Fiscal Convergence, Business Cycle Volatility and Growth*

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Abstract

This paper analyzes the effects of fiscal convergence on business cycle volatility and growth. Using a panel of 11 EMU and 21 OECD countries and 40 years of annual data, we find that countries with similar government budget positions tend to have smoother business cycles. That is, fiscal convergence (in the form of persistently similar ratios of government surplus/deficit to GDP) is systematically associated with smoother business cycles. We also find evidence that reduced business cycle volatility through higher fiscal convergence stimulates growth. Our empirical results are economically and statistically significant, and robust.

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Keywords: Fiscal Convergence, Business Cycle Volatility, Economic Growth.

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1. Introduction

In the last decade, several works in the literature have tried to identify the effects of fiscal policy on economic performances. Most of these works have concentrated on two main potential macroeconomic effects: business cycle volatility and growth.

While there is a broad consensus that higher levels of government expenditure are associated with higher growth rates[1], there is little consensus on the sign of the effects of fiscal policy on business cycle volatility. On the one hand, governments can smooth out business cycle fluctuations by the use of discretionary changes in fiscal policy (such expansionary spending and tax cuts in recessions and contractionary policy in expansions) and by the use of automatic stabilizers.[2] On the other hand, fiscal policy itself might be a source of business cycle fluctuations and exacerbate macroeconomic volatility[3]. Moreover, countries are subject to both symmetric and asymmetric shocks. If countries are subject to persistent asymmetric shocks or symmetric shocks, and those are partially offset by discretionary fiscal policy or automatic fiscal stabilizers, then fiscal divergence can, in principle, be associated with greater business cycle synchronization and reduced business cycle volatility[4]. From another point of view, if fiscal policy is pro-cyclical, fiscal divergence will be associated with reduced business cycle synchronization and higher business cycle volatility. Thus, the question is ultimately empirical.

[1] See, for example, Ashauer (1989), Barro (1990), Evans and Karras (1994a,1994b), Fölster and Henrekson (2001), Munnel (1992).
[2] See, for example, Sachs and Sala-i-Martin (1991), Bayoumi and Masson (1995), Asdrubali et al. (1996), von Hagen (1998), Furceri (2005).
[3] For example, Fatás and Mihov (2003, 2004) show that governments that use fiscal policy aggressively induce significant macroeconomic instability, and that discretionary changes in fiscal policy tend to amplify output volatility.
[4] In particular, in monetary unions, higher business cycle syncronization reduces output volatilty. See, for example, Furceri and Karras (2006).

While the effect of fiscal convergence on business cycle synchronization has been recently investigated by Darvas et al. (2005)[5], no empirical study to our knowledge has analyzed the effect of fiscal convergence on business cycle volatility. The first aim of this paper is to try to fill this gap. In addition, we also want to asses the effect that fiscal convergence has on growth through reduced (or increased) output volatility. From a theoretical point of view, the relationship between macroeconomic volatility and economic growth is a very intricate one. On the one hand, irreversible investment theories suggest that countries with higher volatility will have lower levels of investment and as a consequence lower growth. For example, Bernanke (1983), Pindyck and Solimano (1993), and Blackburn and Varvarigos (2005) show that in models with investment irreversibility and financial frictions, higher uncertainty regarding investment prices will determine a lower level of investment and growth. On the other hand, high growth economies might be based on risky technologies and therefore may experience sharp shifts in economic volatility. These arguments have been tested by Ramey and Ramey (1995) in their empirical study of the link between volatility and growth. The authors found convincing empirical evidence that business cycle volatility is harmful for growth. The robustness of this relation has been confirmed by more recent works[6].

Although the question we approach here is similar, our main concern is whether fiscal divergence can be responsible for business cycle volatility that is harmful to growth.

The remainder of the paper is organized as follows. In Section Two, we present a simple theoretical model showing that the sign odf the relation between fiscal

[5] In particular, the authors found that countries with similar government budget positions tend to have business cycles that fluctuate more closely.
[6] See, for example, Furceri (2007) and Imbs (2007).

convergence and output volatility is ambiguous. In Section Three, we explain our methodology to assess the impact of fiscal convergence on business cycle volatility and growth. In Section Four, we present the empirical analysis and discuss its results. Section Five summarizes the paper's main findings and provides some policy implications.

2. Theoretical Model

The theoretical framework follows the models proposed by Kydland and Prescott (1977), and Barro and Gordon (1983). In particular, we consider an open economy in which the policymakers of each economy *i* minimize the following loss function:

$$L_i = \frac{1}{2}\left\{\beta_i (y_i - k_i)^2 + d_i^2\right\} \tag{1}$$

where *y* denotes output (in deviations from the trend), *d* is deficit, β is the relative weight of output deviations, from its target *k*. This target is assumed to be greater than zero because of distortions such as imperfect competition or taxes.

