WP 52_12

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GROWTH, DEFICITS AND UNCERTAINTY IN A PANEL OF 28 COUNTRIES

Growth, Deficits and Uncertainty in a Panel of 28 Countries

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June 2012

Abstract

We examine the relationship between fiscal deficits and per-capita income growth in a panel of 28 European countries, allowing for perceived risks, in terms of fiscal sustainability, associated with additional government spending. Such risks are proxied by the conditional variability of manufacturing production and stock market returns and by the unconditional variability of two survey-based economic-sentiment indicators. We find evidence of an asymmetric relationship, in that fiscal deficits give rise to adverse growth effects if they coincide with high uncertainty regarding the future prospects of the economy and no significant negative growth effects in the low-uncertainty case.

Key words: growth, fiscal policy, government budget constraint, uncertainty
JEL Classification: O40, E60, H60, D80

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I. Introduction

The relationship between fiscal policy and long-run macroeconomic performance has been a subject of long-standing debate and controversy both among policymakers and in academic circles. Recently, and particularly after the global financial crisis of 2007-2009, this debate has been intensified, as many countries have set constraints on public expenditures, either as part of area agreements, such as the Stability & Growth Pact in Europe, or in an attempt to avoid rising interest rates on public debt and speculative attacks on their currencies. In the Eurozone alone, public expenditures have been reduced by 17% between 1995 and 2011. At the same time, public debt has remained at relatively high levels, ranging from 73% in the Eurozone countries to 68% in the US and 164% in Japan. In view of these developments, how fiscal policy impacts on economic growth becomes crucial. The conventional view in the theoretical literature is that fiscal expansions adversely affect growth by introducing distortions in product and financial markets and by crowding out private investment. A number of analytical studies, however, stress that public spending can be growth-enhancing by having the potential to increase the resource base of the economy and the productivity of all private input factors.[1]The empirical evidence is equally inconclusive, with some authors reporting results that suggest a strong negative relationship between fiscal deficits and growth, while others fail to identify any statistically significant negative link or find evidence of a positive association.

Much of the existing empirical literature ignores the implications of the government budget constraint in terms of the empirical specification and interpretation of results, despite the fact that the impact of higher government spending on growth cannot be examined independently of its financing. Indeed, to examine the relationship between fiscal policy and growth, one needs an indicator of the extent to which existing fiscal imbalances are perceived by the markets to be associated with higher future risks. This can be expected to be related to the degree of uncertainty regarding the future prospects of the economy. If uncertainty is above a certain threshold, any current fiscal deficits are likely to reflect an excessive public-sector position, thus leading to lower investment and growth in the longer run. If, on the other hand, low uncertainty prevails, even a large current fiscal deficit can be expected to reflect either increases in government expenditures that pay off in the future or short-run fiscal adjustment to exogenous shocks that subsequently reverse themselves. Accordingly, in such cases, current fiscal deficits are unlikely to be seen by the markets as phenomena that entail potential dangers in subsequent years, in which case they will have no adverse impact on growth.

The objective of this paper is to explore how uncertainty regarding the future prospects of the economy influences the relationship between fiscal deficits and per-capita income growth. To this end, we construct four alternative measures of uncertainty, based on the conditional variability of manufacturing production and stock-market returns and on the unconditional variability of two survey-based economic-sentiment indicators, and focus on their interactions with fiscal deficits in the context of

[1] See Zagler & Dürnecker (2003), Romp & de Haan (2007) and Bayraktar & Moreno-Dodson (2010) for a survey.

a simple growth model. We focus on 28 European countries[2], using panel data at annual frequency that cover the period 1991-2007 and system-GMM estimation.

Our results provide evidence for the existence of an asymmetry in the way fiscal imbalances affect per-capita income growth. Regardless of the measure of uncertainty used, we find that fiscal deficits have a strong adverse effect on growth in cases of high uncertainty and no significant negative effect in cases of low uncertainty. This has important policy implications. It suggests that information regarding the future prospects of the economy is crucial in any assessment of the growth-fiscal deficit relationship.

The rest of the paper is organized as follows. Section II discusses the existing literature. Section IIIa presents a simple model, with explicit treatment of the government budget constraint and resource-enhancing public expenditures, which serves as a guide for the empirical specification and as a reference point for the interpretation of the empirical results. Section IIIb discusses the empirical specification. Section IV describes the methodology used to derive the uncertainty measures and reports the estimation results. Section V contains concluding comments.

II. Literature overview

The relationship between fiscal policy and economic growth is a subject of long-standing controversy and debate in macroeconomics. Much of the theoretical literature stresses that increases in government spending lower growth by crowding out private investment and by introducing distortions in product and financial markets. Other analytical studies, however, along the lines suggested by Aschauer (1989) and Barro (1990)[3], emphasize that public spending has the potential to improve the quality, and/or increase the total supply, of all input factors, and thus can be growth-enhancing. The empirical evidence is equally inconclusive: while the findings of some studies provide support for the hypothesis of a strong adverse effect of higher public expenditures on economic growth, other studies fail to identify a robustly negative effect or report evidence of a positive impact.

In particular, Barro (1991) and Easterly & Rebelo (1993), who were among the first to examine empirically the link between fiscal variables and per-capita income growth, have found evidence suggesting negative growth effects of increased government spending and fiscal deficits respectively, using average data from a large number of countries. Bleaney *et al*. (2001) have reported analogous results, implying that fiscal deficits reduce output growth, for a panel of 22 OECD countries after addressing the issue of potential endogeneity of the fiscal variables included in growth regressions. Fölster & Henrekson (2001) have found negative effects of public expenditures on growth in a panel of 23 OECD countries, while Bose *et al*. (2003) and Gupta *et al.* (2005) have reported estimates indicating

[2]Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom. We restrict our sample to these countries to allow for more homogeneity in the panel.

[3]Aschauer (1989) and Barro (1990) were among the first to include tax-financed government expenditures into endogenous growth models, stressing externalities that lead to private choices which are Pareto-inefficient.

that fiscal deficits are growth-reducing in panels of developing and low-income countries, respectively. Romero-Avila & Strauch (2008) report similar results, using panel data from 15 European countries, which indicate negative responses of growth to both higher public spending and higher taxation. The findings of Alesina *et. al.* (2002) and Afonso & Furceri (2010) are in the same direction: they suggest significant crowding-out effects of increased public spending and a small favourable impact on GDP.

