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THE IMPACT OF FISCAL RULES ON FISCAL POLICY VOLATILITY

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In this paper, we study the impact of fiscal rules, in the form of explicit deficit or debt constraints, on fiscal policy volatility. The main motivation behind this research is, on the one hand, a negative and robust correlation of fiscal policy volatility and long run growth documented in several papers and, on the other, the relatively small number of works that discuss possible determinants of the former. We argue that fiscal rules have a significant impact on fiscal policy volatility, but depending on the target of the rule –public debt or fiscal balance– rules will increase or decrease policy volatility. This result is novel, and, to the best of our knowledge, has not been discussed in the literature.

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I. Introduction

The relation between fiscal rules and fiscal policy volatility has received up to date very limited attention and in this paper we try to fill this gap. The main motivation behind this research is, on the one hand, a negative and robust correlation of fiscal policy volatility and long run growth documented in several papers (see, for example Fatas and Mihov 2003, 2005, 2007; Furceri 2007; Aizenman and Marion 1993) and, on the other, the relatively small number of works that discuss possible determinants of the former.

We aim to answer the following questions: Do fiscal rules matter for fiscal policy volatility? Do different types of fiscal rules have a different impact on policy volatility? We argue that the answers to both questions are affirmative. Fiscal rules,

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in form of explicit deficit or debt constrains, have a significant impact on fiscal policy volatility, but depending on which fiscal measure is being constrained by the rule –public debt or fiscal balance– rules will increase or decrease policy volatility. This result is novel, and, to the best or our knowledge, has not been discussed in the literature before.

The significance of fiscal policy volatility for countries' growth prospects has been documented by a number of papers. In a series of works, Fatas and Mihov (2003, 2005, 2007) show that volatility of fiscal policy, measured by the standard deviation of the error term extracted from a fiscal policy reaction function, is negatively correlated with the GDP growth rate. Furceri (2007), who uses a measure of fiscal policy volatility derived from the Hodrick-Prescott filter, shows that the results of Fatas and Mihov (2003, 2005, 2007) hold, irrespective of the method used to quantify policy volatility. Afonso and Furceri (2008) provide additional evidence of this negative impact, studying the consequences of fiscal policy on growth in the OECD countries.

According to the above mentioned authors, the negative correlation between policy volatility and growth can be largely explained by the impact of the former on output volatility and, through this effect, on long run growth (on GDP volatility and growth see, for example, Ramey and Ramey 1995 or Hnatkovska and Loayza 2004).

A negative correlation between fiscal policy variability and growth had also been documented by, among others, Aizenman and Marion (1993), Lensink, Bo and Sterken (1999) or Brunetti (1998); however these authors refer to fiscal policy uncertainty rather than volatility and consequently hold that it depresses growth mainly through the uncertainty that it induces. Yet, they measure fiscal policy uncertainty by the standard deviation of the residual of a first-order or second order autoregressive process; therefore it seems that the addressed fiscal policy phenomenon is closely related to the one examined by Fatas and Mihov (2003, 2005, 2007).

Hence, existing works on fiscal policy instability and growth take on a somewhat different perspective, with important differences at the theoretical level, yet at the same time, the phenomena to which they refer – fiscal policy volatility or fiscal policy uncertainty – are closely related and measured in a similar way. Both approaches provide robust evidence that instability of fiscal policy is detrimental for growth.

Recently, several papers have examined the determinants of policy volatility and concluded that it may be affected by political processes and the institutional setup (see, for example, Fatas and Mihov 2003, 2005, 2006, 2007, Woo 2008, Afonso, Agnello and Furceri 2010 and the references therein). In a paper closest to our work, Fatas and Mihov (2006) explore the relationship between fiscal rules and fiscal policy volatility and cyclicality in the U.S. states. They find that fiscal rules, in the form of explicit balanced budget and spending constraints, decrease fiscal policy volatility. In a related work, Fatas and Mihov (2003) show that fiscal policy volatility is affected by a set of institutions, which they call "constraints on the executive" (i.e., the presence of a freely elected and independent parliament, bi-cameral legislature, separation of judiciary power from the executive and a federal system, with central and local governments). Woo (2008) shows that the degree of social polarization, by influencing the behaviour of opportunistic policymakers, is also a factor that affects fiscal policy volatility. Hence, there is a strong evidence that fiscal policy volatility, like other features of fiscal policy, is an outcome of opportunistic behaviour of policymakers, political games and conflict. This implies that formal constraints imposed on fiscal policy, among them fiscal rules, by changing incentives faced by policymakers, may affect the degree of fiscal volatility.

Inspired by this work, in this paper we aim to provide both theoretical and empirical evidence on the impact of balanced budget and debt rules on the degree of fiscal policy volatility. We argue –and we consider this as the main novelty of our approach– that different fiscal rules may have significant, but contradictory, impact on fiscal policy volatility. Contrary to Fatas and Mihov (2006), we argue that balanced budget rules exacerbate fiscal policy volatility; however debt rules limit the degree of volatility. We explain our ideas by the use of a simple model outlined below.

II. Optimal policy rules in a linear-quadratic framework

In this section we present a simple model of the behaviour of fiscal authorities seeking to strike a balance among competing objectives summarised by quadratic preferences. The maximization of the policymaker's objective function is subject to a set of linear constraints which describe an imperfect control of the magnitude of the fiscal deficit and a transmission mechanism through which fiscal policy affects output. Different fiscal rules have a distinct impact on the shape of the loss function. To highlight the specificity of deficit rules and debt rules, we will analyse them in turn. Our framework is general enough to allow a joint analysis of both types of fiscal rules applied simultaneously.

A. Deficit rule

The fiscal policymaker is assumed to have additively separable preferences over output stabilization and obedience to the deficit rule. In other words, the government is penalized for deviations of output from potential and budget deficit from the level imposed by the rule. The loss function takes the following form:

$$L = \frac{\gamma}{2}\left(y - y_n\right)^2 + \frac{\lambda}{2} H(d)\left(d - d^T\right)^2, \tag{1}$$

where y and y_n stand for, respectively, the level of output and the full-employment level of output. The costs of deviation of the deficit, d, from the target level, d^T, are asymmetric because there are no costs stemming from keeping the deficit from exceeding the official boundary. Hence $H(d)$ is the Heaviside step function whose value is equal to 0 if $d–d^T<0$ and 1 otherwise. For the value of actual deficit exactly matching the official target value the second term in Equation (1) is equal to zero and the loss function reduces to the term reflecting the output stabilization objective. Finally, γ and λ are the weights attached to both goals of fiscal policy. The higher is γ relative to λ, the more the policymaker is concerned with achievement of output goal at the likely detriment of deficit objective.

The quadratic form of the loss functions outperforms other formulations. First, it takes account of the stabilizing role of public finance since the value of the first term in Equation (1) is minimized when $y=y_n$. Second, it reflects the likely relationship between the costs of a failure to maintain the deficit below the official threshold and the magnitude of the actual deviation. The second term in Equation (1) is quadratic which means that the marginal cost of deviation from the target is assumed to be linear in the magnitude of deviation. Larger deviations of the deficit from the target are associated with higher costs in terms of public disapproval or the loss of credibility which translates into larger premium on government securities in the financial markets.