For each (open) economy we assume that the aggregate demand is given by:

$$y_i = A + \theta_i d_i + \varepsilon_i + w_i \varepsilon_j \tag{2}$$

where *A* is the autonomous component of aggregate demand, ε_i and ε_j are the domestic and foreign shocks which we assume to have zero mean and variance equal respectively to σ_i^2 and σ_j^2, and w_i is the effect of foreign shock on domestic output.

Minimizing (1) with respect to (2), in equilibrium the optimal level for the deficit will be:

$$d_i = \frac{\beta_i (k - A) - \beta_i \varepsilon_i - \beta_i w_i \varepsilon_j}{1 + \beta_i \theta_i} \tag{3}$$

Substituting this in (2) and computing the variance of output, it will result that output volatility will be:

$$\text{var}(y_i) = \frac{1}{(1+\beta_i\theta_i)^2}\sigma_i^2 + \frac{w_i^2}{(1+\beta_i\theta_i)^2}\sigma_j^2 + \frac{2w_i}{(1+\beta_i\theta_i)^2}\text{cov}(\varepsilon_i, \varepsilon_j) \tag{4}$$

In order to assess the impact of fiscal convergence on output volatility for each economy we rearrange (3) and express the country domestic shock as function of the domestic level of deficit and the foreign shock.

$$\varepsilon_i = -w_i\varepsilon_j + (k-a) - \frac{1+\beta_i\theta_i}{\beta_i}d_i \tag{5}$$

Successively, given the symmetrical equilibrium for each economy, by substituting for the foreign shock in (5), we can express each domestic shock as function of domestic and foreign deficit:

$$\varepsilon_i = \frac{1-w_i}{1-w_i-w_j}(k-A) - \frac{1+\beta_i\theta_i}{\beta_i(1-w_i-w_j)}d_i + \frac{w_i(1+\beta_j\theta_j)}{\beta_j(1-w_i-w_j)}d_j \tag{6}$$

This will lead to the following variance:

$$\sigma_i^2 = \frac{(1+\beta_i\theta_i)^2}{\beta_i^2(1-w_i-w_j)^2}\sigma_{d_i}^2 + \frac{w_i^2(1+\beta_j\theta_j)^2}{\beta_j^2(1-w_i-w_j)^2}\sigma_{d_j}^2 - \frac{w_i(1+\beta_i\theta_i)(1+\beta_j\theta_j)}{\beta_i\beta_j(1-w_i-w_j)^2}\text{cov}(d_i, d_j) \tag{7}$$

and covariance:

$$\text{cov}(\varepsilon_i, \varepsilon_j) = -\frac{w_j(1+\beta_i\theta_i)^2}{\beta_i^2(1-w_i-w_j)^2}\sigma_{d_i}^2 - \frac{w_i(1+\beta_j\theta_j)^2}{\beta_j^2(1-w_i-w_j)^2}\sigma_{d_j}^2 + \frac{2w_iw_j(1+\beta_i\theta_i)(1+\beta_j\theta_j)}{\beta_i\beta_j(1-w_i-w_j)^2}\text{cov}(d_i, d_j) \tag{8}$$

Analyzing (4) together with (7) and (8), we can see that the effect of fiscal coordination on output volatility is ambiguous. From one hand, assuming that the foreign shock is positively transmitted $(w_i > 0)$ and the fiscal deficit is

countercyclical $\left(\frac{1+\beta_i\theta_i}{\beta_i} > 0\right)$, higher deficits convergence $\left(\text{cov}\left(d_i, d_j\right)\right)$ will decrease the variance of country specific shocks, and thereby will reduce output volatility. On the other hand, assuming that the foreign shock is positively transmitted $\left(w_i > 0\right)$ and the fiscal deficit is countercyclical $\left(\frac{1+\beta_i\theta_i}{\beta_i} > 0\right)$, higher deficits convergence $\left(\text{cov}\left(d_i, d_j\right)\right)$ will increase the covariance between domestic and foreign shock, and thereby will increase output volatility.

Summarizing, the sign of the relation between fiscal coordination and output volatility is ambiguous, and it will further depend on the transmission of the foreign shock and on the countercyclicality of the deficits in each country. Thus, the question remains ultimately empirical.

3. Empirical Methodology

3.1 Estimation Strategy

The aim of our paper is to investigate the effects of cross-country difference in fiscal policy on business cycle volatility and growth. In line with Darvas et al. (2005), we will use several measure of fiscal divergence.

Our primary measure of fiscal divergence is the difference between countries in the general government budget surplus (+) or deficit (-), measured as a percentage of national GDP. Taking the average of this over a decade of annual data yields our measure of fiscal divergence between countries:

$$FiscalDivergence_{ij\tau} \equiv .1*\Sigma_{\tau}\left(|Budg_{it} - Budg_{jt}|\right) \quad (9)$$

Finally, to get a measure of fiscal divergence for each country, we take the average of this measure over the set of j countries (with j=…n-i):

$$FiscalDivergence_{i\tau} \equiv \Sigma_j \, FiscalDivergence_{ij\tau} \qquad (10)$$

where $Budg_{it}$ is the general government budget surplus (+) or deficit (-) at time t expressed as a percentage of nominal GDP for country i. A larger value of $FiscalDivergence_{ij}$ corresponds to higher average divergence between the fiscal positions of the two countries over a long period of time. In the same way, a higher value of $FiscalDivergence_i$ means that the country i has a fiscal position very dissimilar to the rest of the other countries.