On the other hand, Levine & Renelt (1992), based on average-growth data and a broad country sample, have questioned the robustness of earlier results by showing their sensitivity to small variations in the set of regressors. Their findings have suggested no clear evidence that fiscal deficits are growth-reducing. Hsieh & Lai (1996), based on vector-autoregression analysis and historical data from the G7 countries, have also found no uniform causal relationship between the size of government and economic growth and no consistent evidence that higher public spending slows down growth. Miller & Russek (1997) have failed to identify any significant negative link between debt-financed increases in public expenditures and growth in the case of the advanced economies, using both fixed- and random-effects panel estimation. Bassanini & Scarpetta (2001) report positive effects of higher public expenditures on per-capita income growth for a panel of 21 OECD countries, even after allowing for short-term heterogeneity among economies, by employing pooled-mean-group estimation. Adam & Bevan (2005), using data from 45 developing countries, find evidence of a non-linear effect of fiscal policy on growth, with their estimates suggesting that public deficits below a certain threshold are growth-enhancing. Lin (2000), Futagami *et.al.* (2008) and Minea & Villieu (2009), based on analytical endogenous growth models, also find non-linearities in the way fiscal expenditures affect per-capita growth rates, showing that fiscal deficits and government debt do not necessarily reduce growth. At the same time, Perotti (2004) reports no significant negative response of private investment to increases in public deficits in Australia, Canada, Germany and the UK, while Biau & Girard (2005) report a positive investment response in the case of France. Analogous results are reported in Fatás & Mihov (2001), Arpaia & Turrini (2008) and Baldacci *et al.* (2009). Fatás & Mihov (2001), using vector-autoregression methodology and a Cholesky decomposition to identify fiscal shocks, report estimates suggesting that fiscal deficits have long-lasting expansionary effects. Baldacci *et al.* (2009), based on data corresponding to 118 episodes of systemic financial crises in advanced and emerging-market economies, find evidence indicating that fiscal deficits are growth-enhancing in periods of financial distress. Arpaia & Turrini (2008), using panel data from the EU-15 countries and pooled-mean-group estimation, find a positive long-run relationship between the growth rate of potential output and the growth rate of primary government expenditures. Afonso & Gonzàlez-Alegre (2008) also find that deficits have a non-negative effect on growth in a panel of 14 European countries. Moreover, a positive effect on growth of higher public expenditures is reported in Morgese-Borys *et al*. (2008) for the 12 new-EU member states.

These results suggest that despite the growing number of studies, the channels through which government expenditures and fiscal deficits affect growth still are not well documented in the existing empirical literature. Indeed, to examine the relationship between fiscal deficits and growth one needs an indicator of the extent to which current fiscal deficits are perceived by the markets to be associated with higher future risks.[4] Fiscal deficits may result from excessive, purely consumptive expenditures or from inefficient public-investment projects. Such deficits can be expected to slow down growth since they will signal the possibility of an unsustainable public-sector position and poor macroeconomic performance in the future and, consequently, reduced long-term investment opportunities and lower profit margins. Deficits may also arise from public expenditures that serve to mitigate certain market failures, associated with education, health-care and other social services, as well as with R&D activity and infrastructure services.[5] As far as education is concerned, individuals may have limited access to private educational services due to credit-market imperfections and/or imperfect information that do not allow them to borrow sufficiently to finance their education.[6] Limited access to education causes a fall of human capital in the long run, implying that public education spending can be growth-enhancing. Also, due to spillover effects and other market failures, health-care services may be supplied by the private sector at a socially sub-optimal level, in which case publicly financed health-care will help increase labour supply, by reducing illnesses, and improve labour quality, since a good state of health is a pre-requisite for workers' ability to rapidly acquire new skills.[7] Other types of public services, such as active labour-market programmes and maintenance of law & order, can further increase labour supply and improve labour quality to the extent that they may induce entry of more workers into the labour force and provide incentives for the acquisition of additional skills and experience. Analogous considerations apply to research and development. While R&D has an unambiguously positive effect on growth, funds are required to finance the corresponding projects. If private firms face credit constraints and/or the non-excludability principle prevails, a sub-optimal level of R&D activity may result in the absence of government involvement and financing.[8] Similarly, the provision of certain infrastructure services, including transport and information & communication systems, may be unprofitable from a single producer's point of view to the extent that, due to externalities and the non-excludability principle, private costs can exceed private benefits. This justifies government intervention, with public spending on these services contributing to lower the unit cost of private fixed-capital formation.[9] Moreover, in all the above cases, any fiscal deficits arising from increases in government expenditures are unlikely to entail higher future risks since deficits will tend to be self-correcting, and thus temporary, as the higher growth rates

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[4] In the majority of the existing analytical studies the government is assumed to continuously run a balanced budget. Lin (2000), Greiner & Semmler (2000), Gosh & Mourmouras (2004), Adam & Bevan (2005), Minea & Villieu (2009) and Greiner (2007, 2010) are among the few analytical studies in which the government budget constraint is explicitly considered and alternative methods of financing public expenditures are examined. Even in empirical studies, the implications of the government budget constraint are often neglected.

[5] For a discussion see Aschauer (1989), Barro (1990), Barro & Sala-i-Martin (1992), Glomm & Ravikumar (1992, 1997), Devarajan *et al.* (1996) and Turnovsky (1996, 1997, 2000).

[6] See e.g. Fisher & Keuschnigg (2002), Tamura (2006) and Blankenau *et al.* (2007).

[7] See Bloom *et al.* (2004), Aguayo-Rico *et al.* (2005), Agénor (2008, 2010).

[8] See, for example, Devarajan *et al.* (1996).

[9] See e.g. Aschauer (2000), Demetriades & Mamuneas (2000), Turnovsky (2004), Pintea & Turnovsky (2006), Romp & de Haan (2007).

and per-capita incomes induced by the increased public expenditures will generate additional public revenue in the longer term.

The extent to which current fiscal deficits entail higher future risks can be expected to be related to the future prospects of the economy, as seen by the markets, which can be proxied by alterative measures of economic uncertainty. If uncertainty is above a certain threshold, fiscal deficits are likely to reflect an excessive public-sector position, thus leading to lower investment and growth in the longer run. If, on the other hand, low uncertainty prevails, even a large current fiscal deficit is likely to reflect either increases in government expenditures that pay off in the future or short-run fiscal adjustment to exogenous shocks that subsequently reverse themselves. Accordingly, in such cases, current fiscal deficits will be seen by the markets as phenomena that entail no potential dangers in subsequent years, in which case they will have no adverse impact on output growth.

This paper adds to the existing literature in two ways: first, we allow for the possibility of growth-enhancing public expenditures while taking explicitly into account the implications of the government budget constraint for the empirical specification; second, we allow for current fiscal deficits to be associated with higher future risks by constructing various measures of uncertainty as proxies for the state of the economy. Much of the empirical literature on fiscal policy and growth implicitly assumes a balanced-budget or simply adds government-activity variables to reduced-form convergence equations, ignoring the implications of the government budget constraint in terms of empirical specification and interpretation of results. In this paper, we allow the government to run deficits, and, by taking explicitly into account government financing, we obtain directly from the model an asymmetric relationship between fiscal policy and growth, where the effect on growth of deficits depends both on the return to public expenditures and on the perceived future risks associated with any current fiscal deficits, which we proxy with various uncertainty measures.

III. Theoretical underpinnings and empirical specification

III.a A simple model

Following much of the recent growth literature, we assume that additional public spending has the potential to improve the quality, and/or increase the supply, of all private input factors. If income-tax revenue remains unchanged, the resulting fiscal deficit can be seen as an instrument to finance the additional government spending. This leads to an indirect effect of deficits on growth.