The relation between output and government spending is described by an aggregate demand relation. In the short run fiscal authorities can boost output above the full-employment level by running a larger budget deficit:

$$y = y_n + \kappa d + u, \tag{2}$$

where u is an aggregate demand shock, $u \sim \left(0, \sigma_u^2\right)$, that displays no persistence, i.e., is not serially correlated. Parameter κ can be interpreted as the value of the fiscal multiplier.

The government revenue, r, is given by:

$$r = t + \varepsilon, \tag{3}$$

where t is certain or predictable flow of tax revenues and ε, $\varepsilon \sim \left(0, \sigma_{\varepsilon}^{2}\right)$, is a government revenue shock which is not serially correlated. Provided the stochastic nature of the revenues, the budget deficit is beyond the perfect control of the authorities. The government's budget constraint reads as follows:

$$d = g - r, \tag{4}$$

where g is politically desired level of government spending, regarded as a control variable.

Substitution of the aggregate demand relation (2) and budget constraints (3) and (4) into the loss function (1) reduces the problem to an unconstrained optimisation of

$$L = \frac{\gamma}{2}\left(\kappa\left(g - t - \varepsilon\right) + u\right)^{2} + \frac{\lambda}{2} H(d)\left(g - t - \varepsilon - d^{T}\right)^{2}. \tag{5}$$

The first order condition is obtained from the differentiation of Equation (5) with respect to g. Applying the differentiation rule for a product of two functions, we obtain the first order condition

$$\begin{aligned} \frac{\partial L}{\partial g} &= \gamma\kappa\left(\kappa\left(g - t - \varepsilon\right) + u\right) + \lambda H\left(d\right)\left(g - t - \varepsilon - d^{T}\right) \\ &+ \frac{\lambda}{2} H'\left(d\right)\left(g - t - \varepsilon - d^{T}\right)^{2} = 0. \end{aligned} \tag{6}$$

Special attention should be paid to the differentiation of the second term because it involves the derivative of the Heaviside function that takes d, and thereby g, as its argument. Since the calculation of the derivative of the second term in Equation (5) is relevant only when the actual and target values of the deficit do not match, we can conclude that $H'(d)=0$ and then disregard the derivative of the Heaviside function at 0. This leads to the following optimal level of the choice variable, i.e., the level of government spending:

$$g = t + \varepsilon - \frac{\gamma\kappa}{\gamma\kappa^{2} + \lambda H\left(d\right)} u + \frac{\lambda H\left(d\right)}{\gamma\kappa^{2} + \lambda H\left(d\right)} d^{T}. \tag{7}$$

It seems that fiscal policy is more expansionary when the tax revenue, either expected or generated by a favourable income shock, is high, an adverse demand shock occurs, and the official deficit limit is high. Further inspection of Equation

(7) reveals that government spending volatility is fuelled by the shock emanating from aggregate demand or tax revenues. The expression for the variance of g is given by

$$\operatorname{var} g=\sigma_{\varepsilon}^{2}+\left(\frac{\gamma\kappa}{\gamma\kappa^{2}+\lambda H}\right)^{2}\sigma_{u}^{2}-2\frac{\gamma\kappa}{\gamma\kappa^{2}+\lambda H}\operatorname{cov}(\varepsilon,u), \tag{8}$$

where, to ease notation, we dropped the argument of the Heaviside function H. It is straightforward to deduce from Equation (8) a positive relationship between the size of both types of shock and the magnitude of the variability of government spending. It is noteworthy that a larger weight attached to the deficit objective, λ, reduces the government's response to an aggregate demand shock. On the contrary, volatility decreases with the strength of the covariance of both types of shock, which is obvious because the shocks have an offsetting effect on the value of government spending in Equation (7). If both disturbances tend to buffet an economy in concert, an income shock calling for fiscal contraction and an aggregate demand shock necessitating fiscal policy loosening, they will have a stabilizing impact on government spending. It is natural to assume that the covariance is positive because beneficial aggregate demand shock tends to be accompanied by a positive tax income shock.

It is important to acknowledge the ambiguity of the impact of the weight attached to the deficit objective in the loss function on the variance of government spending. The parameter λ reduces the value of the second and third terms in Equation (8) which enter with opposite signs. To shed light on this issue it is useful to resort to the derivative of the variance of government spending with respect to λ:

$$\frac{\partial \operatorname{var} g}{\partial\lambda}=-\frac{2H(\gamma\kappa)^{2}}{\left(\gamma\kappa^{2}+\lambda H\right)^{3}}\sigma_{u}^{2}+\frac{2H\gamma\kappa}{\left(\gamma\kappa^{2}+\lambda H\right)^{2}}\operatorname{cov}(\varepsilon,u). \tag{9}$$

Equation (9) allows to draw the main conclusion from the analysis conducted in this section. For a sufficiently large value of the covariance of tax income and aggregate demand shocks, the greater emphasis put on the achievement of budget deficit objective may paradoxically increase the volatility of public spending. More formally:

$$\frac{\partial \operatorname{var} g}{\partial\lambda}>0 \qquad \text{if} \qquad \operatorname{cov}(\varepsilon,u)>\frac{\gamma\kappa}{\gamma\kappa^{2}+\lambda H}\sigma_{u}^{2}. \tag{10}$$

The interpretation of the result in Equation (10) is not challenging if one recalls the negative influence of λ on the reaction of government spending to an aggregate demand shock found in Equation (7). Larger values of the weight associated with deficit objective in the loss function turns the government neglectful of an aggregate demand shock while preserving the strength of the response to a tax income shock. Hence the simultaneity of both shocks lessens its stabilizing property because the fiscal policy stance would be predominantly driven by the occurrence of a tax income shock. An adverse aggregate demand shock, for instance, coupled with a negative tax income shock should have a virtually nil effect on the level of government spending unless the value of λ is large. In contrast, if the deficit rule ranks high among government's objectives, a negative tax income shock would have a predominant effect on public spending, leading to a tightening of fiscal policy. The above reasoning is based on the condition that the covariance of shocks is high enough to trigger this stabilizing effects and Equation (10) provides the relevant range of values it should take.

Government debt is a legacy of past deficits. At first sight the impact of deficit and debt rules on the variability of government spending should be alike. In the next section we show that under a plausible assumption both rules can be poles apart in their effect on fiscal volatility.

B. Debt rule

The crucial difference between the deficit and debt rules resides in the intertemporal character of the latter. Breaking the deficit rule in one period does not impinge on the prospects of future fiscal policy consistent with the rule. By contrast, government debt exceeding the official threshold in one period will persist in the next period unless corrective measures are implemented. Our simple model has to be extended to include two periods to capture this intertemporal nature of the debt rule. The basic linear-quadratic structure of our theoretical setting remains otherwise unaltered.