We obtain the output business cycle measures by detrending the series of real GDP. Four different methods are used to detrend the output series of each country i and estimate its cyclical component. The first measure is simple differencing (growth rate of the real GDP). The second and the third methods use the Hodrick-Prescott (HP) filter. The second method consists of using the value recommended by Hodrick and Prescott (1997) for annual data for the smoothness parameter (λ) equal to 100. The third method considers the smoothness parameter (λ) equal to 6.25. In this way, as pointed out by Ravn and Uhlig (2002), the Hodrick-Prescott filter produces cyclical components comparable to those obtained by the Band-Pass filter. The fourth method makes use of the recently popular Band-Pass (BP) filter proposed by Baxter and King (1999), and evaluated by Stock and Watson (1999) and Christiano and Fitzgerald (2003) that also compares its properties to those of the HP filter. While minor differences among the results obtained by the three filters are not difficult to detect (for example, differencing generally produces the most volatile series, while the BP produces the smoothest ones),

the main characteristics are remarkably similar. This robustness will be formally assessed by the estimations of the empirical section.

In practice, we measure GDP busyness cycle volatility for each country and for each decade as the standard deviation of the country's cyclical component over the relevant decade ($\sigma_{i\tau}$).

Thus, in order to estimate the effect of fiscal divergence on business cycle volatility, our benchmark regression would be:

$$\sigma_{i\tau} = \alpha + \beta FiscalDivergence_{i\tau} + \gamma X_{\sigma} + \varepsilon_{i\tau}. \quad (11)$$

Where, $\sigma_{i\tau}$ and $FiscalDivergence_{i\tau}$ denote our measures of business cycle volatility and fiscal divergence for country i over the decade τ, respectively. X_{σ} is a set of control variables including: *i*) openness, measured as the natural log of the GDP's share of total exports and imports (*lnopen*); *ii*) country size, measured as the natural log of the total population (*lnpop*). In fact, both variables are found to have an extremely significant effect on business cycle volatility, and their exclusion could cause serious problems of omission variables[7].

The object of interest of our first analysis is the slope coefficient β. A positive estimate of β indicates that a decrease in fiscal divergence (or an increase in fiscal convergence) is associated with reduced business cycle volatility. That is, fiscal policy convergence is linked to smoother business cycles.

As we discussed in the previous section, business cycle volatility has a significant and negative effect on growth. Thus, in principle, a higher fiscal convergence could be helpful for growth through reduction of business cycle volatility. The second object of

[7] See Furceri and Karras (2007a, 2007b).

our analysis is to test if this effect exists and its relative magnitude. For this purpose, we will consider the following growth equation:

$$g_{i\tau} = \theta + \delta\sigma_{i\tau} + \gamma X_g + \zeta_{i\tau} \quad (12)$$

Where, $g_{i\tau}$ and $\sigma_{i\tau}$ denote our measures of real GDP growth and business cycle volatility for country i over the decade τ, respectively. X_g is a set of controls variables including those variables that Levine and Renelt (1992), applying the Extreme Bound Analysis initially proposed by Leamer (1983), found to be robust cross-country growth correlates: (i) the average investment share of GDP (*investment*); (ii) the initial log of GDP per capita(y_o); (iii) initial human capital (*human capital*) ; and (iv) the average growth rate of the population (n).

Thus, in order to estimate the effect of fiscal convergence on growth, first we will estimate the effect of fiscal convergence on business cycle volatility and then the effect of (instrumented) business cycle volatility on growth.

3.2 Data Set

In this paper, we focus on twenty-one OECD countries. The countries included in the analysis are eleven of the fifteen Euro Area members (excluding Luxembourg), thereafter indicated as EMU (Austria, Belgium, France, Finland, Germany, Greece, Italy, Ireland, the Netherlands, Portugal, Spain), and the other ten OECD countries: Australia, Canada, Denmark, Japan, New Zealand, Norway, Sweden, Switzerland, the UK and the United States.

The analysis of just these two samples of countries offers several advantages. Firstly, a longer span of data is available than for a broader set of countries, including, for

instance, developing countries. Secondly, data quality and cross-country comparability are also likely to be of a higher standard for the OECD, and this is extremely important when we consider the measure of business cycle volatility, since volatility would increase in presence of measurement errors. Thirdly, as argued by Grier and Tullock (1989), data from the OECD and the rest of the world do not share a common set of coefficients in cross-country growth regressions and thus should not be pooled.

Fiscal data, in terms of budget surplus (+) or deficit (-), measured as a percentage of national GDP, are obtained from the OECD Economic Outlook database and from Andrew Rose's website. Real GDP, real GDP per capita growth, average investment, openness and population are taken from the Heston-Summers-Aten (2006) dataset (Penn World Table 6.2). Human capital is taken from the Barro-Lee (2001) data set. [8]

4. Results

4.1 Fiscal Convergence and Business Cycle Volatility

We start our investigation on the effects of fiscal convergence on business cycle volatility, analyzing the simple correlation between budget divergence and business cycle volatility.