Thus, on the supply side, output, Y, can be assumed to be produced with a simple, constant-returns-to-scale technology, according to the production function (1a):

$$Y(t) = A(E_L L(t))^a (E_K K(t))^{(1-a)} \tag{1a}$$

with $A = E_A A_0$, $E_A = (G/Y)^{\mu}$, $E_L = (G/Y)^{\beta}$, $E_K = (G/Y)^{\delta}$, $\mu, \beta, \delta \geq 0$

where L and K are labour and private capital respectively, A_o is a technology variable (constant over time, for simplicity) and E_L, E_K and E_A are labour-, capital- and technology-enhancing factors, assumed to be positively related to government activity, as measured by the share of public expenditures in GDP, *G/Y*.[10] μ, β and δ are non-negative constants representing the return to public spending. Expressing *Y* and *K* in per capita terms ($y = Y/L$, $k = K/L$), output supplied can be written as[11]

$$y(t) = A_o g*^{\theta} k(t)^{(1-a)} \tag{1b}$$

with $\theta = \mu + \beta a + \delta(1-\alpha)$, $g* = (G/L)/(Y/L) = g/y$

To the extent that the size of government, as measured by the share of public expenditures in GDP, reflects socio-economic considerations and elements related to the decision-making process at the political level, $g*$ can be treated as a policy instrument, and so it is specified as time-invariant.[12]

On the demand side, in the absence of unexpected events, $y(t)$ must equal planned private consumption $c(t)$, total planned private investment $i(t)$, and overall public spending $g(t)$, all defined in per capita terms (i.e. $c = C/L$, $i = I/L$, $g = G/L$):

$$y(t) = c(t) + i(t) + g(t) \tag{2a}$$

The excess of households' income over consumption, $y(t) - c(t)$, equals private savings, $s(t)$, and total tax payments $\tau(t)$, while planned private investment consists of replacement investment and net additions to the capital stock, that is, $i(t) = \left(n + \delta\right) k(t) + \dot{k}(t)$ where δ is the depreciation rate, n is the rate of labour-force growth (assumed exogenous) and $\dot{k}(t) = dk/dt$. If we further assume that agents save a constant proportion s_y of their after-tax income $y(t) - \tau(t)$, then, from (2a), we have that $s_y[y(t) - \tau(t)] + \tau(t) = i(t) + g(t)$, or $s_y \left(y(t) - \frac{\tau(t)}{y(t)} y(t) \right) + \frac{\tau(t)}{y(t)} y(t) = i(t) + \frac{g(t)}{y(t)} y(t)$ and thus we can write the equilibrium condition in the goods markets as:

$$[s_y + \tau*(t)(1 - s_y) - g*]y(t) = \left(n + \delta\right) k(t) + \dot{k}(t) \tag{2b}$$

[10] Following Barro (1990) and much of the more recent growth literature (e.g. Adam & Bevan (2005), Futagami *et.al* (2008), Minea & Villieu (2009)), we specify public spending as a flow variable, which implies that *(G/Y)* can be interpreted as the amount of public services provided as percent of GDP. Public services that can have a capital-enhancing effect include water, eletricity and transport services as well as services related to the maintenance of law & order and property rights. Public services that can have a labour-enhancing effect include educational services, health-care services, active labour-market policies and law & order services, while the government's involvement in R&D activity can be taken to represent technology-enhancing public services. Alternatively, public spending could be specified as a stock variable. In such a case, *G/Y* would correspond to public investment as percent of GDP and a public-capital accumulation function would have to be added. This would complicate the model, while there would be little difference as far as steady-states were concerned (see e.g. Futagami *et al.* (1993)).

[11] Specifying (1a) as a function of *(G/Y)* corresponds more closely to the idea that public services are non-rival and non-excludable, although making the factor-enhancing terms E_L, E_K and E_A a function of the per capita government services rather than a function of the amount of public services provided as percent of GDP would not change the main predictions of the model.

[12] Over time the government sets g to grow at the same rate as y so $g*$ is constant.

where both government-activity variables, g^* and $\tau^* = \tau / y$ (total tax revenue) are scaled in terms of GDP.

Combining (1b) with (2b), gives the rate of capital accumulation as:

$$\gamma_k(t) \equiv \frac{\dot{k}(t)}{k(t)} = [s_y + \tau^*(t)(1-s_y) - g^*]A_O g^{*\theta} k(t)^{-a} - (n+\delta) \qquad (3)$$

Abstracting from the option of issuing money,[13] higher public expenditures can be financed either from increased tax revenue or from new-debt issues. Thus, the government's budget constraint is

$$g^* = \tau^*(t) + \dot{b}^*(t) - [r(t) - \gamma_y(t) - n]b^*(t) \qquad (4a.1)$$

where $b^* = b/y$ is the debt-to-GDP ratio (in per-capita terms) and $\dot{b}^* = db^*/dt$. The last term on the right-hand side represents interest payments on outstanding public debt. r is the real interest rate, which, under competitive assumptions, can be taken to equal the (net) marginal product of capital $\frac{\partial y(t)}{\partial k(t)} - \delta$, while $\gamma_y = \frac{\dot{y}(t)}{y(t)}$ is the growth rate of per-capita output. Rearranging terms, and substituting out $r(t)$, we can write (4a.1) as:[14, 15]

$$\dot{b}^*(t) = g^* - \tau^*(t) + \omega(t)b^*(t) \qquad (4a.2a)$$

where $$\omega(t) = \frac{(1-a)A_0}{k(t)^a}\pi - a(n+\delta) \stackrel{<0}{>0}, \quad \pi = [(1-s_y)(1-\tau^*(t)) + g^*]g^{*\theta} \qquad (4a.2b)$$

If taxes remain unchanged, any increase in public spending, for a given capital stock, will lead to a deficit both directly, and indirectly, through the rise in the real interest rate on the outstanding public debt, via the impact of the higher g^* on capital productivity (i.e. the term π). Thus, over time b^* will rise, and, unless the capital stock $k(t)$ is growing enough so that the real interest rate is falling sufficiently to ensure that $\omega(t) < 0$ in (4a.2b), the rising b^* will be followed by additional government outlays on interest payments. For a given $k(t)$, the risk of a self-fuelling explosion of public debt, and therefore an unsustainable public-sector position, can be eliminated if the increased government outlays on interest payments are accompanied by a primary surplus $(\tau^*(t) - g^*) > 0$, and thus, for an unchanged government

[13] This option is not available to most of the countries in our sample.

[14] All public debt is domestically held, for simplicity. Interest income from public-debt holdings can be included in households' disposable income (at the expense of more complicted algebra) with no substantive change in the results as long as the tax rate on these interest payments is between 0 and 1.

[15]For a given A_o and a time-invariant g^*, the growth rate of per-capita output is uniquely linked to the growth rate of k, that is, from (1b), $\gamma_y(t) = (1-a)\gamma_k(t)$. Accordingly, the term $[r(t) - \gamma_y(t) - n]$ in (4a.1) can be written as $[(1-a)A_o k(t)^{-a} g^{*\theta} - \delta - (1-a)\gamma_k(t) - n]$, which, using (3), yields the expression for $\omega(t)$ in (4a.2b).

share in GDP, are financed by higher tax revenue. Accordingly, if the government is capable of enforcing a debt-stabilization rule,[16] which leads to higher tax revenues as debt rises, of, for example, the form $\tau_b = \rho b^*$, net government receipts as percent of GDP will be

$$\tau^*(t) - g^* = \tau_y + \rho b^*(t)\,, \rho > 0 \qquad (5)$$

and debt accumulation relative to GDP will be given as:

$$\dot{b}^*(t) = g^* - \tau_y - \zeta(t) b^*(t)\,, \zeta(t) = \rho - \omega(t) \qquad (6)$$

where τ_y is the (average) income-tax rate (i.e. revenue from ordinary income taxes as percent of GDP) which can be treated as a policy instrument (and therefore is specified as time-invariant), while ρ measures the government's response to rising debt and thus the weight it gives to debt stabilization. For a sufficiently strong government reaction to rising debt (a large enough ρ), the sign over time of $\zeta(t)$ will unambiguously be positive even if the capital stock $k(t)$ is not growing enough to ensure that $\omega(t) < 0$, in which case changes over time in the debt-to-GDP ratio will gradually dampen out and the potential danger of an explosive debt process, and therefore an unsustainable public-sector position, will be eliminated.

