*) and a dummy that takes value 1 in the intervals starting in 1996 and 2001 (*d96eu*).

[29] This value is not very far from the one obtained by Islam (1995) using a fixed effects estimator in a basic growth equation over a panel of 22 OECD countries.

GMM is the difference of the log of output per capita lagged one period.[30] Moreover, the Hansen test of over-identifying restrictions does not rejects the overall validity of those instruments.

Results for the DIF-GMM estimator show a higher rate of convergence of output per capita to its steady-state, but the physical capital variable is no longer significant and government investment has a coefficient contrary to the expected. As the sample contains just a small number of time periods, this might be the result of the finite sample bias and imprecision of this estimator. In order to avoid that problem, we also report the results from a system-GMM estimator (SYS-GMM) that seems to produce more reliable results in this kind of studies.

The SYS-GMM estimator reports a lower estimate for the speed of convergence than the DIF-GMM, but not very far from the one obtained by using a FE estimator.[31] In fact, the majority of the coefficients are not very different from the ones obtained by fixed effects. The main difference comes from the dummy for the period in which fiscal rules are officially assessed. In this case, we find evidence of a higher growth rate in that period than before. Results show that in the period after 1996 annual growth of real GDP per capita is, on average, about 0.86 percentage points higher than in the period before.[32] In addition, no significant differences in growth are found in the pre- and post-

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[30] Here it is important to clarify two technical issues:

First, despite it being reasonable to consider that some other right-hand side variables like, for example, physical and human capital and population growth, can be considered endogenous because they can be determined simultaneously with the rate of growth (Caselli *et al.*, 1996), practical and technical reasons inherent to the finite sample used in this work impede us from proceeding in that way. When those variables are treated as potentially endogenous in the estimation, we end up with a problem of too many instruments in comparison with the number of observations. Although this fact does not bias the coefficient estimates – indeed, treating those variables as endogenous does not affect greatly the coefficient estimates or their statistical significance in this work (results not reported) – it increases the distance of the feasible efficient GMM estimator from the asymptotic ideal and weakens the Hansen test to a point it generates unreliable p-values of 1.000 (Roodman, 2006). Therefore, the solution to reduce the number of instruments and solve this problem was to consider those right-hand side variables as exogenous. In fact, Ederveen *et al.* (2006) also consider them as exogenous in a growth specification to study the impact of structural funds in a group of 13 EU countries.

Second, Blundell and Bond (1998) and Bond et al. (2001) argue that in finite samples the asymptotic standard errors from a two-step GMM estimator can be biased and unreliable for inference. Therefore, the choice was to present the results from the one-step GMM estimators, with robust standard errors to heteroscedasticity, which seem to be more reliable for finite sample inference.

[31] The SYS-GMM estimates indicate a speed of convergence of about 7% to 9%. These estimates are very similar to the ones obtained with the PMG estimator for yearly-time spans. They are also close to the GMM estimates obtained by Ederveen *et al.* (2006) in a growth study for 13 EU countries. Caselli *et al.* (1996) also find a high rate of convergence (10% per year) in their study, which they conclude is an indication that countries are very near to their steady states and consequently the important differences in output per capita across countries will be explained by differences in their steady-states.

[32] This result is in line with the one obtained when annual data was used. The value of 0.86 was computed dividing the estimated coefficient on *d96eu* by 5. In fact, as here the dependent variable represents the

Maastricht periods.[33] Therefore, these results strengthen the conclusion that EU economic growth was not negatively affected by the imposition of fiscal rules in this period.

As the coefficients associated with the additional explanatory variables are not significant, a simple basic growth model was considered in the regression presented in column 5. Despite the evidence of a slightly lower speed of convergence, the main conclusions of this paper are not affected. In regression 6, an additional variable to control directly for the deficit rule (*def_rule*) was included. This variable is a dummy that takes value 1 when the average deficit over each five-year time interval is lower than 3% of GDP. Results show that high deficits are not synonymous of higher growth, giving some additional support to the 3% rule for the budget deficit.

As a final robustness check of the results obtained so far, column 7 reports the results obtained by a simple two-stage least squares estimator (2SLS), where the log of the initial output per capita is instrumented with its second lag. As the sample size is not large, reasonable results are expected from this estimator. Indeed, the main findings are not substantially different from the ones obtained with the other estimators.

In sum, the results obtained using five-year time spans corroborate the main conclusion of the yearly-time spans analysis: growth of real GDP per capita in the EU was not negatively affected in the period after Maastricht, i.e. in the period in which fiscal rules were imposed over the EU countries.

5. Conclusions

Although some economists claiming that the SGP fiscal rules may have affected EU growth negatively, others argue that those rules are necessary to promote fiscal consolidation and economic stability in the EMU which will be beneficial for growth in the long-run. Nevertheless, very little empirical work has been done to clarify this debate. The work presented in this paper intends to find a clear empirical answer to this issue and, in doing so, tries to contribute to the literature with some improvements

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growth over each five-year period, we just need to divide the coefficients by 5 to get the annual impacts on growth. This is the same as estimating the same regressions using $\Delta \ln gdppc/5$ as dependent variable.