Figure 1 provides a scatter plot of business cycle output volatility (measured by the natural logarithm of the standard deviation of the GDP's annual growth rate) against budget divergence (measured by natural logarithm of the budget balance deviation) relative to the full set of countries, for the four decades: 1964-1973, 1974-1983, 1984-1993, and 1994-2003. Figure 1 exhibits the relation between these two variables. In particular, the estimate of this simple bivariate relation is:

[8] See Appendix 2 for a detailed description of all the variables and their availability.

$$\sigma_{i\tau} = \underset{(-9.79)}{-6.615} + \underset{(3.52)}{0.601}\ FiscalDivergence_{i\tau}$$

with R^2=0.13, and *t* statistics are in parenthesis. The relationship is clearly positive and statistically significant. Moreover, it does not seem to be affected by outliers. In particular, this estimate suggests that a one percent increase of fiscal divergence translates into 0.6 percent increase of business cycle volatility. Or that, in other words, a one percent increase of fiscal convergence determine a reduction of 0.6 percent in business cycle volatility.

In Figure 2, we repeat this simple exercise, including (the natural logarithm of) openness and population as control variables. In particular, the associated estimate is:

$$\sigma_{i\tau} = \underset{(-4.32)}{-2.424} + \underset{(4.35)}{0.616}\ FiscalDivergence_{i\tau}$$

with R^2=0.19, and *t* statistics are in parenthesis. The relationship is clearly still positive and statistically significant. Moreover, also in this case it does not seem to be affected by outliers, and the effect of fiscal convergence on business cycle volatility is almost unchanged.

Now we proceed with more formal statistical evidence. Table 1 reports the estimated slope coefficient (β) of Fiscal Divergence, along with the associated t-statistics in parentheses for several specifications of equation (11). The Table's four columns correspond to the OLS and country fixed effect estimates for both the EMU and the OECD countries. The detrending method employed for the results in the table is differencing (growth rate of GDP), additional results obtained using the other detrending methods discussed in the previous section are presented in Appendix 1.

The five rows of Table 1 correspond to seven different measure of budget divergence: (i) Average of absolute value of budget deviations form the Maastricht reference value; (ii) Absolute value of budget deviations form the Maastricht reference value; (iii) Average absolute value of budget balance differential; (iv) Absolute value of average budget balance differential; (v) Standard deviation of budget differential.

Focusing on the first column, it can be readily seen that the relation between fiscal divergence and business cycle volatility is positive and statically significant: the higher is the level of fiscal convergence, the less volatile is the business cycle. This result holds for each of the five measures of fiscal divergence. A simple average of the seven estimates is 0.558. This implies that a one percent increase of fiscal convergence would decrease business cycle volatility by 0.558 percent.

The results are still significant when we use country fixed effects, and actually the magnitude of the effects of fiscal convergence on business cycle volatility is larger.

Analyzing the overall set of OECD countries, we can see that the results are still positive and extremely significant. However, comparing the results for the two sets of countries, it emerges that the effect of fiscal convergence on business cycle volatility is larger for the EMU countries than for the rest of OECD countries. This is particularly important for two reasons. First, the EMU countries are those that manifested a higher convergence of fiscal position. Second, it seems that the process of fiscal convergence for these countries has sensibly reduced the possible stabilization cost associated with the creation of the EMU and the loss of independent domestic monetary policies.

The analysis discussed so far is extremely robust with respect to the different detrending methods (HP100, HP6.25 and Band–Pass). In fact, repeating the same

analysis with different detrending methods, we can see (Table A1, A2 and A3 of Appendix 1) that the effect of fiscal divergence (convergence) on business cycle volatility is still positive (negative) and extremely significant.

We also examined the robustness of the relation between fiscal convergence and business cycle volatility with respect to different time periods. In particular we considered two time sample: the first, including the first two decades (1964-1973, 1974-1983); the second including the second two decades (1984-1994,1994-2003). Table 2 presents, across the above mentioned time periods, the coefficient on fiscal divergence obtained using the OLS for both EMU and OECD countries. Our results suggest that while the statistical significance of the relation is broadly constant over the two time samples, the magnitude of the coefficient for all measure of fiscal convergence and for all groups of countries is remarkably increased. From an economic point of view, a possible explanation is that in the last period the economies under investigation became more interdependent, amplifying spillover effects of stabilization policies from one country to others.

Another robustness check that we provide is to control for possible heterogeneity over time. Indeed, our dependent variable has a trend and decreased remarkably over the four decades.[9] In order, to consider this issue we replicate estimation of equation (11) using both fixed and random time effects.[10] Table 3 reports the coefficient on fiscal divergence with respect to all measures considered and with respect to EMU and OECD countries. Analyzing the table we can immediately see the effect of fiscal divergence on

[9] In contrast, the data do not show a particular pattern overtime for our measures of fiscal convergence.
[10] Similar results are obtianed when we include time trend as expalnatory variable instead of using time effects.

business cycle volatility, is still positive and significant, even though the magnitude is lower for some measures of fiscal divergence for the fixed effect specification.