Assuming dynamic stability, the solution to (3) and (6)[17] leads to a steady-sate response of capital to changes in the fiscal-policy instruments g^* and τ_y given by (7):

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[16] The evidence is consistent with this assumption. For the eurozone countries, for example, a debt-stabilization rule like (5) could be interpreted in the context of the Maastricht Treaty since the Stability & Growth Pact constraints member states to maintain a debt-to-GDP ratio below 60%. In the UK the Code of Fiscal Stability constraints the government to maintain a low debt-to-GDP ratio, while similar budgetary rules are used in other countries, including Japan. Analytical growth studies that include public debt are Greiner & Semmler (2000), Gosh & Mourmouras (2004), Futagami *et al.*(2008), Minea & Villieu (2009), Greiner *et.al.*(2007) and Greiner (2010).Although these studies explore the growth and welfare effects of alternative financing methods, none of them explicitly considers the dynamic-stability implications of the government budget constraint in terms of the empirical specification of growth equations and in terms of interpreting the empirical results.

[17] Using (5), the rate of capital accumulation is given by

$$\gamma_k(t) \equiv \frac{\dot{k}(t)}{k(t)} = [s_y + (\tau_y + \rho b^*(t))(1 - s_y) - g^*] A_O g^{*\theta} k(t)^{-a} - (n + \delta)\,,$$

while, from (6), debt accumulation as percent of GDP is given by:

$$\dot{b}^*(t) = (g^* - \tau_y) - \zeta(t) b^*(t)$$

where $\varsigma(t) = \rho - \frac{(1-a)A_0}{k(t)^a}[(1 - s_y)(1 - \tau_y - \rho b^*(t)) + g^*] g^{*\theta} + a(n + \delta)$

Taking partial derivatives, the linearized dynamics of the economy can be written as:

$$\begin{bmatrix} \gamma_k(t) \\ \dot{b}^*(t) \end{bmatrix} = V \begin{bmatrix} \hat{k}(t) \\ \hat{b}^*(t) \end{bmatrix} + M \begin{bmatrix} \hat{g}^* \\ \hat{\tau}_y \end{bmatrix} + H \begin{bmatrix} \hat{A}_0 \\ \hat{s}_y \\ (\hat{n} + \hat{\delta}) \end{bmatrix} \qquad \text{(i)}$$

with

$$V = \begin{bmatrix} v_1 & v_2 \\ v_3 & v_4 \end{bmatrix}, \; M = \begin{bmatrix} m_1 & m_2 \\ m_3 & m_4 \end{bmatrix}, \; H = \begin{bmatrix} h_1 & h_2 & h_3 \\ h_4 & h_5 & h_6 \end{bmatrix}$$

$$\frac{dk_\infty}{dg^*} = (\lambda_1/\eta), \qquad \frac{dk_\infty}{d\tau_y} = (\lambda_2/\eta) \tag{7}$$

with

$$\lambda_1 = -(1-\frac{\theta i^*}{g^*}) + (\frac{\rho}{\zeta})[1+(\frac{\theta}{g^*})(1-a)(y/k)b^*](1-s_y) \lessgtr 0, \quad \lambda_2 = -(1-s_y)(\frac{\omega}{\zeta}) \lessgtr 0$$

$$\eta = [i^* + (1-a)(y/k)b^*(\frac{\rho}{\zeta})(1-s_y)]a(1/k)(>0), \quad i^* = i/y > 0$$

The sign of λ_1 is a priori unclear. With debt-financing, and therefore an unchanged τ_y, a rise in public spending implies that the government absorbs resources that could have been used for private investment. At the same time, the increase in pubic expenditures improves the resource base of the economy through the factor-enhancing terms E_L, E_K and E_A, leading to an expansion of output. The rise in y in turn leads to higher private savings and increased tax revenues. These two elements are reflected in the term $-(1-\frac{\theta i^*}{g^*})$. The overall return to government spending, θ, determines the size of the increase in per-capita output resulting from the factor-enhancing effects of the higher public expenditures. On the other hand, the larger is the saving rate s_y and the higher the initial income-tax rate τ_y, the greater the amount of resources that become available for investment through the increase in output due to the rise in fiscal expenditures. If θ is large and the initial level of government spending is not excessive, then the increase in savings and tax revenue is possible to compensate for the rise in government spending, leaving on balance a larger quantity of output available for private investment. In such a case, the term $-(1-\frac{\theta i^*}{g^*})$ in λ_1 will be positive. Additionally, with deficit-financing, we have the term

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where the circumflex over the variables denotes deviations from an initial steady state,

and

$$v_1 = -i^*(y/k)(1/k)a < 0,\ v_2 = (y/k)(1-s_y)\rho > 0,\ v_3 = -a(1-a)(y/k)b^*(1-i^*)(1/k) < 0,\quad i^* = i/y > 0,$$

$$v_4 = -[\zeta + b^*(1-a)(y/k)(1-s_y)\rho] \lessgtr 0,\ m_1 = -(y/k)[1-(\theta i^*/g^*)] \lessgtr 0,\ m_2 = (y/k)(1-s_y) > 0,$$

$$m_3 = 1 + b^*(1-a)(y/k)[1+(\theta/g^*)(1-i^*)] > 0,\quad m_4 = -[1+b^*(y/k)(1-s_y)(1-a)] < 0,\ h_1 = i^*(y/k) > 0,$$

$$h_2 = (y/k)(1-\tau^*) > 0,\ h_3 = -1 < 0,\ h_4 = b^*(1-a)(y/k)(1-i^*) > 0,\quad h_5 = -b^*(y/k)(1-\tau^*)(1-a) < 0,\ h_6 = -b^*a < 0,$$

$$\det(V) = v_1v_4 - v_2v_3,\ \mathrm{tr}(V) = v_1 + v_4$$

Provided that $\zeta > 0$ the determinant of the state matrix, $\det(V)$, will unambiguously be positive, implying that the system will have two characteristic roots of the same sign. For $\zeta > 0$ the trace of the state matrix, $\mathrm{tr}(V)$, will also unambiguously be negative in which case both roots will be negative and thus the system will be stable converging to steady-state equilibrium. Assuming stability, the solution to (i) yields long-run responses of k and b^* to changes in the fiscal-policy instruments, g^* and τ_y, and in the other exogenous variables, s_y, A_o and $n+\delta$, which can be obtained from (ii):

$$\begin{bmatrix} \hat{k}_\infty \\ \hat{b}^*_\infty \end{bmatrix} = -MV^{-1}\begin{bmatrix} \hat{g}^* \\ \hat{\tau}_y \end{bmatrix} - HV^{-1}\begin{bmatrix} \hat{A}_o \\ \hat{s}_y \\ (\hat{n}+\hat{\delta}) \end{bmatrix} \tag{ii}$$