For tractability reasons, we assume that the government planning horizon is confined to two periods. The extension of time span would lead to quantitatively different results, leaving however the qualitative predictions of the model unchanged. It may also be argued that a two-period horizon is more realistic than an infinite-time horizon in a world marked by political cycles. Hence, we assume that the government minimizes the following loss function:

$$L = L_1 + \beta L_2 = \frac{\gamma}{2}\left(y_1 - y_n\right)^2 + \beta\frac{\gamma}{2}\mathrm{E}_1\left[\left(y_2 - y_n\right)^2\right] + \frac{\phi}{2}H\left(b_1 - b^T\right)^2 + \beta\frac{\phi}{2}H\mathrm{E}_1\left[\left(b_2 - b^T\right)^2\right], \tag{11}$$

where the numerical subscripts refer to periods, β stands for the government's discount factor, and E is the expectations operator. The first and the second term in Equation (11) represent the output stabilization objective in both periods. The two remaining terms describe the debt rule: b is the actual value of debt, whereas b^T is the official debt limit. The Heaviside function H in Equation (11) has now a property that the value of the wedge (b_t–b^T) crossing zero flips the function from 0 to 1. A close analogy should be drawn between Equation (1) and Equation (11) when interpreting the virtues of quadratic preferences.

We claim that the debt rule has potentially more pronounced consequences for fiscal policy, because today's spending decisions have persistent effects on the debt level. A deficit in one period adds to the existing debt and increases the value of interest payments in the future. Higher interest rates make the government following a debt rule more cautious about the current deficit because of the interest payments burden. Hence the condition for a stabilizing or destabilizing role of the debt rule should disentangle the impact of the interest payments from the genuine influence of the rule establishment. To separate the intertemporal implications of interest payments and debt rules we assume that the interest rate is equal to zero. Under this assumption the government's concern about the future consequences of today's higher spending is solely driven by the official debt ceiling.

Further, we set the inherited value of debt in the period preceding period 1 equal to zero. This is an innocuous simplification because optimal spending decisions in period 1 are not connected to the past spending decisions.

Finally, we impose the long run debt stability condition. Stability should be distinguished from the debt solvency condition. To display the intertemporal solvency the discounted value of the sum of future primary budget surpluses should cover the present public debt and the government should be able to eventually pay off its debts. In the present context it is more natural to assume that defining a public debt target implies that the government is expected to achieve the debt target in the long run. As shown in Appendix A, the debt converges to its target level in the long run if a breach of the debt rule in one period is followed in the next period by a budget surplus equal to α percent of the previous period's gap between the actual and target level of the debt. The long run debt stability condition may be written as:

$$d_t = -\alpha\left(b_{t-1} - b^T\right), \qquad 1 > \alpha > 0. \tag{12}$$

Briefly, under the assumption of zero initial debt and zero interest rate, debt would be equal to deficit in period 1, whereas debt in period 2 would be equal to the sum of deficits in periods 1 and 2. When the debt rule has been violated, i.e., H=1 in period 1, we would have:

$$b_1 = d_1, \quad b_2 = b_1 + d_2 \quad \text{and} \quad d_2 = -\alpha\left(b_1 - b^T\right) \quad \Rightarrow \quad b_2 = \left(1-\alpha\right)d_1 + \alpha b^T. \tag{13}$$

The calculations from Equation (13) can be plugged into the loss function, combined with the aggregate demand relation (2) and government budget constraints (3) and (4), to yield:

$$\begin{aligned} L = &\frac{\gamma}{2}\left(\kappa\left(g_1 - t_1 - \varepsilon_1\right) + u_1\right)^2 + \beta\frac{\gamma}{2}\mathrm{E}_1\left[\left(-\kappa\alpha\left(g_1 - t_1 - \varepsilon_1 - b^T\right) + u_2\right)^2\right] + \\ &+ \frac{\phi}{2}H\left(g_1 - t_1 - \varepsilon_1 - b^T\right)^2 + \beta\frac{\phi}{2}H\left(\left(1-\alpha\right)\left(g_1 - t_1 - \varepsilon_1 - b^T\right)\right)^2, \end{aligned} \tag{14}$$

where the terms with the control variable, namely the level of spending in period 1, have been made explicit. Equation (14) demonstrates that the debt rule ties the hands of the policymaker in both periods even if it has been broken in the first period only.

Keeping in mind that the aggregate demand shock is not serially correlated and the covariance of period 1 tax revenue shock with period 2 aggregate demand shock is equal to zero, we can compute the expected value of the loss function in (14) as follows:

$$\begin{aligned} L = &\frac{\gamma}{2}\left(\kappa\left(g_1 - t_1 - \varepsilon_1\right) + u_1\right)^2 + \beta\frac{\gamma}{2}\left[\left(-\kappa\alpha\left(g_1 - t_1 - \varepsilon_1 - b^T\right)\right)^2 + \sigma_u^2\right] + \\ &+ \frac{\phi}{2}H\left(g_1 - t_1 - \varepsilon_1 - b^T\right)^2 + \beta\frac{\phi}{2}H\left(\left(1-\alpha\right)\left(g_1 - t_1 - \varepsilon_1 - b^T\right)\right)^2. \end{aligned} \tag{15}$$

The first order condition:

$$\begin{aligned} \frac{\partial L}{\partial g_1} = &\gamma\kappa\left(\kappa\left(g_1 - t_1 - \varepsilon_1\right) + u_1\right) + \beta\gamma\kappa^2\alpha^2\left(g_1 - t_1 - \varepsilon_1 - b^T\right) + \phi H\left(g_1 - t_1 - \varepsilon_1 - b^T\right) \\ &+ \frac{\phi}{2}H'\left(g_1 - t_1 - \varepsilon_1 - b^T\right)^2 + \beta\phi H\left(1-\alpha\right)^2\left(g_1 - t_1 - \varepsilon_1 - b^T\right) \\ &+ \beta\frac{\phi}{2}H'\left(\left(1-\alpha\right)\left(g_1 - t_1 - \varepsilon_1 - b^T\right)\right)^2 = 0, \end{aligned} \tag{16}$$

enables to calculate the optimal level of government expenditures in period 1:

$$g_1 = t_1 + \varepsilon_1 - \frac{\gamma\kappa}{\gamma\kappa^2 + \beta\gamma\kappa^2\alpha^2 + \phi H + \beta\phi H\left(1-\alpha\right)^2} u_1 + \frac{\beta\gamma\kappa^2\alpha^2 + \phi H + \beta\phi H\left(1-\alpha\right)^2}{\gamma\kappa^2 + \beta\gamma\kappa^2\alpha^2 + \phi H + \beta\phi H\left(1-\alpha\right)^2} b^T, \tag{17}$$

which was obtained after substitution of $H'=0$ in Equation (16). According to Equation (17) government spending under the debt rule is higher when tax revenues and the official debt limit are higher. Fiscal authorities respond to tax income and aggregate demand shocks, the reaction to the latter being dampened when the weight attached to the debt rule, ϕ, is large.