4.2 Business Cycle Volatility and Growth

In Table 4, we report the estimate of the effect of business cycle volatility on growth, controlling for the initial level of GDP, average investment share, human capital and population growth. The results in the first and fourth columns are relative to the OLS estimates for the EMU and the OECD countries, respectively. Analyzing these results, we can see that the effect of business cycle volatility on growth is negative and extremely significant.

Successively, in order to evaluate the importance of fiscal convergence for growth, we use our measure of fiscal convergence as an instrument for business cycle volatility. Columns 2 and 5 report the coefficient on output volatility when output volatility is instrumented by fiscal divergence (measured as the absolute value of budget balance differentials). The estimate is highly significant and negative and implies that the volatility in output induced by fiscal divergence has negative consequences for growth. Or, conversely, that reduced output volatility determined by fiscal convergence has positive effects on growth. In addition to showing that fiscal divergence is harmful for economic growth, the results provide additional evidence of the significant effect of fiscal convergence on business cycle volatility. In fact, if the relation between fiscal divergence and output volatility identified in the previous section was mispecified, then the use of our measure as an instrument in the growth equation will simply replicate the variation in business cycle volatility and will not lead to changes in the coefficient. Instead, the

coefficient on output volatility changes sharply and significantly in the expected direction. In particular, a one percent increase in the inducted (by fiscal divergence) business cycle volatility will determine a decrease of 2.4 (2.5) percentage points in the average growth rate for the EMU (OECD) countries.

The results are also significant when we include openness and country size as instrument for business cycle volatility, and it does not seem that it significantly differs between EMU and OECD countries (Columns 3 and 6). Also, this analysis is extremely robust with respect to different detrending methods (HP100, HP6.25 and Band–Pass). In fact, repeating the same analysis with different detrending methods, we can see (Table A4, of Appendix 1) that the effect of inducted business cycle volatility on growth is still negative and extremely significant.

Finally, repeating the analysis for the five measures of fiscal divergence analyzed in the previous section, we can see that the results are almost unchanged, both in terms of magnitude and significance level (Table A5 of Appendix 1).

5. Conclusions

The aim of this paper is to analyze the effects that fiscal convergence has on business cycle volatility and growth. From a theoretical point of view, there is no clear consensus about the sign of these two effects. In fact, if countries are subject to persistent asymmetric shocks or symmetric shocks, and those are partially offset by discretionary fiscal policy or automatic fiscal stabilizers, then fiscal divergence can, in principle, be associated with greater business cycle synchronization and reduced business cycle volatility. On the other hand, if fiscal policy is pro-cyclical fiscal divergence will be associated with reduced business cycle synchronization and higher business cycle

volatility. At the same way, while irreversible investment theories suggest that countries with higher volatility will have lower levels of investment and as a consequence lower growth, high growth economies might be based on risky technologies and therefore may experience sharp shifts in economic volatility. Thus, both questions are ultimately empirical.

To help answering these questions we investigate the relation between fiscal convergence and business cycle volatility, and the relation between business volatility (inducted by fiscal convergence) and growth, for a panel of 21 OECD countries over a period of 40 annual years.

Using several measures of fiscal convergence and business cycle volatility our results suggest that (on average) a one percent increase of fiscal convergences reduces business cycle volatility by 0.570 percent. Moreover, this effect is larger for the EMU countries than for ten other OECD countries. At the same way, we found that a 1 percent increase of inducted (by fiscal divergence) business cycle volatility determines a decrease of 2.4 percentage points in the average growth rate. These results are robust to the different detrending methods and measures of fiscal convergence considered.

The policy implications of these results are quite straightforward. Fiscal convergence, especially in integrated economies as the EMU, plays an important role. In fact, not only it could have helped to dramatically reduce the possible stabilization costs associated with the creation of a common currency but can also contribute, through reduction of macroeconomic uncertainty, to higher long-term growth.

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Figure 1. Fiscal Divergence and Volatility