$(\frac{\rho}{\zeta})[1+(\frac{\theta}{g^*})(1-a)(y/k)b^*](1-s_y)$ in λ_1, whose sign and size can be viewed as reflecting the potential dangers, as seen by the markets, associated with fiscal deficits. Firstly, if the state of the economy is expected to be poor, the markets will not preclude the possibility that $\zeta < 0$, in which case the government will have problems servicing its debt and may not avoid default or end up reducing public expenditures in order to accomplish a primary surplus. Secondly, the less determined is the government to enforce a debt stabilization rule like (5), the higher the risks involved in any deficit-financed increase in public expenditures, since a weak government reaction to rising debt may not ensure that $\zeta > 0$, particularly if the capital stock is not large enough to imply a sufficiently low real interest rate. Thirdly, the lower the existing capital stock, the higher the real interest rate and therefore the less likely it is that $\zeta > 0$. And fourthly, for a positive ζ but a small ρ , the rise over time in public debt resulting from the initial deficit (whose size is captured by the term $[1+b^*(\theta/g^*)(1-a)(y/k)]$), will not be followed by a large enough reduction in private consumption (and large enough incrase in tax receipts) to allow for sufficient resources to be spent on investment. Accordingly, if the state of the economy is not expected to be particularly satisfactory, the term $(\frac{\rho}{\zeta})[1+(\frac{\theta}{g^*})(1-a)(y/k)b^*](1-s_y)$ in λ_1, even if positive, will be relatively small. And combined with an insufficiently large return to public spending it can lead to an overall negative response of steady-state capital to increases in government expenditures ($\lambda_1 < 0$). The reverse is true if the government's credibility to enforce a debt-stabilization rule like (5) is beyond doubt and the existing capital stock is relatively large so that the real interest rate is low and therefore interest payments on outstanding public debt are limited. If this is the case, then the bracketed term in λ_1 will be positive and large in size, and thus, combined with a strong enough return to public expenditures, may well lead to an overall favourable effect of increased public spending on steady-state capital.

In short, with deficit-financing, the better the prospects of the economy, and thus the more weight the government attaches to debt stabilization and the lower the real interest rate, the more likely it is that the capacity-enhancing effects of increased government expenditures will, on balance, lead to a higher level of capital in the long run. By contrast, if the government were to continuously run a balanced-budget, then $b^* = 0$ in (7) and the overall effect on steady-state capital would reduce to $\frac{dk_\infty}{dg^*} + \frac{dk_\infty}{d\tau_y} =$

$$-[s_y - (\frac{\theta i^*}{g^*})](\frac{1}{ai^*(1/k)}) .$$

IIIb. Empirical specification

For estimation purposes we need an expression for the evolution of per capita output in terms of measurable variables. Imposing the steady-state condition $\gamma_k(t) = \dot{b}^*(t) = 0$, we can write the long-run per-capita output as:

$$y_\infty = \frac{A_o^{1/a}}{(n+\delta)^{(1-a)/a}} (g^{*\theta/a})[s_y(1-\tau_y) - (g^* - \tau_y)[1-(1-s_y)(\frac{\rho}{\zeta_\infty})]]^{(1-a)/a} \qquad (8a)$$

with $$\varsigma_\infty = \rho - \frac{(1-a)A_0}{k^a_\infty}[(1-s_y)(1-\tau_y - \rho b^*_\infty) + g^*]g^{*\theta} + a(n+\delta)$$

Outside steady states, along the adjustment path, and with a time-invariant g^*, the path of per capita output will be determined by the path of k. Letting $\psi(t)$ be the rate at which the (log of) per-capita capital, $\ln k(t)$, approaches (the log of) its steady-state value, $\ln k_\infty$, and denoting by $\ln y_o$ an initial steady-state per-capita output, outside steady states we can write as an approximation:[18]

$$\ln y(t) - \ln y_\infty = e^{-(1-a)\psi(t)}(\ln y_o - \ln y_\infty),$$

or

$$\ln y(t) - \ln y_o = (1 - e^{-(1-a)\psi(t)})(\ln y_\infty - \ln y_o) \qquad (8b)$$

Upon substitution into (8b) of a linearized version of (8a) by taking derivatives, and making use of the expressions for k_∞ and b^*_∞ derived from the steady-state solution of the model (see footnote 17), we can derive an output-growth equation of the form given by (9a):

$$d\ln y(t) = \upsilon(t)F\Big(A_o, s_y, n+\delta, g^*, \tau_y, \Big) - \upsilon(t)\ln y \qquad (9a)$$

where

$$d\ln y(t) = \frac{\ln y(t) - \ln y_0}{t}, \quad \upsilon(t) = \frac{(1-e^{-(1-a)\psi(t)})}{t} > 0$$

and

$$F_{A_o} = (1 + \frac{(1-a)i^*}{\sigma a})(\frac{1}{A_o}) > 0, \; F_{s_y} = (1-\tau_y)\frac{(1-a)}{\sigma a} > 0, \; F_{n+\delta} = -\frac{(1-a)}{\sigma a(n+\delta)}[i^* + (1-s_y)b^*(\frac{\rho}{\zeta})(n+\delta)] < 0,$$

$$F_{g^*} = \Big(\theta - [1-(1-s_y)(\frac{\rho}{\zeta})](1-a)(\frac{g^*}{\sigma})\Big)(\frac{1}{g^* a}) \lesseqgtr 0, \; F_{\tau_y} = -\frac{(1-a)}{\sigma a}(1-s_y)(\frac{\omega}{\zeta}) \lesseqgtr 0, \; \sigma = [i^* + (1-a)(y/k)(1-s_y)(\frac{\rho}{\zeta})b^*] \; (>0), \; i^* = i/y > 0$$

F_A and F_{s_y}, the partial derivatives of per-capita output growth with respect to technology and private savings, respectively, are positive, while $F_{n+\delta}$, the partial derivative with respect to the sum of population growth and depreciation rate has a negative sign. The sign of the partial derivative with respect to government spending F_{g^*}, depends on the magnitude of θ, and thus on the overall return to public expenditures, as well as on the sign and size of ρ/ζ, and thus on the requirement for a sustainable public-sector position. If public spending has a strong productivity-enhancing effect and the state of the economy, including the government's determination to maintain fiscal sustainability, is sufficiently satisfactory, then deficit-financed increases in public expenditures are more likely to have a favourable

[18] See e.g. Mankiw *et al.* (1992) and Bassanini & Scarpetta (2001).

effect on output growth (i.e. $F_{g*} > 0$) than income-tax-financed increases.[19] On the other hand, whether or not the economy meets the requirements for public-sector sustainability can be taken to represent the perceived future risks associated with any current deficit that arise from increases in government expenditures. Such risks can be expected to be related to the overall prospects of the economy, as seen by the markets, which we proxy with various uncertainty measures.