We are now in a position to calculate the variance of government spending under the assumption that the debt rule prescribes the reduction of debt in the period following the contravention of the rule.

$$\operatorname{var} g_1 = \sigma_\varepsilon^2 + \left(\frac{\gamma\kappa}{\gamma\kappa^2 + \beta\gamma\kappa^2\alpha^2 + \phi H + \beta\phi H\left(1-\alpha\right)^2}\right)^2 \sigma_u^2 - 2\frac{\gamma\kappa}{\gamma\kappa^2 + \beta\gamma\kappa^2\alpha^2 + \phi H + \beta\phi H\left(1-\alpha\right)^2} \operatorname{cov}\left(\varepsilon, u\right). \tag{18}$$

It is evident from Equation (18) that the weight attached to debt objective, ϕ, has equivocal consequences for the volatility of government spending. The value of covariance between tax income and aggregate demand shocks is again crucial in assessing the impact of the debt rule on fiscal volatility. The precise condition is given by:

$$\frac{\partial \operatorname{var} g_1}{\partial \phi} = -2\frac{\left(H + H\beta\left(1-\alpha\right)^2\right)\gamma^2\kappa^2}{\left(\gamma\kappa^2 + \beta\gamma\kappa^2\alpha^2 + \phi H + \beta\phi H\left(1-\alpha\right)^2\right)^3}\sigma_u^2 + 2\frac{\left(H + H\beta\left(1-\alpha\right)^2\right)\gamma\kappa}{\left(\gamma\kappa^2 + \beta\gamma\kappa^2\alpha^2 + \phi H + \beta\phi H\left(1-\alpha\right)^2\right)^2}\operatorname{cov}\left(\varepsilon, u\right), \tag{19}$$

$$\frac{\partial \operatorname{var} g_1}{\partial \phi} < 0 \quad \text{if} \quad \operatorname{cov}\left(\varepsilon, u\right) < \frac{\gamma\kappa}{\gamma\kappa^2 + \beta\gamma\kappa^2\alpha^2 + \phi H + \beta\phi H\left(1-\alpha\right)^2}\sigma_u^2.$$

It can be inferred from Equation (19) that the debt rule weakens public spending volatility if the covariance between tax income and aggregate demand shocks is weak. The reasoning behind this result is similar to one conducted in the preceding section. Greater weight attached to the debt rule attenuates the government's response to an aggregate demand shock thus contracting the overall volatility of fiscal policy. The fact that larger values of ϕ reduce at the same time the stabilizing impact of the synchronization of tax income and aggregate demand shocks is of lesser importance because the covariance between the shocks is small.

Equipped with the conditions for the destabilizing effects of deficit rule in Equation (10) and stabilizing effects of debt rule in Equation (19) we can obtain the range of values of the covariance for which both rules have opposite implications for the volatility of government spending. More precisely, government spending is more volatile under the deficit rule and, simultaneously, is more stable under the debt rule if the following necessary and sufficient conditions are met:

$$\frac{\gamma\kappa}{\gamma\kappa^2+\lambda H}<\frac{\gamma\kappa}{\gamma\kappa^2+\beta\gamma\kappa^2\alpha^2+\phi H+\beta\phi H\left(1-\alpha\right)^2} \quad \text{and}$$

$$\frac{\gamma\kappa}{\gamma\kappa^2+\lambda H}\sigma_u^2<\operatorname{cov}\left(\varepsilon,u\right)<\frac{\gamma\kappa}{\gamma\kappa^2+\beta\gamma\kappa^2\alpha^2+\phi H+\beta\phi H\left(1-\alpha\right)^2}\sigma_u^2. \tag{20}$$

Condition (20) is more likely to hold, i.e., the covariance of shocks falls into the prescribed range, if the weight attached to the deficit rule is large or the weight attached to the debt rule is small. Fiscal authorities who are more committed to the deficit rule than to the debt rule tend to maintain a stable government spending profile under the debt rule while under the deficit rule their expenditures would vary considerably. This seems to be likely when the actual value of public debt is lower than the threshold value imposed by the rule. In such conditions, the probability (threat) of breaking the deficit rule is usually higher than breaking the debt rule, as the threshold values of fiscal deficit are usually quite small, hence easier to surpass, than the threshold value of debt (when actual debt is several percentage points away from the threshold).

The conclusions drawn from inequality (20) hinge on the assumptions relating to the value of covariance of shocks and different weights attached to deficit and debt targets. A suspicion, therefore, arises that the obtained result does not survive a confrontation with plausible values of the above-mentioned parameters. The truth is that condition (20) encompasses two special cases which naturally come to mind.

A very tight relation between aggregate demand and revenue shock is the first special case to consider. Although not a rule, a demand shock tends to be associated with a change in tax revenues because of its correlation with the volume of transactions and incomes of the factors of production. Hence, it is interesting to elaborate on a linear relationship between u and ε, such as $\varepsilon=\psi u$. In this situation the value of covariance is given by $\mathrm{cov}(\varepsilon,u)=\psi\sigma_u^2$ and condition (19) boils down to:

$$\frac{\gamma\kappa}{\gamma\kappa^2+\lambda H}<\frac{\gamma\kappa}{\gamma\kappa^2+\beta\gamma\kappa^2\alpha^2+\phi H+\beta\phi H(1-\alpha)^2} \quad \text{and}$$

$$\frac{\gamma\kappa}{\gamma\kappa^2+\lambda H}<\psi<\frac{\gamma\kappa}{\gamma\kappa^2+\beta\gamma\kappa^2\alpha^2+\phi H+\beta\phi H(1-\alpha)^2}. \tag{21}$$

The general conclusion drawn in this section is preserved in (21). The deficit rule can magnify the volatility of government spending whereas the reverse holds true for the debt rule if the proportionality factor between aggregate demand and tax revenues shocks, ψ, is contained within a well defined range. The endpoints of the interval depend on the values of weights attached to deficit and debt objectives. The critical importance of the relative value of weights leads to the second special case.

The assumption of equality between the weights attached to debt and deficit rules provides new insights into the volatility of government spending and it deserves special attention. In the case where $\lambda=\phi$ the necessary condition in (20) never holds and the deficit rule flattens the pattern of government spending always more than the debt rule:

$$\beta\gamma\kappa^2\alpha^2+\beta\phi H(1-\alpha)^2>0 \quad \text{and}$$

$$\frac{\gamma\kappa}{\gamma\kappa^2+\phi H}\sigma_u^2>\mathrm{cov}(\varepsilon,u)>\frac{\gamma\kappa}{\gamma\kappa^2+\beta\gamma\kappa^2\alpha^2+\phi H+\beta\phi H(1-\alpha)^2}\sigma_u^2. \tag{22}$$

The covariance of aggregate demand and tax revenues shocks needs to fall within a specified interval to trigger, respectively, a stabilising and destabilising property of the deficit and debt rules. The equality of weights assigned to debt and deficit rule reveals that the latter is stronger: if the government would conduct a more stable fiscal policy under the deficit rule, it would certainly do so also under the debt rule. If the weights attached to both types of fiscal rules are equal, the debt rule requires in fact correcting deficits in one period by running a surplus in the next, thereby leading to government spending volatility. Under the deficit rule, excessive spending in one period does not need to be reversed in the next. Thus the equality of weights implies that the deficit rule is more stabilizing than the debt rule.