[33] The margin of manoeuvre was also included in the GMM estimations, instead of the dummies (results are not reported here). However, as in the case of the FE estimations, its coefficient was never statistically significant. This result can be interpreted as evidence that the eventual constraints imposed by the fiscal rules over fiscal policy after Maastricht did not affect growth either positively or negatively.

relative to previous empirical works like: using a different method of estimation (pooled mean group estimation), a dummy for the period in which fiscal rules started to be officially assessed, a margin of manoeuvre indicator and providing a cross-comparison between EU and non-EU countries.

Considering those improvements and using a specific growth equation for both yearly and five-year time spans, this study shows that growth was not negatively affected in the period after Maastricht in the EU. This is true either comparing recent performance of EU countries with their past performance or with the performance of other developed countries. Therefore, this paper concludes that Maastricht and SGP fiscal rules should not be blamed for harming growth of real GDP per capita in the EU area. On the contrary, evidence reveals that, on average, growth is statistically higher in the period in which the fulfilment of the 3% criteria for the deficit started to be officially assessed. Furthermore, this study also presents some evidence favouring the EU fiscal rules for the public deficit and debt.

Even though the results presented in this paper show that EU fiscal rules may not have affected growth in Europe in the post-Maastricht period, evidence from the annual analysis also indicates that an increase in government investment has a positive and significant impact on real output per capita. Therefore, EU authorities should give special attention to the potential benefits of productive public investment when assessing whether an excessive deficit exists. Otherwise, some countries could find it easier to cut public investment than current expenditures in 'bad' times to accomplish the 3% for the deficit – behaviour which, according to the findings of this paper would be prejudicial for output growth. Nevertheless, the results also show that the efforts to reduce current expenditures must not be relaxed, especially in the countries that have been breaking the rule for the deficit in recent years.

Finally, it would be interesting to extend the analysis of this paper to the countries that have recently joined to the EU. The study of the impact of the fiscal constraints and institutional changes that they have to face to control their public accounts and to enhance the credibility of their institutions may possibly bring some additional insights to the understanding of the impact of those constraints on their economic performance. One obstacle to do that study may come from the lack of data for the decades of 1970s and 1980s for some of those countries.

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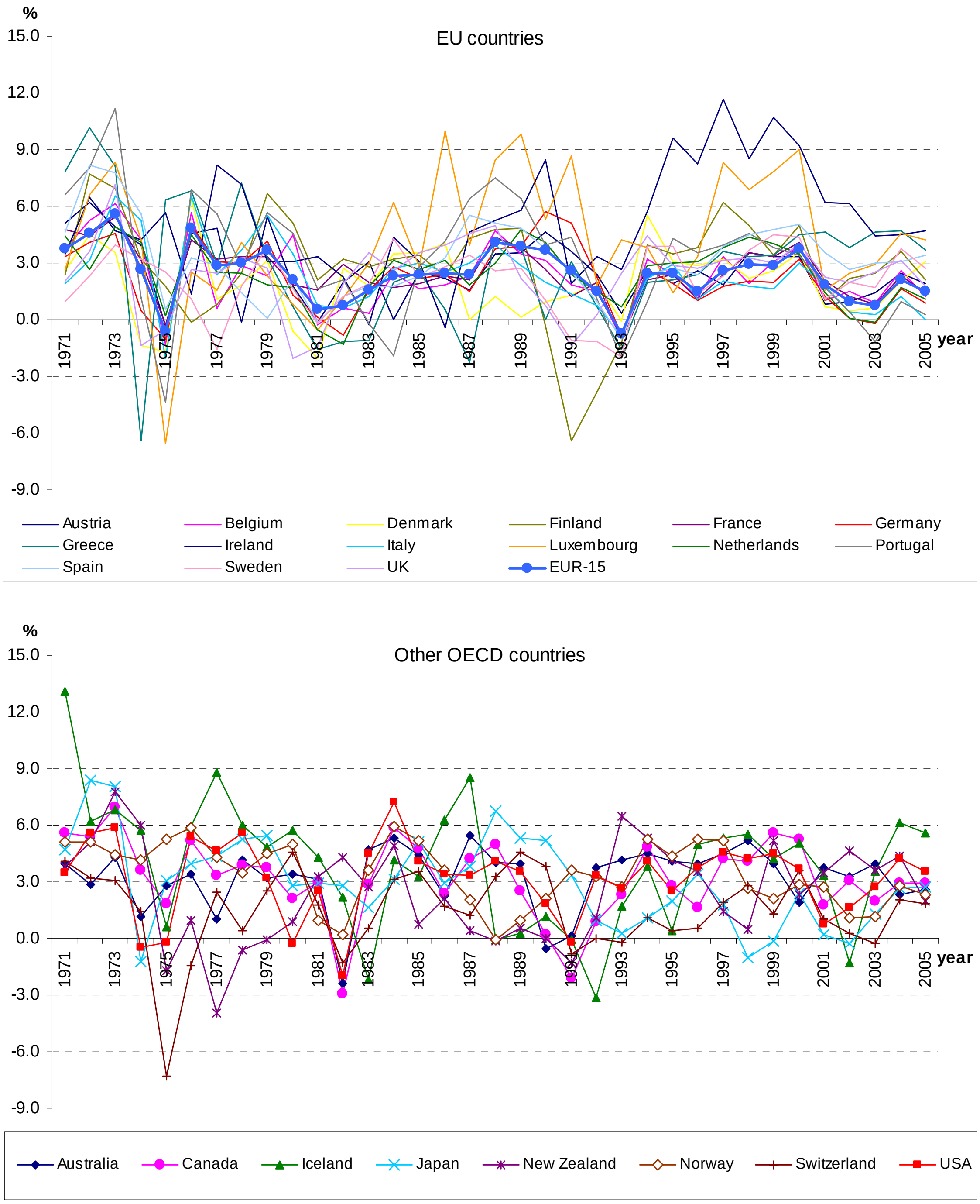
Figures

Figure 1. ***Growth of real GDP in the EU and in other OECD countries, 1971-2005***



Source: OECD (2006). *Statistical Compendium*.