In particular, we classify a country j as facing a higher-than-average degree of uncertainty when the annual (un)conditional standard deviation, $(\sigma)_{j,t}$, of the corresponding variable in j is above the median value, σ^{med}, obtained from the distribution of all countries. Hence, the high uncertainty dummy is defined as

$$HUNC_{j,t} = \begin{cases} 1, & if \quad (\sigma)_{j,t} \geq \sigma^{med} \\ 0, & otherwise \end{cases} \tag{10a}$$

and the low uncertainty dummy is defined as:

$$LUNC_{j,t} = \begin{cases} 1, & if \quad (\sigma)_{j,t} < \sigma^{med} \\ 0, & otherwise \end{cases} \tag{10b}$$

Thus, the empirical specification, which corresponds to (9a), is given by (10c):

$$d\ln(GDP)_{j,t} = \delta_0 + \delta_1 \ln(GDP)_{j,t-1} + \delta_2 (HUNC)_{j,t} * (FISCAL)_{j,t} + \delta_3 (LUNC)_{j,t} * (FISCAL)_{j,t} + \\ + \delta_4 (SAV)_{j,t} + \delta_5 (TEC)_{j,t} + \delta_6 (HUM)_{j,t} + \delta_7 (CAS)_{j,t} + \sum_{t=1991}^{2007} \tau_t (year) + \varepsilon_{j,t} \tag{10c}$$

The δ_i's, τ_i's are unknown constant parameters to be estimated and ε is an unobserved spherical disturbance term. The dependent variable, $d\ln(GDP)_{j,t}$ is real output growth, measured by the annual percentage change of GDP per capita (US$ constant (2005, PPP) prices). $\text{Ln}(GDP)_{i,t-1}$, the lagged value of (the logarithm of) GDP per capita, will enter the regression with a negative coefficient δ_1 provided that conditional convergence applies.[20] The fiscal variable $(FISCAL)_{j,t}$, refers to the general-government deficit as percent of GDP. *FISCAL* will enter the regression with a significantly negative, and large in size, coefficient if the productivity-enhancing effects of public expenditures are weak and the markets perceive that the state of the economy is not sufficiently satisfactory to ensure fiscal-policy sustainability. By contrast, *FISCAL* will enter with a non-negative coefficient if the return to public expenditures is sizable and the state of the economy, as seen by the markets, is satisfactory enough to eliminate the

[19] With income-tax financing and no initial debt, the effect would be $F_{g*} + F_{\tau_y} = [\theta - s_y(1-a)(\frac{g*}{\sigma})](\frac{1}{g*a})$.

[20] According to the conditional convergence hypothesis, when macroeconomic policies and other key characteristics across countries and over time are accounted for, low/high levels of income per capita are associated with higher/ lower growth rates in subsequent years.

possibility of an unsustainable public-sector position. Accordingly, we anticipate rejecting the joint hypothesis of $H_0 : \delta_2 = \delta_3 = 0$ in favour of the alternative that at least one parameter is significant, providing evidence of an asymmetric response of growth to public deficits. For a negative and significant δ_2, we also anticipate that $|\delta_2| > |\delta_3|$ indicating that the growth-deficit elasticity is a function of the combined effect of the return to public expenditures and the perceived future risks associated with deficits, as reflected in the degree of uncertainty regarding the future prospects of the economy. $(SAV)_{j,t}$ represents the saving rate, measured by the ratio of gross national income minus total consumption to GDP, whereas the level of technology, $(TEC)_{j,t}$, is proxied by the share of high-technology exports in total manufactured exports. We thus expect $\delta_4,\ \delta_5 > 0$. Following much of the empirical growth literature, human capital, $(HUM)_{j,t}$, is added as a separate explanatory variable in (10c), with the corresponding coefficient δ_6 expected to be positive. $(HUM)_{j,t}$ is proxied by the ratio of (gross) tertiary enrolment to the population of the corresponding age group. In the set of explanatory variables we also include net export activity, proxied by the current account surplus as percent of GDP, $(CAS)_{j,t}$. $(CAS)_{j,t}$ accounts for the fact that, other things being equal, export activity reduces the domestic resources available for private investment. This suggests a negative sign for δ_7.[21, 22] We further include time dummies to control for common shocks across countries that may have taken place during the period under consideration, such as monetary-policy changes and other factors arising, for example, from the circulation of the euro.[23] Data on all variables except *FISCAL* and *CAS* come from the World Bank (*World Development Indicators* database). Series for *FISCAL* and *CAS* are obtained from the IMF (*World Economic Outlook*).[24]

[21] Taking into account net export activity, *NX*, would give (2a) as $y = c + i + g + nx$ with $nx = NX/L$. Accordingly, the bracketed term in (3) would become $[s_y + \tau^*(t)(1 - s_y) - g^* - nx^*]$ where $nx^* = nx/y$ is net exports as percent of GDP. Eq.(8a) would also become $y_\infty = \frac{A_O^{1/a}}{(n+\delta)^{(1-a)/a}} (g^{*\theta/a})[s_y(1-\tau_y) - (g^* - \tau_y)[1-(1-s_y)(\rho/\zeta_\infty)] - nx^*]^{(1-a)/a}$, implying a negative effect of increases in net exports as percent of GDP on long-run per-capita income.

[22] Population growth has not been included as an explanatory variable because the corresponding series for the sample we consider shows very little variation across countries and over time.

[23] Time dummies can also serve as proxies for the average world-wide growth of technology.

[24] Several studies distinguish between 'productive' and 'unproductive' public expenditures. This distinction, while theoretically relevant, is not very helpful in empirical analyses since it is difficult to a priori establish from the available disaggregation of government expenditures which expenditures are productive and which are not. Some components of public expenditures could a priori be regarded as productive, but for other components, including national defense and police services, crime prevention, occupational safety, pollution control etc., the distinction is not straightforward. For this reason, several empirical studies, instead of using an a priori classification of government expenditures into productive and unproductive, let the data establish to what extent total public expenditures have growth-enhancing effects (see e.g. Hsieh & Lai (1994)). Kneller *et al.* (1999), Bleaney *et. al.* (2001), Bassanini *et al.* (2001) and Angelopoulos *et al.* (2007), among others, examine the growth effects of different components of public expenditures, although none of these studies explicitly allows for the implications of the government budget constraint in their empirical specification.

IV. Construction of Uncertainty Measures and Estimation Results

We construct four different measures of uncertainty. Firstly, uncertainty is proxied by the conditional standard deviation[25] of the annual changes in the industrial (manufacturing) production index, $(P)_{j,t}$, obtained from the OECD database[26]. Conditional uncertainty is constructed by estimating a Pooled Panel-GARCH (PP-GARCH, hereafter) model. In particular, we estimate the following autoregressive model:

$$P_{j,t} = \theta_0 + \theta_1 P_{j,t-1} + \eta_{j,t} \tag{11a}$$

where the θ_i's stand for estimable parameters and η is a disturbance term.

We assume that $\eta_{j,t} \sim N\left[0,\ \Omega_{j,t}\right]$, *i.e.* are multivariate normal error terms with a time-varying conditional variance-covariance matrix producing a PP-GARCH model (Cermeño & Grier (2006)). The variance-covariance matrix $\Omega_{j,t}$ is time-dependent and its diagonal and off-diagonal elements are given by the following equations:[27]

$$\sigma_{j,t}^2 = \alpha + \sum_{n=1}^{p} \delta_n \sigma_{j,t-n}^2 + \sum_{m=1}^{q} \gamma_m \eta_{t-m}^2,\ \ for\ \ j = 1,...N \tag{11b}$$

$$\sigma_{j,s,t} = \kappa + \sum_{n=1}^{p} \lambda_n \sigma_{j,s,t-n} + \sum_{m=1}^{q} \rho_m \eta_{j,t-m} \eta_{s,t-m},\ \ for\ j \neq s \tag{11c}$$

[**Table 1, about here**]

The preferred model was chosen using the Akaike Information Criterion, which led to the adoption of a PP-ARCH (1) model. Table 1 reports the estimation results. The fitted values from the volatility equation are recovered and used as proxies for uncertainty. This measure of volatility possesses the desirable properties of being conditional, as well as being cross-sectional and time-varying.