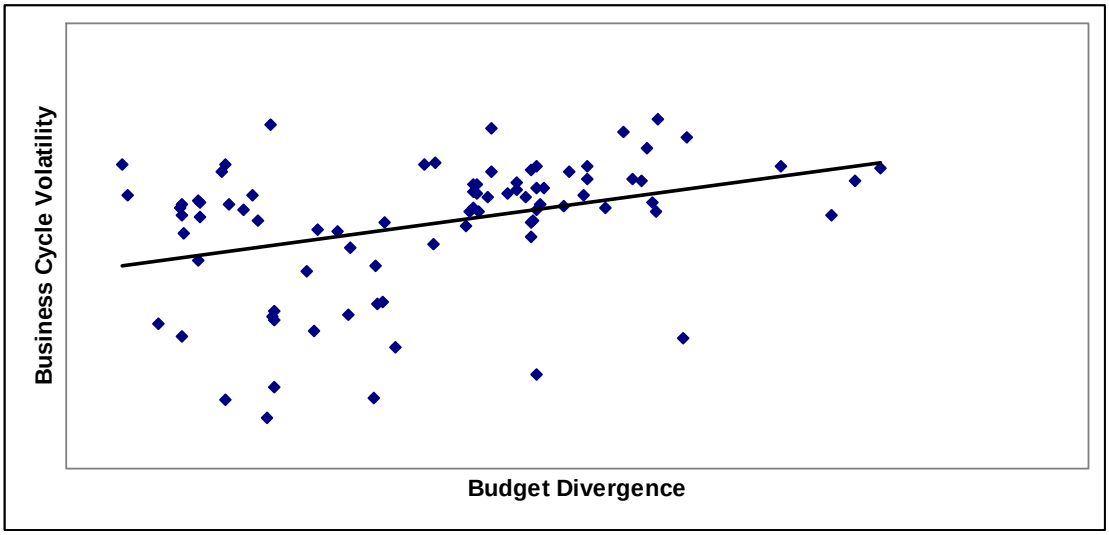

Figure 2. Fiscal Divergence and Volatility (controlling for openness and size)

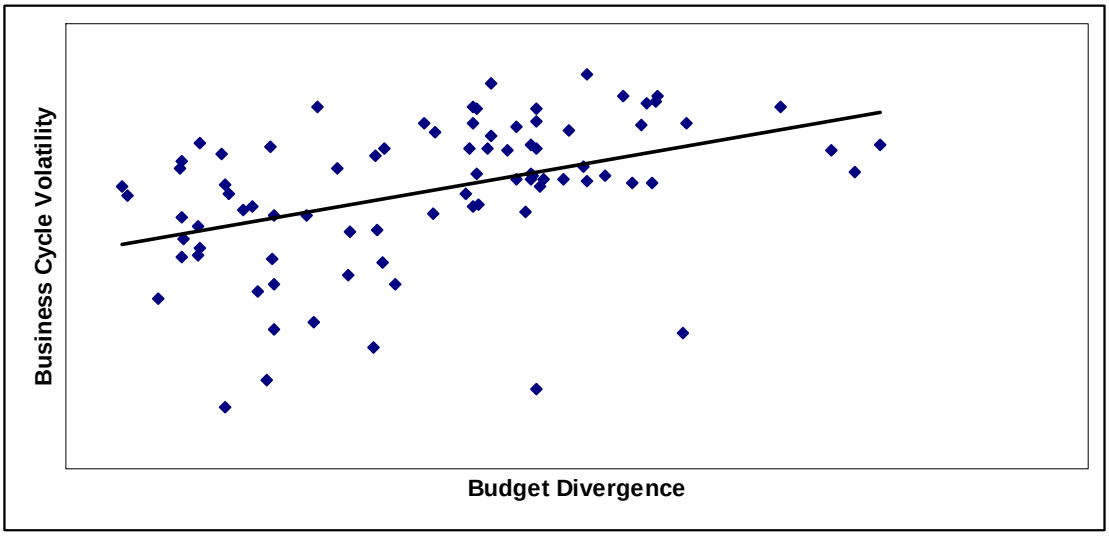

Table 1. Effect of Fiscal Divergence on Business Cycle Volatility (Differencing)

	EMU		OECD	
	OLS	FE	OLS	FE
Maastricht Budget Deviations	0.382***	0.533***	0.307***	0.372***
	(4.28)	(6.48)	(4.23)	(5.67)
Maastricht Budget Deviation Variant	0.343***	0.504***	0.287***	0.353***
	(4.00)	(6.34)	(4.21)	(5.65)
Budget Balance Deviation	0.699***	1.005***	0.627***	0.744***
	(4.07)	(5.58)	(4.24)	(5.52)
Budget Balance Deviation Variant	0.653***	0.913***	0.600***	0.670***
	(4.37)	(6.37)	(5.24)	(5.96)
Standard Deviation Absolute Value Budget Deviations	0.712***	1.433***	0.197	0.925***
	(2.88)	(5.88)	(0.98)	(4.55)

Coefficients represent elasticities. T-statistics in parentheses.
Controls variables and constant term included but not recorded. Coefficients significantly different from zero at 0.10, 0.05, and 0.01 level marked with one, two and three asterisks, respectively. Data set has 21 observations for four decades (1964-73, 1974-83, 1984-93, 1994-2003).