Tables

Table 1. Description of the Variables Used

Dependent variable:

Δln*gdppc* – growth rate of real GDP *per capita* of population aged 15-64 years old at price levels and purchasing power parities (PPP) of 2000.

Convergence variable:

ln$gdppc_{t-1}$ – lagged real GDP *per capita* of population aged 15-64 years at price levels and PPP of 2000.

Basic economic growth explanatory variables:

ln*pfcf* – the logarithm of the ratio of the real private fixed capital formation to real GDP is used as a proxy for the propensity to accumulate physical capital.

ln*hk* – the stock of human capital is proxied by the logarithm of the average number of years of schooling of the (working-age) population from 25 to 64 years of age.

ln*(n+g+d)* – represents the log of population growth (of population aged 15-64) plus the constant *g+d* to which is assigned the value of 0.05 as in Mankiw *et al.* (1992).

Exogenous economic policy variables:

ln*gvfcf* – the log of the ratio of government (gross) fixed capital formation to GDP (both at market or current prices) is used as proxy for government investment.

ln*gvcns* – represents the log of government final consumption expenditure divided by GDP (both at market or current prices).

ln*gvtxr* – log of the ratio of direct to indirect government tax revenues (both at market or current prices).

sdinfl – inflation volatility is measured by the standard deviation of the rate of growth in the consumer price index (CPI) computed as a centred three year moving average.

ln*xmr* – the log of the ratio of exports to imports (both at 2000 prices) is a proxy for gains from trade.

Qualitative variables to control for the period of EU fiscal rules:

d92eu – dummy that takes value 1 for EU countries for the period 1992-2005 and 0 otherwise.

d97eu – dummy that takes value 1 for EU countries for the period 1997-2005 and 0 otherwise.

mg_mnvr – indicator for the margin of manoeuvre of fiscal policy defined according to the SGP rules: before Maastricht it is assumed that EU countries have total margin of manoeuvre over fiscal policy => *mg_mnvr* =1; after Maastricht the margin of manoeuvre will be computed as follows:

mg_mnvr = (GBS+3)/3	if GDP growth>-0.75% and -3%<GBS<0%
= 1	if GDP growth < -2% or GBS > 0%;
= 0.5	if -2% < GDP growth < -0.75% and GBS < -3%;
= 0.5*1+0.5*(GBS+3)/3	if -2% < GDP <-0.75% and -3% < GBS <0%;
= 0	if growth GDP>-0.75% and GBS<-3%;

GBS means government budget surplus and 0.5 represents the probability of the deficit not being considered 'excessive' by the European Commission in a situation of moderate recession.

Sources: OECD *Statistical Compendium*, April 2006 (for all variables except human capital).
Data for human capital from 1970 to 1990 was interpolated from five-year observations from De la Fuente and Domenéch (2000). For the period 1996 to 2004 data were obtained from OECD *Education at a Glance*, various issues (1998 to 2006). Missing observations were filled by linear interpolation.

Table 2. Panel unit root and cointegration tests

Panel unit root tests	Level	1st diff.	***Pedroni panel cointegration tests***	
ln*gdppc*	-1.43	-3.57	Panel υ –statistic	4.54
ln*pfcf*	-1.93	-4.39	Panel rho-statistic	2.28
ln*hk*	-0.38	-3.58	Panel pp-statistic	-2.69
ln(*n*+*g*+*d*)	-2.34	-4.88	Panel ADF-statistic	-1.85
lng*vfcf*	-1.39	-4.15	Group rho-statistic	3.67
lng*vcns*	-1.80	-4.05	Group pp-statistic	-1.99
lng*vtxr*	-1.71	-4.29	Group ADF-statistic	-0.71
sdinfl	-3.32	-5.56		
ln*xmr*	-1.92	-4.22		

Notes: In the panel unit root tests the critical values for 1%, 5% and 10% are -2.04, -1.90, and -1.81, respectively; for example, a k<-1.90 implies rejection of the null hypothesis of unit root or non-stationarity at 5%. Results and critical values for these tests were obtained by using the 'ipshin' command in STATA.

Pedroni tests were performed by using a procedure written by Peter Pedroni for RATS; all reported values for Pedroni statistics are distributed N(0,1) under the null hypothesis of no cointegration and those statistics are one-sided tests with a critical value of -1.64 for a level of significance of 5% (k<-1.64 implies rejection of the null), except the υ-statistic that has a critical value 1.64 (k>1.64 means rejection of the null hypothesis).