Secondly, we consider conditional uncertainty arising from the annual standard deviation of stock market returns, $(R)_{t-1}$. Daily closing prices, in local currencies, for stock market indices[28] have been

[25] The main advantage of conditional measures is that they reflect the information available at the time of decision making.

[26] Note that for Bulgaria, Cyprus, Latvia, Lithuania, Malta and Romania data are obtained from the Eurostat database.

[27] Although multivariate GARCH models are also available, they are not practical for most panel applications because they require the estimation of a large number of parameters which consumes degrees of freedom rapidly. By contrast, PP-GARCH estimation, by imposing common dynamics on the variance-covariance process across cross-sectional units, reduces the number of parameters, dramatically increasing parsimony. Furthermore, the PP-GARCH model does not imply constant cross-sectional correlation over time.

[28] The indices employed are as follows: ATX (Austria), BEL 20 (Belgium), BSE SOFIX (Bulgaria), CYPRUS GENERAL (Cyprus), PRAGUE SE PX (Czech Republic), OMX 20 COPENHAGEN (Denmark), OMX TALLINN (Estonia), OMX HELSINKI (Finland), CAC 40 (France), MDAX FRANKFURT (Germany), ATHEX COMPOSITE (Greece), BUDAPEST PRICE INDEX (Hungary), OMX ICELAND ALL SHARE (Iceland), IRELAND SE OVERALL ISEQ (Ireland), MILAN MIDEX (Italy), OMX RIGA (Latvia), OMX VILNIUS (Lithuania), MALTA SE MSE (Malta), AMSTERDAM SE ALL SHARE (Netherlands), OSLO EXCHANGE ALL SHARE (Norway), WARSAW GENERAL INDEX (Poland), PORTUGAL PSI GENERAL (Portugal), BET

obtained from *Datastream*[29] from 1/1/1991 to 31/12/2007 and cconditional uncertainty is generated by applying standard time-series GARCH models to each country's stock-market index (see e.g. Engle (1982), Bollerslev (1986)). Table 2 reports the time series ARCH results for daily non-overlapping returns.

[**Table 2, about here**]

In all cases, the coefficients in the conditional-variance equations are highly significant, suggesting persistence in volatility, consistent with volatility clustering. Uncertainty is proxied by the fitted values from the volatility equations and the annual conditional standard deviation is calculated by averaging the daily standard deviations.

Finally, we adopt unconditional metrics of uncertainty arising from the annual standard deviation of the monthly changes in the seasonally-adjusted *Industrial Sentiment Indicator*[30] (*ISI*) and the *Economic Sentiment Indicator*[31] *(ESI)*. The data cover the period from January 1991 to December 2007 and are obtained from Eurostat (*Business and Consumer Surveys*, Economic and Financial Affairs of the EU). Since the *ISI* and *ESI* are inherently forward-looking, these two measures of uncertainty are as close to *ex ante* uncertainty as possible. They also have the advantage of being a direct measure of perceived uncertainty to the extent that they are based on the answers of the business community rather than being estimated.

Equation (10c) has been estimated by applying the system-GMM technique (Arellano & Bover, (1995), Blundell & Bond, (1998, 2000)). This technique is relevant for estimating growth models to address, among other things, the possibility of two-way causality (see e.g. Bond *et al.* (2001), Hoeffler (2002), Christiansen *et al.* (2009), Saidi & Aloui (2010), Yamarik (2010)). The system-GMM technique is also particularly appropriate when the period of study is relatively short and the problem of weak instruments causes large finite-sample biases and poor precision of the originally simple first-differences GMM-estimator. The statistical adequacy of the model is established when the generated residuals do not exhibit second-order autocorrelation and the over-identifying restrictions are not rejected. Results are shown in the table below.

[**Table 3, about here**]

Column (1) of Table 3 shows estimates without controlling for perceived risks of higher deficits, proxied by the alternative uncertainty measures, while columns (2)-(5) report estimates after controlling for such risks. In all columns, the Sargan test indicates that the model is well specified.

COMPOSITE INDEX (Romania), MADRID SE GENERAL (Spain), OMX STOCKHOLM (Sweden), SWISS MARKET (Switzerland), FTSE ALL SHARE (UK).

[29] Data on SBI TOP (Slovenia) are obtained from the Ljubljana stock exchange, while data on SAX INDEX (Slovakia) are from the Bratislava stock exchange.

[30] Due to unavailability of data for Norway and Switzerland, we resort to the amplitude-adjusted Business Confidence Indicator (*BCI*) obtained from the monthly indicators of the OECD database.

[31] Similarly, for Norway and Switzerland we utilize the amplitude-adjusted Composite Leading Indicator (*CLI*) obtained from the OECD database.

The results show a statistically significant positive effect on growth of savings and technology in all regressions. The human-capital proxy also has a strong favourable effect on growth, with the corresponding coefficient being positive and highly significant in all columns of Table 3. The current account surplus always enters with the expected negative sign. Moreover, the coefficient on lagged per-capita GDP is negative and significant, indicating conditional convergence for the set of countries in our sample and time period under consideration.

At the same time, the estimates in column (1) indicate no strong general negative relationship between fiscal deficits and per capita output growth: the coefficient on *FISCAL* is small and only marginally significant. In columns (2)-(5), while the results for the other explanatory variables remain roughly unchanged, the results for the fiscal variable change drastically. In the low perceived-risks, low-uncertainty case, the coefficient on *FISCAL* is insignificant (and in column (5) has a positive sign), suggesting no robustly negative association between fiscal deficits on growth. By contrast, in the high uncertainty case, independently of the measure of uncertainty used, *FISCAL* always enters the regressions with a highly significant, and large in size, negative coefficient, indicating that fiscal deficits tend to slow down growth when the markets perceive higher future risks. This will be the case when existing fiscal deficits are associated mostly with excessive consumptive expenditures rather than expenditures that pay off in the future and the state of the economy is not satisfactory enough to eliminate the possibility of an unsustainable public-sector position. Indeed, our results suggest that a tighter budget policy does not necessarily promote economic growth and that the prospects of the economy, as seen by the markets, play a crucial role.

V. Concluding Comments

The relationship between fiscal policy and per-capita income growth has received wide attention in the literature. The conventional view is that increases in government spending lower growth by crowding out private investment and by introducing distortions in product and financial markets. Nevertheless, the empirical evidence is inconclusive: some studies find that growth is negatively related to measures of fiscal imbalance, while other studies report results suggesting a favourable impact of fiscal deficits on growth or present evidence indicating no significant negative effect.