Table 2. Effect of Fiscal Divergence on Business Cycle Volatility (Differencing)

	EMU		OECD	
	1	2	1	2
Maastricht Budget Deviations	0.273***	0.766***	0.190***	0.826***
	(3.63)	(3.36)	(3.56)	(5.42)
Maastricht Budget Deviation Variant	0.261***	0.699***	0.179***	0.760***
	(3.84)	(3.05)	(3.66)	(5. 65)
Budget Balance Deviation	0.479***	1.109***	0.386***	1.232***
	(2.79)	(2.88)	(3.47)	(4.33)
Budget Balance Deviation Variant	0.498***	0.984**	0.361***	1.076***
	(3.68)	(2.81)	(4.09)	(5.59)
Standard Deviation Absolute Value Budget Deviations	1.050***	2.224***	0.541**	1.150***
	(3.92)	(4.41)	(2.39)	(1.98)

Coefficients represent elasticities. T-statistics in parentheses. Controls variables and constant term included but not recorded. Coefficients significantly different from zero at 0.10, 0.05, and 0.01 level marked with one, two and three asterisks, respectively. Data set has 21 observations for four decades (1964-73, 1974-83, 1984-93, 1994-2003). 1= refers to the first two decades, 2 =refers to the second two decades.

Table 3. Effect of Fiscal Divergence on Business Cycle Volatility (Differencing)

	EMU		OECD	
	FE	RE	FE	RE
Maastricht Budget Deviations	0.246***	0.382***	0.210**	0.308***
	(2.79)	(4.64)	(2.13)	(4.83)
Maastricht Budget Deviation Variant	0.222***	0.504***	0.209**	0.285***
	(2.74)	(6.34)	(2.19)	(5.00)
Budget Balance Deviation	0.310**	0.653***	0.284**	0.625***
	(2.05)	(4.60)	(1.92)	(4.36)
Budget Balance Deviation Variant	0.394**	0.913***	0.408***	0.602***
	(1.95)	(6.37)	(2.53)	(6.12)
Standard Deviation Absolute Value Budget Deviations	1.112***	0.712***	0.191	0.197
	(4.66)	(3.59)	(0.68)	(0.90)

Coefficients represent elasticities. T-statistics in parentheses. Controls variables and constant term included but not recorded. Coefficients significantly different from zero at 0.10, 0.05, and 0.01 level marked with one, two and three asterisks, respectively. Data set has 21 observations for four decades (1964-73, 1974-83, 1984-93, 1994-2003).

Table 4. Effect of Business Cycle Volatility on Growth (Differencing)

	EMU			OECD		
	OLS	IV	IV2	OLS	IV	IV2
Initial GDP (Y_o)	-0.004***	-0.004***	-0.004***	-0.002***	-0.003***	-0.003***
	(-5.97)	(-5.59)	(-5.86)	(-4.65)	(-5.00)	(-5.62)
Investment	0.072	0.064	0.066	0.102**	0.085*	0.095**
	(1.31)	(1.02)	(1.13)	(2.38)	(1.83)	(2.56)
Human Capital	0.142	0.122	0.128	0.125	0.184	0.151
	(0.98)	(0.75)	(1.24)	(1.17)	(1.27)	(1.32)
Population Growth	-1.200*	-1.595**	-1.474**	-0.346	-0.568	-0.445
	(-1.73)	(-2.47)	(-2.48)	(-0.97)	(-1.13)	(-1.12)
Business Cycle Volatility ($\sigma_{i\tau}$)	-1.414***	-2.384***	-2.092***	-0.929***	-2.526***	-1.637***
	(-3.29)	(-4.37)	(-4.62)	(-3.92)	(-4.20)	(-4.51)
R^2	0.62	-	-	0.47	-	-
F	9.94	9.19	10.42	7.32	8.60	12.11

T-statistics in parentheses. White Robust Standard Errors. Constant term included but not recorded. Coefficients significantly different from zero at 0.10, 0.05, and 0.01 level marked with one, two and three asterisks, respectively. Data set has 21 observations for four decades (1964-73, 1974-83, 1984-93, 1994-2003).

Appendix 1 – Cyclical Volatility

Table A1. Effect of Fiscal Divergence on Business Cycle Volatility (HP100)

	EMU		OECD	
	OLS	FE	OLS	FE
Maastricht Budget Deviations	0.321**	0.422***	0.304***	0.388***
	(2.50)	(3.22)	(3.58)	(4.24)
Maastricht Budget Deviation Variant	0.282**	0.400***	0.280***	0.366***
	(2.31)	(3.19)	(3.51)	(4.91)
Budget Balance Deviation	0.660***	0.888***	0.646***	0.816***
	(2.75)	(3.42)	(3.86)	(5.18)
Budget balance Deviation Variant	0.528**	0.738***	0.562***	0.708***
	(2.43)	(3.28)	(4.10)	(5.27)
Standard Deviation Absolute Value Budget Deviations	0.678**	1.100***	0.309	0.947***
	(2.04)	(2.92)	(1.35)	(3.93)

Coefficients represent elasticities. T-statistics in parentheses. Controls variables and constant term included but not recorded. Coefficients significantly different from zero at 0.10, 0.05, and 0.01 level marked with one, two and three asterisks, respectively. Data set has 21 observations for four decades (1964-73, 1974-83, 1984-93, 1994-2003).