In the next section we show that condition (20) seems to be supported by the data. It should be, however, noticed that our simple model can yield different results for various values of the parameters. All cases are succinctly presented in Table 1.

Table 1. The impact of fiscal rules on government spending volatility from a theoretical perspective

Value of the covariance of tax income and aggregate demand shocks	Impact on the volatility of government spending	
	Deficit rule	Debt rule
Case 1. Critical condition holds: $\frac{\gamma\kappa}{\gamma\kappa^2+\lambda H}<\frac{\gamma\kappa}{\gamma\kappa^2+\beta\gamma\kappa^2\alpha^2+\phi H+\beta\phi H(1-\alpha)^2}$		
$\frac{\gamma\kappa}{\gamma\kappa^2+\lambda H}\sigma_u^2<\operatorname{cov}(\varepsilon,u)<\frac{\gamma\kappa}{\gamma\kappa^2+\beta\gamma\kappa^2\alpha^2+\phi H+\beta\phi H(1-\alpha)^2}\sigma_u^2$	+	–
$\operatorname{cov}(\varepsilon,u)>\frac{\gamma\kappa}{\gamma\kappa^2-\beta\gamma\kappa^2\alpha^2+\phi H+\beta\phi H(1-\alpha)^2}\sigma_u^2$	+	+
$\operatorname{cov}(\varepsilon,u)<\frac{\gamma\kappa}{\gamma\kappa^2+\lambda H}\sigma_u^2$	–	–
Case 2. Critical condition does not hold: $\frac{\gamma\kappa}{\gamma\kappa^2-\beta\gamma\kappa^2\alpha^2+\phi H+\beta\phi H(1-\alpha)^2}<\frac{\gamma\kappa}{\gamma\kappa^2+\lambda H}$		
$\frac{\gamma\kappa}{\gamma\kappa^2-\beta\gamma\kappa^2\alpha^2+\phi H+\beta\phi H(1-\alpha)^2}\sigma_u^2<\operatorname{cov}(\varepsilon,u)<\frac{\gamma\kappa}{\gamma\kappa^2+\lambda H}\sigma_u^2$	–	+
$\operatorname{cov}(\varepsilon,u)>\frac{\gamma\kappa}{\gamma\kappa^2+\lambda H}\sigma_u^2$	+	+
$\operatorname{cov}(\varepsilon,u)<\frac{\gamma\kappa}{\gamma\kappa^2-\beta\gamma\kappa^2\alpha^2+\phi H+\beta\phi H(1-\alpha)^2}\sigma_u^2$	–	–

III. Fiscal rules and fiscal policy volatility

In this section we present empirical evidence, which suggests that fiscal rules constraining either public debt or the fiscal deficit have significant, but opposing influence on the volatility of government spending.

A. Measures of fiscal policy volatility

In the literature, fiscal policy volatility is measured using several different methods. Fatas and Mihov (2003, 2005, 2007) and Aizenman and Marion (1993) use the standard deviation of the error term extracted from regressions that model the relevant fiscal variable. Precisely, Fatas and Mihov (2003, 2006, 2007) estimate a fiscal reaction function, where the change in the logarithm of public consumption spending is explained by several variables, including change in the logarithm of: real GDP, public debt and CPI. Aizenman and Marion (1993) estimate a first order autoregressive function of selected fiscal variables, including also government consumption spending.

Furceri (2007) and Afonso and Furceri (2008) employ, among other measures, the standard deviation of the unsystematic component of public consumption expenditure, which is extracted from the series, using the Hodrick-Prescott or Baxter-King filters.

In this paper, we measure fiscal policy volatility, using two methods borrowed from the recent literature. Firstly, following Furceri (2007) and Afonso and Furceri (2008), we use the standard deviation of the unsystematic component of public consumption expenditures, which is extracted from the series by means of Hodrick-Prescott filter (HP filter). Secondly, following the approach of Fatas and Mihov (2003, 2006, 2007), we employ the standard deviation of the error term from a fiscal policy reaction function. We use data on general government consumption expenditures, for a wide selection of developed and developing countries. Of course, the use of this data is not faultless. Firstly, this variable neglects many aspect of fiscal policy – most obviously the revenue side. Secondly, public consumption is influenced by business cycle fluctuations, which may cause methodological problems. The advantage of this series is that it is available and comparable across a wide selection of countries.

More precisely, to construct our first measure of fiscal policy volatility, we extract the trend of real public consumption expenditure by means of HP filter, on a country-by-country basis. Then, by subtracting the calculated trend from the raw data, we calculate the unsystematic part of public consumption expenditure. The standard deviation of this unsystematic component, over the relevant period of time, constitutes our first measure of fiscal policy volatility, denoted σ_{HP}.

To construct the second measure, we estimate a fiscal policy reaction function. Although fiscal policy reaction functions have been estimated in quite a large number of papers, there is no consensus on what is "the proper" fiscal policy reaction function. The actual functions estimated by researchers differ with respect to both left-hand side and right hand side variables. Golinelli and Momigliano (2008) provide a thorough discussion of this issue. In choosing the form of the reaction function, we follow Fatas and Mihov (2003, 2006, 2007) and estimate the following equation for each country in the sample:

$$\Delta\left(\ln\left(g_{i,t}\right)\right)=\alpha_i+\beta_i\Delta\left(\ln\left(y_{i,t}\right)\right)+\gamma_i\Delta\left(\ln\left(g_{i,t-1}\right)\right)+\delta_i W_i+e_{i,t}, \tag{23}$$

where $g_{i,t}$, is general government consumption expenditure, in real terms, for country i, y is real GDP for country i and Δ denotes first difference over time and W is a set of control variables. The β coefficient measures the cyclical response of fiscal policy to economic conditions, and the error term e_i measures the unsystematic component of fiscal policy. Control variables include inflation, inflation squared and a time trend. The standard deviation of the error term constitutes the second measure of fiscal policy volatility, denoted σ_{FM}. Since output may be an endogenous variable, when estimating (23), we use two stages least squares method and instrument output with its lags, with lagged inflation and the lagged value of government spending growth.

To check the robustness of our results, we also adopt the function used by Lane (2003):

$$\Delta\left(\ln\left(g_{i,t}\right)\right)=\alpha_i+\beta_i\Delta\left(\ln\left(y_{i,t}\right)\right)+e_{i,t}. \tag{24}$$

When estimating equation (24), we use two stages least squares and instrument output with its lags. The standard deviation of the error term constitutes another measure of fiscal policy volatility, denoted σ_L.

All measures of fiscal policy volatility: σ_{HP}, σ_{FM} and σ_L are calculated for a wide selection of developed and developing countries. The data on general government consumption expenditure, GDP per capita (both in constant prices) and inflation (GDP deflator) have been compiled for the period 1980-2006 from the World Bank, World Development Indicators (WDI) database. We have excluded from the sample theses countries for which the data is available for less than 15 years.