Table 3. Results from dynamic fixed effects panel data estimations

Dep.: $\Delta\ln gdppc_{it}$	1	2	3	4	5	6	7
$\ln gdppc_{it-1}$	-0.0346	-0.0375	-0.0350	-0.0352	-0.0590	-0.0275	-0.0697
	(-2.99)***	(-3.33)***	(-3.12)***	(-4.53)***	(-3.71)***	(-2.06)**	(-4.39)***
Implied λ	[0.035]	[0.038]	[0.036]	[0.036]	[0.061]	[0.028]	[0.072]
hwtc [(a)]	19.7 years	18.1 years	19.4 years	19.3 years	11.4 years	24.9 years	9.6 years
$\ln pfcf_{it}$	0.8103	0.6537	0.7960	0.5073	0.8021	0.1897	0.4055
	(2.57)**	(2.40)**	(2.60)***	(2.31)**	(2.19)**	(0.41)	(1.42)
$\ln hk_{it}$	1.662	1.1573	1.6359	1.1010	1.1815	0.4656	0.8096
	(3.85)***	(3.65)***	(5.22)***	(3.99)***	(3.08)***	(0.88)	(2.54)**
$\ln(n_{it}+g+d)$	-1.589	-1.4384	-1.5892	-1.7553	-1.4018	-0.2449	-1.1757
	(-2.35)**	(-2.56)**	(-2.46)**	(-3.86)***	(-3.09)***	(-0.41)	(-3.45)***
$\ln gvfcf_{it-1}$	0.3694	0.3616	0.3550	0.3203	0.1027	0.1935	0.1508
	(2.19)**	(2.40)**	(2.21)**	(2.66)***	(1.18)	(0.91)	(1.94)*
$\ln gvcns_{it-1}$	-2.411	-2.164	-2.366	-2.0996	-0.9888	-0.6251	-0.9780
	(-2.80)***	(-3.06)***	(-2.97)***	(-4.11)***	(-2.65)***	(-1.20)	(-3.17)***
$\ln gvtxr_{it-1}$	0.1270	0.1137	0.1286	-0.0352	-0.0193	0.2387	0.0263
	(0.68)	(0.67)	(0.70)	(-0.26)	(-0.16)	(1.08)	(0.27)
$sdinfl_{it-1}$	-0.0577	-0.0581	-0.0577	-0.0514	-0.0681	-0.0581	-0.0658
	(-1.97)**	(-2.18)**	(-2.01)**	(-2.33)**	(-1.99)**	(-0.36)	(-2.41)**
$\ln xmr_{it-1}$	0.8044	0.7181	0.7800	0.5004	0.4101	0.6157	0.1462
	(2.42)**	(2.45)**	(2.48)**	(2.26)**	(1.29)	(1.45)	(0.57)
$d92eu_{it}$	-0.0007				0.0039		
	(-0.25)				(0.61)		
$d97eu_{it}$		0.0054		0.0060		0.0112	0.0093
		(2.22)**		(2.98)***		(1.97)**	(3.72)***
mg_mnvr_{it-1}			0.0012				
			(0.52)				
$\Delta\ln pfcf_{it}$	0.1045	0.1047	0.1050	0.1025	0.1106	0.1171	0.1143
	(5.52)***	(5.59)***	(5.54)***	(7.12)***	(4.42)***	(3.77)***	(4.77)***
$\Delta\ln hk_{it}$	-0.0509	-0.0250	-0.0541	0.0264	-0.0784	0.0005	-0.0668
	(-0.81)	(-0.40)	(-0.87)	(0.49)	(-1.42)	(0.01)	(-1.23)
$\Delta\ln(n_{it}+g+d)$	0.0116	0.0104	0.0120	0.0099	0.0155	-0.0200	0.0154
	(0.94)	(0.83)	(0.96)	(1.00)	(1.36)	(-1.85)*	(1.37)
$\Delta\ln gvfcf_{it}$	0.0364	0.0372	0.0361	0.0354	0.0341	0.0357	0.0354
	(3.72)***	(3.81)***	(3.67)***	(4.28)***	(3.40)***	(2.68)***	(3.56)***
$\Delta\ln gvcns_{it}$	-0.2585	-0.2593	-0.2586	-0.2618	-0.1841	-0.1904	-0.1850
	(-8.08)***	(-8.12)***	(-8.09)***	(-10.32)***	(-5.27)***	(-4.69)***	(-5.54)***
$\Delta\ln gvtxr_{it}$	0.0258	0.0252	0.0260	0.0141	0.0145	0.0288	0.0177
	(2.20)**	(2.14)**	(2.22)**	(1.49)	(1.37)	(1.97)**	(1.72)
$\Delta sdinfl_{it}$	0.0001	-0.0001	0.0001	-0.0003	-0.0022	0.0014	-0.0021
	(0.11)	(-0.03)	(0.10)	(-0.35)	(-1.12)	(0.36)	(-1.09)
$\Delta\ln xmr_{it}$	-0.0118	-0.0139	-0.0117	-0.0154	0.0342	0.0500	0.0286
	(-0.52)	(-0.62)	(-0.52)	(-1.06)	(1.29)	(1.40)	(1.13)
constant	0.0489	0.1134	0.0511	0.0652	0.2382	0.2504	0.3505
	(0.40)	(1.00)	(0.47)	(0.89)	(1.40)	(1.74)*	(2.09)**
R^2	0.5873	0.5913	0.5875	0.5634	0.5946	0.5030	0.6133
Time period	1972-2004	1972-2004	1972-2004	1972-2004	1992-2004	1997-2004	1992-2004
No. countries	14	14	14	21	21	21	21
No. observations	448	448	448	641	273	168	273

Sources: see Table 1.