We do not find a strong general negative link between fiscal deficits and per-capita income growth. This is because public deficits will have an adverse effect on growth only to the extent that the overall return to government spending, through its impact on the productivity of all private input factors, is limited and the corresponding deficits are perceived by the markets as implying higher future risks due to the possibility of unsustainable fiscal positions. This can be expected to coincide with high uncertainty regarding the future state of the economy. On the other hand, fiscal deficits may not be as detrimental for growth as generally thought if the economy meets the requirement for a sustainable debt process and public expenditures pay off in the future, in which case existing fiscal deficits can be expected to coincide with low uncertainty regarding the performance of the local economy in subsequent years. Indeed, our results suggest an asymmetry in the way fiscal imbalances affect growth rates. Regardless of the measure of uncertainty used, we find that fiscal deficits have a strong negative effect on per-capita income growth in cases of high uncertainty and no significant adverse effect in cases of low uncertainty.

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TABLES

Table 1. Pooled Panel ARCH model for production index[a]

Regressor[b]	**Estimates (z-scores)**
Mean Equation	
constant	-0.014 (-1.41)
$(P)_{j,t\text{-}1}$	0.636*** (23.43)
Conditional Variance Equation	
constant	0.0007*** (8.64)
$\text{ARCH}(1)$	0.908*** (7.12)
Log-likelihood	694.71
Observations	385

Notes: **(a)** The percentage change of the industrial production index for manufacturing. **(b)** The term $(P)_{j,t\text{-}1}$ represents the first-order lag of the dependent variable. Numbers in parentheses denote z-scores. One, two, three asterisks denote significance at the 10, 5, and 1 percent level respectively. Time effects included.

Table 2. Time-series ARCH models for stock returns[a]

Regressor[b]	Austria	Belgium	Bulgaria	Cyprus	Czech Republic	Denmark	Estonia	Finland	France	Germany	Greece	Hungary	Ireland	Italy
$(R)_{t-1}$	0.141***	0.145***	0.203***	0.120***	0.179***	0.105***	0.269***	0.133***	0.026*	0.132***	0.196***	0.116***	0.164***	0.155***
	(9.23)	(17.56)	(12.59)	(3.70)	(10.20)	(7.77)	(58.51)	(11.26)	(1.86)	(9.41)	(17.60)	(11.04)	(13.03)	(8.18)
ARCH(1)	0.258***	0.462***	0.835***	0.350***	0.309***	0.271***	0.980***	0.492***	0.204***	0.282***	0.311***	0.447***	0.252***	0.267***
	(16.07)	(21.47)	(17.48)	(9.29)	(12.85)	(13.97)	(31.38)	(23.13)	(12.13)	(16.24)	(15.32)	(26.33)	(14.12)	(13.93)
Log-likelihood	-6398.0	-5966.9	-2399.6	-1494.8	-5511.1	-6271.9	-5213.5	-8527.8	-7274.4	-5500.5	-7910.2	-7772.7	-6025.7	-4883.8
Observations	4433	4433	1565	865	3582	4433	3019	4433	4433	4433	4433	4432	4433	3390
Regressor	**Latvia**	**Lithuania**	**Malta**	**Netherlands**	**Norway**	**Poland**	**Portugal**	**Romania**	**Slovakia**	**Slovenia**	**Spain**	**Sweden**	**Switzerland**	**UK**
$(R)_{t-1}$	0.125***	0.162***	0.095***	0.058***	0.048***	0.303***	0.163***	0.320***	-0.031	0.244***	0.062***	0.111***	0.064***	0.060***
	(16.51)	(8.52)	(10.70)	(4.87)	(2.72)	(40.17)	(21.24)	(19.37)	(-1.33)	(11.45)	(4.05)	(8.58)	(5.97)	(5.71)
ARCH(1)	0.678***	0.372***	0.857***	0.445***	0.257***	0.429***	0.593***	0.471***	0.137***	0.506***	0.237***	0.348***	0.389***	0.326***
	(24.09)	(11.76)	(23.42)	(16.81)	(12.28)	(20.58)	(22.96)	(17.64)	(8.48)	(10.88)	(14.05)	(17.64)	(19.71)	(15.88)
Log-likelihood	-3326.1	-2795.4	-3196.3	-5409.9	-4742.1	-8784.4	-5026.8	-4498.8	-4078.3	-1270.1	-6692.5	-7107.6	-6447.5	-5683.8
Observations	2084	2085	3132	3391	3130	4358	4433	2531	2422	1184	4433	4433	4433	4433

Notes: **(a)** Dependent variable is the daily return of the corresponding stock market index. **(b)** The term $(R)_{t-1}$ represents the first-order lag of the dependent variable. Numbers in parentheses denote z-scores, while one, two, three asterisks denote significance at the 10, 5, and 1 percent level respectively. Intercepts are not reported. All models include time effects.

Table 3. System-GMM estimates of the growth model

Dependent Variable $d\ln(GDP)_{j,t}$	**Model (1)**	**Model (2)[a]**	**Model (3)[b]**	**Model (4)[c]**	**Model (5)[d]**
Regressor			**Estimates (z-scores)**		
$\ln(GDP)_{j,t\text{-}1}$	-0.048*** (-4.99)	-0.054*** (-4.53)	-0.046*** (-4.75)	-0.053*** (-4.90)	-0.056*** (-5.64)
$(HUM)_{j,t}$	0.056*** (3.06)	0.057*** (3.17)	0.053*** (2.95)	0.052*** (3.08)	0.051*** (2.82)
$(SAV)_{j,t}$	0.293*** (3.64)	0.316*** (3.46)	0.255*** (3.35)	0.347*** (3.88)	0.360*** (3.44)
$(TEC)_{j,t}$	0.100*** (2.86)	0.102** (2.17)	0.109*** (3.26)	0.091** (2.41)	0.076* (1.92)
$(CAS)_{j,t}$	-0.246*** (-3.47)	-0.228*** (-3.27)	-0.242*** (-3.19)	-0.229*** (-3.42)	-0.198*** (-2.92)
$(FISCAL)_{j,t}$	-0.140* (-1.87)	-	-	-	-
$(HUNC)_{j,t} * (FISCAL)_{j,t}$	-	-0.212*** (-3.00)	-0.172** (-2.44)	-0.269*** (-2.99)	-0.297*** (-3.43)
$(LUNC)_{j,t} * (FISCAL)_{j,t}$	-	-0.013 (-0.11)	-0.190 (-1.59)	-0.011 (-0.12)	0.045 (0.53)
Observations	338	320	317	329	337
m_1	-3.40***	-3.27***	-3.27***	-3.36***	-3.48***
m_2	1.85*	1.65	1.79*	1.87*	1.95*
Sargan Test	97.89 (p-val. 0.93)	83.74 (p-val. 0.97)	100.00 (p-val. 0.89)	84.72 (p-val. 0.99)	86.31 (p-val. 0.99)
$H_0 : \delta_2 = \delta_3 = 0$	-	$x^2 = 11.20$***	$x^2 = 6.72$**	$x^2 = 9.01$**	$x^2 = 12.38$***

Notes: Numbers in parentheses denote z-scores, m_1 and m_2 are residual first and second order serial correlation tests, while Sargan stands for the over-identifying restrictions test. One, two, three asterisks denote significance at the 10, 5, and 1 percent level respectively. All models allow for robust standard errors. Time dummies are included in all specifications. **Source of uncertainty:** **(a)** Industrial Production Index (PP-GARCH estimation). **(b)** Stock Market Returns (Time-series GARCH estimation). **(c)** Industrial Sentiment Indicator *(ISI)*. **(d)** Economic Sentiment Indicator *(ESI)*.