B. Regression analysis

To empirically verify the hypothesis that fiscal policy volatility is influenced by fiscal rules, we run a series of regressions, where the measures of fiscal policy volatility described above - σ_{HP}, σ_L and σ_{FM} - serve as the dependent variables.

We use two proxies for the institutional framework of fiscal policy-making: a dummy denoting the presence of fiscal rules constraining public debt and another dummy denoting the presence of fiscal rules constraining the budget deficit. The data on fiscal rules has been taken from the OECD International Database of Budget Practices and Procedures (www.oecd.org/gov/budget/database). This database contains the results of the 2007/2008 OECD and World Bank survey of budget practices and procedures. It covers 97 countries, including the 30 OECD members and 67 non-members from the Middle East, Africa, Eastern Europe, Asia, Latin America and the Caribbean. The dummy variables were constructed on the basis of countries' answers to question 14 of the Database.[1]

Since the data on fiscal rules doesn't include time variation, regressions were estimated using cross-country data. The estimated equations were of the form:

$$(policy\_volatility)_i = \alpha_i + \beta_{1i}(debt\_rule_i) + \beta_{2i}(budget\_rule_i) + \sum_{n=3}^{k} \beta_{in} \ln(X_{ni}) + \gamma_i . \tag{25}$$

policy_volatility is measured either by σ_{FM}, σ_L or σ_{HP}; i.e., by the standard deviation of the error term from regression equation (23) or (24) or by the standard deviation of the unsystematic component extracted using the HP filter.

The dummy variable *debt_rule* equals one, if in a given country a constraint on public debt exists.[2] The dummy *budget_rule* is equal to one if a budget balance rule exists.[3] Naturally, these proxies are very simple, as they do not reflect the other important differences that exist between fiscal rules, like their statutory basis, the sanctions for breaking the rules, etc. Although the International Database of Budget Practices and Procedures contains questions on the details of fiscal rules, yet the

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[1] Question 14 of the Database reads as follows: "In developing the budget, are there any fiscal rules that place limits on fiscal policy?" The possible answers were: no; yes, expenditure rule; yes, revenue rule; yes, budget balance (surplus/deficit) rule; yes, debt rule; other.

[2] The debt rule may target a specific amount of debt in nominal terms; a specific debt-to-GDP ratio; a given reduction in the debt-to-GDP ratio; it may establish a ceiling for the Government (or a specific sub sector) debt in level or as a % of GDP or other.

[3] The deficit rule may target a specific budget balance in nominal terms; a specific budget balance as a percentage of GDP; a specific budget balance as a percentage of GDP in cyclically-adjusted or structural terms; a specific budget balance as a percentage of GDP within a range of possible values depending on growth development; a given improvement of the budget balance (as a % of GDP); a given improvement of the structural or cyclically-adjusted budget balance (as a % of GDP) or other.

percentage of missing answers to these questions is over 50%, hence an attempt to use more sophisticated measures of fiscal rules implies a significant reduction in sample size. Therefore we chose to use only the simple measures.

The vector *X* is a set of control variables. It includes: logarithm of GDP per capita in constant 2000 US$ (GDP); logarithm of GDP volatility, calculated as a standard deviation of annual GDP per capita growth (*vol*). They are averages of series between years 1995-2006. GDP per capita controls for the level of countries development, which has been shown to affect the volatility of fiscal policy. The possible impact of GDP volatility is explained by the model in the previous section, yet besides being the cause of policy volatility, it might also be its effect (Fatas and Mihov 2003, 2005, 2007). Following the approach of Furceri and Poplawski Ribeiro (2009) and Afonso, Agnello and Furceri (2010), additional control variables have also been introduced. Among them are: the logarithm of average size of population between 1995-2006 (*pop*); an index of overall governance quality (*govern*), calculated for each country as the average value of the governance indicators from the Worldwide Governance Indicators (i.e., the average value of the indexes: Voice and Accountability, Political Stability and Absence of Violence/Terrorism, Government Effectiveness, Regulatory Quality, Rule of Law and Control of Corruption), over the years 1996-2006; a dummy variable that takes a value of zero for Presidential regime, the value one for the Assembly-elected Presidential regime and two for Parliamentary regime (*polit*) and the proportion of countries' land lying in geographical tropics (*tropics*). The full list of data and its description can be found in Appendix B.

Equation (25) is estimated using cross-section data only. The lack of time dimension is a major drawback of our approach, as it prohibits the use of panel data estimation methods, but the data on fiscal rules in time series format are up to date unavailable. However, the lack of time dimension is a feature shared by most works on fiscal policy volatility.

The lack of time dimension related to our measures of fiscal rules has also hindered the construction of our dependent variable. In order to calculate σ_{FM}, σ_L, or σ_{HP}, we naturally needed data in a time series format. As we mentioned above, in application of the HP filter and in estimation of Equation (23), we used time-series data from the years 1980-2006. Again, the time period chosen was arbitrary, but long enough to have statistically meaningful estimates. Since the information regarding fiscal rules has been compiled in years 2007/2008, we made an attempt to keep the measure of fiscal volatility close to recent periods. Note, however, that in majority of countries fiscal rules have been introduced in the second half of 1990's or in the beginning of 2000's (see for example Kopits, 2001; IMF, 2009), hence the database captures rules which in most cases have been effective over the course of at least 8 years. To that end, the values σ_{FM} , σ_L, and σ_{HP} have been calculated using the observations on errors e_{it} from Equation (23) or (24) or the unsystematic component of public spending (extracted with the help of the HP filter, by subtracting the calculated trend from the raw data) only from the years 1995-2006 (hence, when we calculated the standard deviations, we have omitted the observations from the years 1980-1994).

Regressions were estimated using ordinary least squares (OLS) and least absolute deviation (LAD) methods. As Afonso, Agnello and Furceri (2010) note, the regression residuals can be thought of as having two components: the sampling error (the difference between the true value of the dependent variable and its estimated value) and the stochastic shock that would have been obtained even if the dependent variable was observed directly. This might lead to an increase in the standard deviation of the estimates. Related to this problem would be the possibility of heteroskedasticity, which we correct by using robust standard errors.

Since GDP volatility may be an endogenous variable, a number of regressions were also estimated using instrumental variables (IV). To instrument for GDP volatility we used the share of exports and imports to GDP, and GDP volatility, both from years 1985-1994. The first measure is intended to capture the openness of a country, which has been showed to affect GDP volatility (see, for example Easterly and Kraay 2000). To check that the results were not driven by outliers, we additionally run the regressions using least absolute deviations (LAD). Table 2 presents the results of the baseline regressions and Table 3 delivers the results from regressions with additional control variables.

Columns 1 to 3 of Table 2 show the results for σ_{FM} as the dependent variable, columns 4 to 6 show the results for σ_L as the regressand and columns 7 to 9 display the results for σ_{HP}. Columns 1, 2, 4 and 7 present results derived using OLS, columns 5 and 8 contain results obtained with instrumental variables estimates, columns 3, 6 and 9 – these using LAD. Estimation results show that the impact of the deficit rule is everywhere significant and positive. This indicates that deficit rules increase the volatility of public consumption expenditure. The sign of the coefficient of the debt rule is negative and significant (the only exceptions are regressions 1 and 2, where the debt rule is significant at 11%). This suggests that the presence of debt rules attenuates fiscal policy volatility. If both rules exist simultaneously, their impact is roughly offset.