Notes: *t*-statistics are in parentheses; significance level at which the null hypothesis is rejected: ***, 1%; **, 5%; and *, 10%; the estimated speed of convergence to the steady-state (λ) is in square brackets; models estimated controlling for fixed effects (see text for reasons why fixed effects make more sense in this context; Hausman tests also rejected random effects, nevertheless, equation in column 6 was estimated by random effects because the dummy *d97eu* was dropped in the fixed effects estimation due to lack of variability). In all estimations the presence of any pattern of heteroscedasticity and autocorrelation was controlled for by using robust standard errors. The long-run coefficients, their respective standard errors and *t*-statistics were estimated according to the relation $\theta_s=a_{si}/\phi_i$.

Luxembourg and Iceland were excluded from the sample due to lack of observations for human capital.

(a) *hwtc* means half way to convergence and measures the time it takes to go half way to the new steady-state output per capita or the time it takes to reduce half of the differences in output per capita among countries.

Table 4. Pooled mean group panel data estimations and robustness analysis

Dep.: Δln*gdppc*$_{it}$	**1**	**2**	**3**	**4**	**5**	**6**	**7**
ln*gdppc*$_{it-1}$	-0.0700	-0.0643	-0.0594	-0.1726	-0.0377	-0.0871	-0.0886
	(-6.72)***	(-7.59)***	(-7.87)***	(-5.51)***	(-2.14)**	(-3.28)***	(-1.35)
Implied λ	[0.073]	[0.066]	[0.061]	[0.1894]	[0.0384]	[0.0911]	[0.0928]
hwtc [(a)]	9.6 years	10.4 years	11.3 years	3.7 years	18.0 years	7.6 years	7.5 years
ln*pfcf*$_{it}$	0.5451	0.3551	0.4937	0.4745	0.5679	1.1965	0.2398
	(4.21)***	(3.09)***	(3.87)***	(4.48)***	(1.67)*	(2.40)**	(0.30)
ln*hk*$_{it}$	1.2879	0.8142	1.4183	-0.0131	0.8971	-0.7826	2.3633
	(7.78)***	(3.89)***	(10.27)***	(-0.07)	(1.78)*	(-0.96)	(1.59)
ln$(n_{it}+g+d)$	-0.9556	-1.0070	-0.9183	-0.4429	-1.8416	-0.5974	-1.4288
	(-5.28)***	(-4.52)***	(-3.99)***	(-4.78)***	(-1.89)*	(-2.31)**	(-1.10)
ln*gvfcf*$_{it-1}$	0.1770	0.2672	0.2120	0.1089	0.2812	0.1041	0.0407
	(3.14)***	(3.01)***	(3.21)***	(3.21)***	(1.29)	(0.83)	(0.18)
ln*gvcns*$_{it-1}$	-1.5428	-1.5558	-1.8797	-0.3853	-1.9274	-0.1352	-1.6997
	(-5.42)***	(-4.36)***	(-5.23)***	(-2.42)**	(-1.75)*	(-0.35)	(-1.15)
ln*gvtxr*$_{it-1}$	0.0077	-0.0428	0.0925	0.0187	-0.2074	-0.0357	-0.3744
	(0.10)	(-0.43)	(1.12)	(0.42)	(-0.86)	(-0.22)	(-1.03)
sdinfl$_{it-1}$	-0.0421	-0.0547	-0.0480	-0.0131	-0.0507	-0.0358	-0.0531
	(-3.48)***	(-4.34)***	(-3.48)***	(-0.74)	(-1.63)	(-0.78)	(-0.68)
ln*xmr*$_{it-1}$	0.1948	0.4043	0.3992	0.1634	0.7463	0.3146	0.3369
	(1.41)	(3.17)***	(3.09)***	(1.51)	(1.73)*	(0.78)	(0.70)
d92eu$_{it}$	-0.0010						
	(0.29)						
d97eu$_{it}$		0.0087		0.0101			
		(4.06)***		(5.38)***			
Mg_mnvr$_{it-1}$			0.0012				
			(0.42)				
R^2					0.5953	0.7355	0.6172
Log-likelihood	1472.3	1469.9	1464.2				
Time period	1972-2004	1972-2004	1972-2004	1997-2004	1972-1996	1997-2004	1997-2004
No. countries	14	14	14	21	14	14	7
No. observations	448	448	448	168	336	112	56
ln*gdppc*$_{it-1}$ [(b)]				-0.1946	-0.0593	-0.0611	-0.0592
				(-2.40)**	(-2.32)**	(-2.70)***	(-1.71)*
d92eu$_{it}$ [(b)]				0.0068			
				(0.87)			
Time period				1992-2004	1972-1991	1992-2004	1992-2004
No. observations				252	266	182	91

Sources: See Table 1.