Table A2. Effect of Fiscal Divergence on Business Cycle Volatility (HP6.25)

	EMU		OECD	
	OLS	FE	OLS	FE
Maastricht Budget Deviations	0.322**	0.508***	0.296***	0.399***
	(2.58)	(4.71)	(3.04)	(4.87)
Maastricht Budget Deviation Variant	0.290**	0.498***	0.276***	0.380***
	(2.45)	(4.94)	(3.02)	(4.89)
Budget Balance Deviation	0.623**	0.982***	0.661***	0.822***
	(2.64)	(4.39)	(3.44)	(4.95)
Budget balance Deviation Variant	0.600***	0.929***	0.595***	0.716***
	(2.90)	(5.25)	(3.81)	(5.06)
Standard Deviation Absolute Value Budget Deviations	0.582**	1.460***	0.173	1.071***
	(2.15)	(4.93)	(0.67)	(4.37)

Coefficients represent elasticities. T-statistics in parentheses. Controls variables and constant term included but not recorded. Coefficients significantly different from zero at 0.10, 0.05, and 0.01 level marked with one, two and three asterisks, respectively. Data set has 21 observations for four decades (1964-73, 1974-83, 1984-93, 1994-2003).

Table A3. Effect of Fiscal Divergence on Business Cycle Volatility (Band-Pass)

	EU		OECD	
	OLS	FE	OLS	FE
Maastricht Budget Deviations	0.141**	0.157**	0.115***	0.113***
	(2.46)	(2.13)	(2.70)	(2.74)
Maastricht Budget Deviation Variant	0.126**	0.150**	0.109***	0.107***
	(2.30)	(2.17)	(2.72)	(2.75)
Budget Balance Deviation	0.233**	0.395**	0.225***	0.472***
	(2.15)	(2.48)	(2.67)	(4.27)
Budget Balance Deviation Variant	0.306**	0.382***	0.382***	0.440*
	(2.11)	(2.89)	(3.61)	(4.77)
Standard Deviation Absolute Value Budget Deviations	0.243*	0.546**	0.050	0.615***
	(1.77)	(2.46)	(0.43)	(3.80)

Coefficients represent elasticities. T-statistics in parentheses. Controls variables and constant term included but not recorded. Coefficients significantly different from zero at 0.10, 0.05, and 0.01 level marked with one, two and three asterisks, respectively. Data set has 21 observations for four decades (1964-73, 1974-83, 1984-93, 1994-2003).

Table A4 – Effect of Volatility on Growth, Robustness Check (EMU)

	Differencing	HP100	HP6.25	Band Pass
$\sigma_{i\tau}$	-1.414***	-0.897***	-1.192***	-1.642***
	(-3.29)	(-2.98)	(-4.63)	(-4.02)

Table A5. Effect of Business Cycle Volatility on Growth (Differencing)

	EMU		OECD	
	IV	IV2	IV	IV2
Maastricht Budget Deviations	-2.281***	-2.070***	-2.693***	-1.663***
	(-4.52)	(-4.78)	(-4.04)	(-4.53)
Maastricht Budget Deviation Variant	-2.423***	-2.169***	-2.868***	-1.698***
	(-4.44)	(-4.65)	(-3.92)	(-4.54)
Budget Balance Deviation	-2.384***	-2.070***	-2.526***	-1.637***
	(-4.37)	(-4.78)	(-4.20)	(-4.51)
Budget Balance Deviation Variant	-2.281***	-2.070***	-2.643***	-1.663***
	(-4.52)	(-4.78)	(-4.30)	(-4.53)
Standard Deviation Absolute Value Budget Deviations	-2.197***	-1.999***	-4.462*	-1.149***
	(-3.65)	(-3.90)	(-1.78)	(-2.68)

Coefficients represent elasticities. T-statistics in parentheses. Controls variables and constant term included but not recorded. Coefficients significantly different from zero at 0.10, 0.05, and 0.01 level marked with one, two and three asterisks, respectively. Data set has 21 observations for four decades (1964-73, 1974-83, 1984-93, 1994-2003).

Appendix 2 – Data Sources

The following variables are available for all countries from 1964 to 2003:

Initial Output *(Yo)* - The log of Heston-Summers-Aten (2006) variable "Real GDP per Capita at the Beginning of Each Time Period, 2000 International Prices; Laspeyres Index".

Growth-rate *(g)* - The 10-year average of the Heston-Summers-Aten (2006) annual growth rate variable.

Population Growt*h (n)* - The average of the annual log difference of Heston-Summers-Aten (2006) population variable.

Size (pop) - The 10-year average of the Heston-Summers-Aten (2006) annual population variable.

Investment Share of GDP *(investment)* – The 10-year average of the Heston-Summers-Aten (2006) variable "Real Gross Domestic Investment, Private and Public, % Real GDP per Capita, 2000 International Prices".

Human Capital *(human capital)* – The initial value of the Barro-Lee (2001) variable "Average Schooling Years in the Total Population over Age 25 at the Beginning of Each Time Period".

Openness (*open*) - The 10-year average of the Heston-Summers-Aten (2006) variable "Exports plus Imports Divided by Real GDP".

Budget, Nominal GDP - Source: OECD Economic Outlook, Andrew Rose' website.