The signs of control variables coefficients are as expected – a negative value of the coefficient of GDP per capita and a positive value of the coefficient of GDP volatility.

Table 2. Fiscal rules and volatility of public consumption expenditures for years 1995-2006

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	σ_{FM}	σ_{FM}	σ_{FM}	σ_{L}	σ_{L}	σ_{L}	σ_{HP}	σ_{HP}	σ_{HP}
gdp	-0.034^{***}	-0.034^{***}	-0.018^{***}	-0.033^{***}	-0.023^{***}	-0.017^{***}	-0.011^{***}	-0.0085^{***}	-0.009^{***}
	(0.010)	(0.009)	(0.001)	(0.001)	(0.008)	(0.002)	(0.002)	(0.002)	(0.001)
vol	0.002			0.030^{**}	0.081	0.016^{***}	0.015^{**}	0.031^{**}	0.006^{***}
	(0.020)			(0.014)	(0.053)	(0.006)	(0.006)	(0.012)	(0.002)
budget_rule	0.081^{*}	0.080^{*}	0.039^{***}	0.087^{**}	0.092^{**}	0.034^{***}	0.020^{***}	0.022^{***}	0.017^{***}
	(0.042)	(0.041)	(0.006)	(0.040)	(0.042)	(0.009)	(0.007)	(0.008)	(0.003)
debt_rule	-0.078	-0.078	-0.039^{***}	-0.104^{**}	-0.102^{**}	-0.037^{***}	-0.015^{**}	-0.015^{**}	-0.015^{***}
	(0.048)	(0.048)	(0.006)	(0.044)	(0.042)	(0.008)	(0.007)	(0.007)	(0.003)
Constant	0.331^{***}	0.336^{***}	0.189^{***}	0.310^{***}	0.189^{**}	0.180^{***}	0.106^{***}	0.0706^{**}	0.0911^{***}
	(0.097)	(0.079)	(0.012)	(0.083)	(0.089)	(0.023)	(0.019)	(0.030)	(0.008)
Estimation method	OLS	OLS	LAD	OLS	IV	LAD	OLS	IV	LAD
Observations	69	69	69	69	69	69	72	72	72
R-squared	0.291	0.290	.	0.419	0.365	.	0.566	0.512	.

Note: Standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 3. Fiscal rules and volatility of public consumption expenditures for years 1995-2006

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	σ_{FM}	σ_{FM}	σ_L	σ_L	σ_L	σ_{HP}	σ_{HP}	σ_{HP}
gdp	0.009	0.027	-0.058*	-0.059*	-0.059***	-0.011*	-0.0107**	-0.010*
	(0.018)	(0.025)	(0.032)	(0.033)	(0.021)	(0.0056)	(0.005)	(0.005)
vol			0.032		0.096**	0.019***	0.030**	0.032***
			(0.021)		(0.042)	(0.006)	(0.014)	(0.010)
budget_rule	0.094**	0.072**	0.071**	0.070**	0.058*	0.023***	0.024***	0.025***
	(0.045)	(0.035)	(0.033)	(0.033)	(0.034)	(0.0071)	(0.007)	(0.008)
debt_rule	-0.086**	-0.081*	-0.080**	-0.084**	-0.065**	-0.012*	-0.012	-0.009
	(0.052)	(0.047)	(0.035)	(0.035)	(0.029)	(0.0072)	(0.008)	(0.007)
pop	-0.024*	-0.027*	0.015	0.015	0.010	-0.0040	-0.004	-0.007**
	(0.013)	(0.014)	(0.018)	(0.018)	(0.013)	(0.0027)	(0.003)	(0.003)
govern	-0.101**	-0.093**	0.026	0.007	0.056	-0.0039	0.003	0.001
	(0.038)	(0.037)	(0.034)	(0.030)	(0.042)	(0.011)	(0.013)	(0.010)
tropics	0.0022		0.026	0.008		-0.001	0.007	
	(0.026)		(0.031)	(0.022)		(0.013)	(0.013)	
polit	0.015	0.017	0.048	0.049	0.054***	0.006	0.007*	0.010**
	(0.018)	(0.019)	(0.034)	(0.034)	(0.017)	(0.0042)	(0.004)	(0.004)
trop_pop		0.103			0.056			0.006
		(0.094)			(0.063)			(0.015)
gov_cons		-0.056			0.023			-0.007
		(0.054)			(0.047)			(0.011)

Table 3 (continued). Fiscal rules and volatility of public consumption expenditures for years 1995-2006

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	σ_{FM}	σ_{FM}	σ_{L}	σ_{L}	σ_{L}	σ_{HP}	σ_{HP}	σ_{HP}
open		-0.014			-0.054			-0.012
		(0.025)			(0.036)			(0.009)
transit		0.003			-0.051			0.004
		(0.023)			(0.043)			(0.010)
Constant	0.414**	0.510	0.178	0.242	0.369	0.154***	0.133**	0.243***
	(0.187)	(0.308)	(0.178)	(0.157)	(0.348)	(0.0525)	(0.056)	(0.089)
Estimation method	OLS	OLS	OLS	OLS	IV	OLS	IV	IV
Observations	66	64	66	66	64	69	68	66
R-squared	0.380	0.414	0.494	0.480	0.508	0.625	0.614	0.642

Note: Standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 3 shows that our results are robust, even after additional control variables are included. Columns 1 and 2 show the results for σ_{FM}, columns 3 to 5 for σ_L, and columns 6 to 8 for σ_{HP}. Columns 1, 2, 3, 4 and 6 present results calculated using OLS, columns 5, 7 and 8 contain results obtained with instrumental variables estimates. Again, estimation results show that the impact of the deficit rule is everywhere significant and positive. The sign of the coefficient of the debt rule is everywhere negative and in most specifications significant. To further check the robustness of our results, we have made an attempt to exclude from the database the countries which have introduced fiscal rules relatively recently, that is, after the year 2000 (this has been done using the information from IMF, 2009). The results have not significantly changed and are reported in Appendix C, Table A3. Therefore our results seem robust.

IV. Conclusions

Volatility of government spending is an undesirable feature of fiscal policy. A smooth time profile of government spending enhances economic growth and justifies the quest for institutional solutions conducive to a steady fiscal policy stance. Deficit and debt rules are among the most widespread legislative measures implemented to that end. In this paper we assess, both theoretically and empirically, likely similarities and differences between the abovementioned fiscal rules.

From a theoretical perspective the sign of the relation between fiscal rules and volatility of government spending can go either way. We demonstrate that the weights attached to deficit and budget rules in the government's objective function and the strength of the covariance of shocks hitting aggregate demand and fiscal revenues are critical in this context. In particular, the deficit and debt rules can have contradictory impacts, positive and negative respectively, on the volatility of government spending if the weight attached to the deficit rule or the discount factor are large and the weight attached to the debt rule is small.