Notes: All equations were estimated including short-run dynamics and a constant, but due to space limitations only long-run and dummy coefficients are reported. PMG estimations are presented in columns 1, 2 and 3; Arellano-Bond techniques are used to estimate model 4; and a fixed effects estimator is used to estimate models in columns 5, 6 and 7. Robust standard errors are used to control for the presence of heteroscedasticity. *t*-statistics are in parentheses (*z*-statistics for the PMG and Arellano-Bond estimations); significance level at which the null hypothesis is rejected: ***, 1%; **, 5%; and *, 10%.; again, the speed of convergence (λ) is in square brackets.

Luxembourg and Iceland were excluded from the sample due to lack of observations for human capital.

(a) See Table 3.

(b) In these lines the convergence coefficient and the coefficient on the dummy *d92eu* (when included in the model, instead of *d97eu*) are presented and result from a similar specification to the one above but using another time period or threshold; the coefficients on the other exogenous variables are not reported but are available upon request.

Table 5. Sensitivity analysis I

$\Delta \ln gdppc_{it}$	1	2	3	4	5	6	7	8
$\ln gdppc_{it-1}$	-0.0623 (-6.99)***	-0.0657 (-9.24)***	-0.0678 (-9.40)***	-0.1062 (-6.88)***	-0.0538 (-7.48)***	-0.0593 (-7.02)***	-0.0884 (-7.19)***	-0.0722 (-7.37)***
$\ln pfcf_{it}$	0.4559 (3.32)***	0.5297 (3.74)***	0.4361 (3.22)***	0.4521 (6.91)***	0.4669 (3.10)***	0.6222 (4.03)***	0.4498 (5.90)***	0.4250 (3.33)***
$\ln hk_{it}$	1.2519 (7.10)***	1.0804 (5.22)***	1.5567 (8.70)***	0.8579 (14.58)***	1.7914 (6.44)***	1.4134 (7.61)***	1.2592 (11.21)***	0.9969 (5.85)***
$\ln(n_{it}+g+d)$	-0.9477 (-5.11)***	-0.4132 (-2.84)***	-1.1205 (-5.27)***	-0.6763 (-5.26)***	-0.8816 (-3.52)***	-1.0763 (-4.70)***	-1.1358 (-6.77)***	-0.8216 (-4.19)***
$\ln gvfcf_{it-1}$	0.2112 (3.26)***	0.2971 (3.43)***	0.1815 (3.20)***		0.2110 (2.36)**	0.1668 (2.64)***	0.2133 (5.57)***	0.2802 (3.35)***
$\ln gvcns_{it-1}$	-1.9465 (-3.12)***	-1.6298 (-4.33)***	-1.5047 (-4.94)***		-1.2972 (-3.60)***	-1.5463 (-4.71)***	-1.4404 (-7.21)***	-1.0231 (-4.58)***
$\ln gvtxr_{it-1}$		0.2615 (3.07)***			0.1679 (1.57)	0.0763 (0.91)	0.0187 (0.28)	-0.0131 (-0.17)
$\ln gvrcp_{it-1}$	0.0915 (0.37)							
$sdinfl_{it-1}$	-0.0509 (-3.68)***				-0.0505 (-3.04)***	-0.0378 (-2.78)***	-0.0380 (-4.12)***	-0.0399 (-3.57)***
$infl_{it-1}$		-0.0314 (-4.12)***						
$\ln xmr_{it-1}$	0.0482 (0.29)	0.4305 (2.84)***	0.1882 (1.36)		0.6289 (2.84)***	0.1389 (0.97)	0.1687 (2.43)**	0.2443 (2.03)**
$\ln oilp_{it-1}$					-0.2046 (-2.86)***			
$gwgdp_{it}$						0.3411 (7.15)***		
$devtr_{it-1}$							-0.0040 (-1.74)*	
$debt_{it-1}$								0.0001 (0.03)
$d92eu_{it}$	-0.0002 (-0.04)	-0.0035 (-1.24)	0.0001 (0.02)	0.0054 (1.18)	-0.0070 (-2.36)**	-0.0004 (-0.11)	0.0001 (0.01)	0.0011 (0.32)
$\ln gdppc_{it-1}$ (a)	-0.0460 (-8.11)***	-0.0427 (-8.23)***	-0.0450 (-11.13)***	-0.0841 (-5.93)***	-0.0595 (-6.57)***	-0.0582 (-7.80)***	-0.0746 (-6.62)***	-0.0732 (-6.20)***
$\ln oilp_{it-1}$ (a)					-0.1716 (-3.66)***			
$gwgdp_{it}$ (a)						0.3481 (6.15)***		
$devtr_{it-1}$ (a)							0.0038 (-1.31)	
$debt_{it-1}$ (a)								0.0001 (0.05)
$d97eu_{it}$ (a)	0.0080 (2.90)***	0.0078 (3.98)***	0.0062 (2.54)**	0.0110 (3.36)***	0.0090 (3.41)***	0.0065 (3.45)***	0.0102 (4.13)***	0.0076 (2.77)***
Time period	1972-2004	1971-2004	1971-2004	1971-2004	1972-2004	1972-2004	1972-2004	1972-2004
No. countries	14	14	14	14	14	14	14	14
No. Obs.	448	462	462	462	448	448	411	439

Sources: See Table 1.