Our empirical results seem to corroborate our theoretical findings. Using a wide selection of countries, we show that fiscal rules constraining the value of fiscal deficit tend to destabilise fiscal policy, while rules constraining the value of public debt have an opposite result – they tend to have a stabilising effect. This result is novel and bears important policy consequences.

Appendix

A. Proof of long run debt stability condition (12)

Let's suppose that fiscal authorities follow the rule described by equation (12) which is rewritten here for convenience:

$$d_t = -\alpha\left(b_{t-1} - b^T\right), \qquad 1 > \alpha > 0. \tag{A1}$$

The dynamics of the debt level can be then written as:

$$b_t = b_{t-1} - \alpha\left(b_{t-1} - b^T\right). \tag{A2}$$

Equation (A2) is a first order difference equation which can be represented with the use of the lag operator L as:

$$b_t\left(1 - \left(1 - \alpha\right)L\right) = \alpha b^T. \tag{A3}$$

Equation (A3) has the following general solution:

$$b_t = b^T + C\left(1 - \alpha\right)^t, \tag{A4}$$

where C is a constant. Under the assumption that $1 > \alpha > 0$, the second term in (A4) converges to zero and debt converges to the target level in the long run.

B. Description of the data and its sources

Data series used in the country-specific regressions are: general government consumption expenditure, in real terms, real GDP and inflation (proxied by GDP deflator). Source: World Bank (2008), *World Development Indicators*. Table A1 details the data series used in the cross-section regressions, while Table A2 reports the descriptive statistics.

Table A1. Data series used in the cross-section regressions

Name	Concept	Source
debt_rule	Dummy variable equal to one, if in a given country a constraint on public debt exists.	OECD International Database of Budget Practices and Procedures (www.oecd.org/gov/budget/database).
budget_rule	Dummy variable equal to one if a budget balance rule exists.	OECD International Database of Budget Practices and Procedures (www.oecd.org/gov/budget/database).
gdp	Logarithm of GDP per capita in constant 2000 US$, averaged over 1995-2006.	World Bank (2008), World Development Indicators
vol	Logarithm of GDP volatility, calculated as a standard deviation of annual GDP per capita growth, over 1995-2006.	Own calculations using data from World Bank (2008), World Development Indicators.
pop	The logarithm of average size of population between 1995-2006.	World Bank (2008), World Development Indicators.
govern	Average value of all governance indicators, i.e.: the average values of: Voice and Accountability, Political Stability and Absence of Violence/Terrorism, Government Effectiveness, Regulatory Quality, Rule of Law and Control of Corruption, over years 1996-2008.	Own calculations based on data from Kaufmann, Kraay and Mastruzzi (2008), The Worldwide Governance Indicators.
polit	A dummy variable that takes a value of zero for Presidential regime, the value one for the Assembly-elected Presidential regime and two for Parliamentary regime.	Database of Political Institutions (2009).
tropics	Proportion of countries' land lying in geographical tropics.	Gallup, Sachs and Mellinger (1999) Geography Database.
trop_pop	Percent of population in geographical tropics.	Gallup, Sachs and Mellinger (1999) Geography Database.
safri	A dummy for Sub-Saharan countries.	Gallup, Sachs and Mellinger (1999) Geography Database.
transit	A dummy for transition economies.	Gallup, Sachs and Mellinger (1999) Geography Database.
gov_cons	General government consumption expenditure, as % of GDP, averaged over 1995-2006.	World Bank (2008), World Development Indicators.
trade	Exports and imports, as % of GDP, averaged over 1995-2006.	World Bank (2008), World Development Indicators.

Table A2. Descriptive statistics of the main data

Variable	No. of observations	Mean	Std. deviation	Min	Max
σ_{FM}	69	0.076	0.136	0.006	0.896
σ_{L}	69	0.077	0.1335	0.007	0.920
σ_{HP}	72	0.035	0.039	0.004	0.181
budget_rule	89	0.730	0.446	0	1
debt_rule	89	0.551	0.500	0	1
gdp	88	8693.926	11279.06	123.608	45183.79
vol	89	3.587	4.405	0.537	32.782
pop (in thousands)	89	27660.68	47390.66	281.263	281819.1
tropics	80	0.380	0.467	0	1

Out of the 89 countries included in the database, 65 had budget and/or debt rules, among them: Albania, United Arab Emirates, Argentina, Austria, Belgium, Benin, Burkina Faso, Bulgaria, Bosnia and Herzegovina, Bolivia, Brazil, Botswana, Canada, Chile, Cyprus, Germany, Denmark, Spain, Ethiopia Finland, Fiji, France, United Kingdom, Ghana, Guinea, Greece, Haiti, Indonesia, Ireland, Israel, Italy, Jordan, Japan, Kenya, Cambodia, Liberia, Lithuania, Luxembourg, Latvia, Morocco, Mauritius, Moldova, Madagascar, Mexico, Mali, Malta, Mozambique, Malawi, Namibia, Nigeria, Netherlands, Norway, Peru, Philippines, Poland, Portugal, Russian Federation, Rwanda, Solomon Islands, Suriname, Slovak Republic, Slovenia, Sweden, Thailand, Tajikistan, Zambia, Zimbabwe.

C. Additional regression results

Table A3. Fiscal rules and volatility of public consumption expenditures for years 1995-2006 (countries which adopted fiscal rules after 2000 excluded)

	(1)	(2)	(3)	(4)	(5)	(6)
	σ_{FM}	σ_L	σ_{HP}	σ_{FM}	σ_L	σ_{HP}
gdp	-0.0380***	-0.0345***	-0.0114***	0.0440*	-0.0324	-0.00441
	(0.0102)	(0.0106)	(0.00182)	(0.0239)	(0.0306)	(0.00781)
vol		0.0357*	0.0164**		0.0555*	0.0239***
		(0.0181)	(0.00740)		(0.0287)	(0.00702)
budget_rule	0.0997*	0.107**	0.0219**	0.0939**	0.0985*	0.0257***
	(0.0510)	(0.0519)	(0.00882)	(0.0454)	(0.0500)	(0.00821)
debt_rule	-0.0975*	-0.122**	-0.0161*	-0.0892*	-0.110**	-0.0133*
	(0.0574)	(0.0551)	(0.00809)	(0.0515)	(0.0520)	(0.00712)
pop				-0.0238**	0.0130	-0.00545
				(0.0115)	(0.0177)	(0.00349)
gover				-0.131***	0.0240	-0.00499
				(0.0399)	(0.0488)	(0.0124)
safri				0.0993*	0.0590	0.0145
				(0.0561)	(0.0399)	(0.0161)
Constant	0.366***	0.318***	0.105***	0.137	0.0410	0.127
	(0.0895)	(0.0891)	(0.0216)	(0.194)	(0.188)	(0.0798)
Estimation method	OLS	OLS	OLS	OLS	OLS	OLS
Observations	57	57	61	55	55	59
R-squared	0.312	0.428	0.547	0.430	0.451	0.612

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

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