Notes: All equations were estimated including short-run dynamics and a constant, but only long-run and dummy coefficients are reported; a PMG estimator is used to estimate the models; *z*-statistics are in parentheses; significance level at which the null hypothesis is rejected: ***, 1%; **, 5%; and *, 10%.

Luxembourg is excluded from the sample due to lack of observations for human capital.

(a) In these lines only the convergence coefficient, the control variables and the coefficient on the dummy *d97eu* (when included in the model, instead of *d92eu*) are presented and come from a similar specification to the one above; the coefficients on the other exogenous variables are not reported but are available upon request.

Table 6. Sensitivity analysis II

Δln*gdppc*$_{it}$	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
ln*gdppc*$_{it-1}$	-0.0629 (-6.35)***	-0.0959 (-5.77)***	-0.0810 (-7.51)***	-0.0625 (-7.38)***	-0.0665 (-7.36)***	-0.1004 (-4.40)***	-0.0599 (-2.57)***	-0.0997 (-2.10)**
ln*pfcf*$_{it}$	0.4578 (3.31)***	0.2218 (1.73)*	0.3771 (3.12)***	0.4537 (3.70)***	0.4380 (3.86)***	0.3967 (3.46)***	1.0348 (4.65)***	0.5205 (5.52)***
ln*hk*$_{it}$	1.2262 (6.94)***	0.9069 (10.42)***	1.3549 (8.22)***	1.4433 (10.72)***	1.4600 (11.49)***	1.3724 (5.08)***	0.7508 (4.68)***	0.5444 (3.73)***
ln$(n_{it}+g+d)$	-1.0391 (-5.06)***	-0.9707 (-6.25)***	-0.9518 (-5.38)***	-0.9324 (-4.26)***	-0.8825 (-4.40)***	-0.8830 (-3.93)***	-1.0884 (-3.96)***	-0.2041 (-1.86)*
ln*gvfcf*$_{it-1}$	0.2432 (3.91)***		0.2152 (3.77)***	0.2188 (3.31)***	0.2215 (3.53)***	0.1978 (1.85)*	0.1756 (2.60)***	
ln*gvcns*$_{it-1}$	-0.8947 (-3.95)***		-1.2463 (-5.35)***	-1.8386 (-5.59)***	-1.7376 (-5.91)***	-1.5269 (-3.54)***	-0.0477 (-0.29)	
ln*gvtxr*$_{it-1}$	-0.1172 (-1.35)		-0.0688 (-0.88)	0.1085 (1.33)	0.0770 (0.98)			
sdinfl$_{it-1}$	-0.0296 (-2.36)**	-0.0162 (-2.23)**	-0.0395 (-3.72)***	-0.0499 (-3.86)***	-0.0480 (-4.03)***	-0.0433 (-3.67)***	0.0201 (1.43)	
ln*xmr*$_{it-1}$	0.1852 (1.42)	0.0332 (0.46)	0.2802 (2.12)**	0.4169 (3.31)***	0.3948 (3.40)***	0.5277 (2.75)***	0.2429 (1.89)*	
$\Delta debt_{it-1}$	-0.0208 (-4.09)***							
gbs_{it-1}		0.0239 (5.11)***						
def_rule_{it-1}			0.0039 (2.65)***					
$d92eu_{it}$	-0.0005 (-0.13)	-0.0014 (-0.25)	-0.0008 (-0.21)			-0.0075 (-1.20))	0.0023 (0.37)	0.0110 (1.89)*
mg_mnvr_{it-1} (b)				0.0031 (1.02)	0.0027 (0.90)			
ln*gdppc*$_{it-1}$ (a)	-0.0526 (-6.17)***	-0.0985 (-5.56)***	-0.0765 (-10.07)***			-0.0775 (-4.69)***	-0.0555 (-3.81)***	-0.0871 (-5.27)***
$\Delta debt_{it-1}$ (a)	-0.0266 (-3.82)***							
gbs_{it-1} (a)		0.0192 (4.90)***						
def_rule_{it-1} (a)			0.0065 (2.41)**					
$d97eu_{it}$ (a)	0.0053 (2.11)**	0.0044 (0.84)	0.0097 (2.97)***			0.0096 (2.06)**	0.0098 (3.52)***	0.0045 (0.66)
Time period	1972-2004	1972-2004	1972-2004	1972-2004	1972-2004	1972-2004	1972-2004	1971-2004
No. countries	14	14	14	14	14	6	8	7
No. Obs.	436	448	448	448	448	192	256	231

Sources: See Table 1.

Notes: See Table 5. Regression 6 considers only the sample of the 6 EU countries that have had problems is accomplishing the 3% rule for the deficit (France, Germany, Greece, Italy, Portugal and UK), whilst regression 7 encompasses the other 8 countries; column 8 presents the results of a regression including just the non-EU countries.

(a) In these lines only the results for the convergence coefficient and the coefficients on the debt, deficit and *d97eu* variables (when included in the model, instead of *d92eu*) are reported and come from a similar specification to the one above; the coefficients on the other exogenous variables are not reported but are available upon request.

(b) In column 4, the margin of manoeuvre was computed in the same way as before, but the values for the GBS were estimated by rolling regressing GBS as a function of time; In column 5, the margin of manoeuvre was computed considering the following non-linear relation: $mg\_mnvr=\exp\{GBS\}$ if $GBS<0$ and year>1991; and $mg\_mnvr=1$, otherwise.

Table 7. Results from five-year time spans estimations

Dep.: $\Delta \ln gdppc_{it}$	(1) FE	(2) FE	(3) DIF-GMM	(4) SYS-GMM	(5) SYS-GMM	(6) SYS-GMM	(7) 2SLS
$\ln gdppc_{it-5}$	-0.3427	-0.3272	-0.5334	-0.3802	-0.3123	-0.3311	-0.2825
	(-5.44)***	(-5.15)***	(-4.57)***	(-3.10)***	(-2.96)***	(-3.30)***	(-3.67)***
Implied λ	[0.084]	[0.079]	[0.152]	[0.096]	[0.075]	[0.080]	[0.066]
hwtc (a)	8.3 years	8.7 years	4.5 years	7.2 years	9.3 years	8.6 years	10.4 years
$\ln pfcf_{it}$	0.1935	0.1972	0.1204	0.1217	0.1028	0.1421	0.0859
	(2.91)***	(3.08)***	(1.10)	(2.14)**	(3.10)***	(3.13)***	(1.94)*
$\ln hk_{it}$	0.3989	0.4586	0.6555	0.3094	0.2658	0.2494	0.2400
	(3.61)***	(6.94)***	(3.13)***	(2.88)**	(2.31)**	(2.20)**	(3.01)***
$\ln(n_{it}+g+d)$	-0.2443	-0.2822	-0.2363	-0.2436	-0.2296	-0.2548	-0.2212
	(-4.19)***	(-5.32)***	(-4.76)***	(-5.71)***	(-4.07)***	(-4.61)***	(-2.73)***
$\ln gvfcf_{it}$	0.0126	0.0062	-0.0290	0.0240			0.0462
	(0.63)	(0.31)	(-2.19)**	(1.21)			(2.10)**
$\ln gvcns_{it}$	-0.3309	-0.3429	-0.3239	-0.0880			0.1083
	(-3.81)***	(-4.08)***	(-3.45)***	(-0.82)			(-1.52)
$\ln gvtxr_{it}$	0.0750	0.0769	0.0874	-0.0282			0.0365
	(2.25)**	(2.33)**	(1.57)	(-0.81)			(1.42)
$sdinfl_{it}$	-0.0110	-0.0112	-0.0111	-0.0100			-0.0108
	(-1.17)	(-1.26)	(-1.36)	(-1.02)			(-0.98)
$\ln xmr_{it}$	0.1587	0.1362	0.0648	0.1689		0.1734	0.1511
	(2.19)**	(1.84*)	(0.64)	(2.06)*		(2.34)**	(1.83)*
def_rule_{it}						0.0245	
						(2.16)**	
$d96eu_{it}$	0.0151		0.0149	0.0432	0.0444	0.0366	0.0369
	(0.84)		(1.07)	(3.47)***	(2.59)**	(2.32)**	(2.05)**
mg_mnvr_{it}		0.0294					
		(1.21)					
R^2	0.6115	0.6162					0.4418
Hansen test			0.74	0.90	0.63	0.87	
$\ln gdppc_{it-5}$ (b)	-0.3251		-0.4606	-0.2866	-0.2322	-0.3265	-0.2303
	(-4.96)***		(-4.52)***	(-1.76)*	(-1.81)*	(-2.50)**	(-3.13)***
Implied λ	[0.079]		[0.123]	[0.068]	[0.053]	[0.079]	[0.052]
hwtc (a)	8.8 years		5.6 years	10.3 years	13.1 years	8.8 years	13.2 years
def_rule_{it} (b)						0.0321	
						(3.36)***	
$d91eu_{it}$ (b)	-0.0141		-0.0217	0.0059	0.0070	0.0216	-0.0010
	(-0.91)		(-1.79)*	(0.33)	(0.49)	(1.35)	(-0.05)
R^2	0.6114						0.3986
Hansen test			0.70	0.92	0.65	0.90	
No. countries	14	14	14	14	14	14	14
No. time periods	7	7	6	7	7	7	6
No. observations	98	98	84	98	98	98	84

Sources: See Table 1.

Notes: *t*-statistics are in parentheses; significance level at which the null hypothesis is rejected: ***, 1%; **, 5%; and *, 10%; the estimated speed of convergence to the steady-state ($\lambda=[-ln(1-\phi)]/5$) is in square brackets. In columns 1 and 2 the model is estimated controlling for fixed effects. The instruments used for DIF-GMM are the second and third lags of the log of output per capita; all other right-hand-side variables are assumed exogenous and are instrumented with their own values; the additional instrument used in the SYS-GMM is the difference of the log of output per capita lagged one period. A two-stage least squares estimator is used to obtain the results presented in the column 7 (here the log of initial output per capita is instrumented with its second lag). The presence of any pattern of heteroscedasticity and autocorrelation is controlled for by using robust standard errors. The values reported for the Hansen test are the *p*-values for the null hypothesis of a valid specification. Luxembourg was excluded from the sample due to lack of observations for human capital.

(a) See Table 3.

(b) These results come from a similar specification to the one reported above in the same column but including the variable *d92eu* instead of *d97eu*; the coefficients on the other exogenous variables are not reported but are available upon request.