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The impact of fiscal rules on fiscal policy volatility*.

Abstract

In this paper, we study the impact of fiscal rules, in 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 – 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 or our knowledge, has not been discussed in the literature.

KEYWORDS: fiscal rules, fiscal policy volatility

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1. 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 - relatively small number of works that discuss possible determinants of the former.

This paper aims 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

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argue that the answers to both questions are affirmative. Fiscal rules, 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 below.

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 standard deviation of the error term extracted from a fiscal policy reaction function, is negatively correlated with 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 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 institutional setup (see, for example, Fatas and Mihov, 2003, 2005, 2006, 2007 or Woo, 2008, and the references therein). In a paper closest related 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 set of institutions, which they call "constraints on the executive" (precisely - 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.

2. 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 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 and to highlight the specificity of deficit rules and debt rules, we will analyse them in turn. Needless to say that our framework is general enough to allow a joint analysis of both types of fiscal rules applied simultaneously.

2.1. 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:

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

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 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 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*. 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 $d - d^T > 0$, we can conclude that when $d - d^T < 0$, $H'(d) = 0$ and then disregard the derivative of the Heaviside function at 0. Applying the differentiation rule for a product of two functions, we obtain the first order condition

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

which leads to the following optimal level of the choice variable, i.e. the level of government spending:

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

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 precise 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 larger weight attached to deficit objective, λ, reduces the government's response to 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, income shock calling for fiscal contraction and 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 weight attached to deficit objective in the loss function on the variance of government spending. The parameter λ reduces the value of the second and third term in Equation (8) which they enter with opposite signs. To shed light on this issue it is useful to make recourse 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 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:

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

The interpretation of the result in Equation (10) is not challenging if one recalls a 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 shock looses its stabilizing property because 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 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.

2.1 Debt rule

The crucial difference between the deficit and debt rule 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 would be 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 cycle. Hence, we assume that the government minimizes the following loss function:

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

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 a 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 is more stabilizing, 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 role of the debt rule is more likely to hold when interest rates are high. Our empirical work in the next section suggests that the debt rule has a positive and the deficit rule a negative effect on the volatility of government spending. To make the theoretical condition for the above relation between spending volatility and rules stronger, we suppose that the interest rate is equal to zero. Under this assumption the positive influence of the debt rule on the volatility of government expenditures is less likely.

Further, we set the inherited value of debt in 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 assume that the debt rule imposes on fiscal authorities an obligation to reduce the level of debt by α percent in the next period if the threshold value has been reached in the current period. This assumption sharpens the process of transmission from one period to another of disadvantages of excessive public spending under the debt rule.

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 period 1 and 2. When the debt rule has been violated, i.e. H=1, in period 1 we would have:

$$b_1 = d_1$$
$$b_2 = b_1 + d_2 \qquad \text{and} \qquad b_2 = (1-\alpha)b_1 \quad \Rightarrow \quad d_2 = -\alpha d_1 \tag{12}$$

The calculations from Equation (12) plugged into the loss function, combined with the aggregate demand relation (2) and government budget constraints (3) and (4), can then be modified to yield:

$$L = \frac{\gamma}{2}\left(\kappa(g_1 - t_1 - \varepsilon_1) + u_1\right)^2 + \beta\frac{\gamma}{2}\mathrm{E}_1\left[\left(-\kappa\alpha(g_1 - t_1 - \varepsilon_1) + u_2\right)^2\right]$$
$$+ \frac{\phi}{2}H\left(g_1 - t_1 - \varepsilon_1 - b^T\right)^2 + \beta\frac{\phi}{2}H\left((1-\alpha)(g_1 - t_1 - \varepsilon_1) - b^T\right)^2 \tag{13}$$

where the terms with the control variable, namely the level of spending in period 1, have been made explicit. Equation (13) demonstrates that the debt rule ties the hands of the policymaker in both periods even if it has been solely broken in the first period.

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 (13) as follows:

$$L = \frac{\gamma}{2}\left(\kappa(g_1 - t_1 - \varepsilon_1) + u_1\right)^2 + \beta\frac{\gamma}{2}\left(-\kappa\alpha(g_1 - t_1 - \varepsilon_1) + \sigma_u^2\right)^2$$
$$+ \frac{\phi}{2}H\left(g_1 - t_1 - \varepsilon_1 - b^T\right)^2 + \beta\frac{\phi}{2}H\left((1-\alpha)(g_1 - t_1 - \varepsilon_1) - b^T\right)^2 \tag{14}$$

The first order condition:

$$\frac{\partial L}{\partial g_1} = \gamma\kappa\left(\kappa(g_1 - t_1 - \varepsilon_1) + u_1\right) - \beta\gamma\kappa\alpha\left(-\kappa\alpha(g_1 - t_1 - \varepsilon_1)\right)$$
$$\phi H\left(g_1 - t_1 - \varepsilon_1 - b^T\right) + \frac{\phi}{2}H'\left(g_1 - t_1 - \varepsilon_1 - b^T\right)^2 + \tag{15}$$
$$\beta\phi H(1-\alpha)\left((1-\alpha)(g_1 - t_1 - \varepsilon_1) - b^T\right) + \beta\frac{\phi}{2}H'\left((1-\alpha)(g_1 - t_1 - \varepsilon_1) - b^T\right)^2 = 0$$

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

$$g_1 = t_1 + \varepsilon_1 - \frac{\gamma\kappa}{\gamma\kappa^2 - \beta\gamma\kappa^2\alpha^2 + \phi H + \beta\phi H(1-\alpha)^2}u_1 + \frac{\phi H + \beta\phi H(1-\alpha)}{\gamma\kappa^2 - \beta\gamma\kappa^2\alpha^2 + \phi H + \beta\phi H(1-\alpha)^2}b^T. \tag{16}$$

which was obtained after substitution of $H'=0$ in Equation (15). According to Equation (16) government spending under the debt rule is higher when tax revenues and 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.

$$\operatorname{var} g_1 = \sigma_\varepsilon^2 + \left(\frac{\gamma\kappa}{\gamma\kappa^2 - \beta\gamma\kappa^2\alpha^2 + \phi H + \beta\phi H(1-\alpha)^2} \right)^2 \sigma_u^2 + \\ -2 \frac{\gamma\kappa}{\gamma\kappa^2 - \beta\gamma\kappa^2\alpha^2 + \phi H + \beta\phi H(1-\alpha)^2} \operatorname{cov}(\varepsilon, u) . \tag{17}$$

It is evident from Equation (17) 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:

$$\frac{\partial \operatorname{var} g_1}{\partial \phi} = -2 \frac{\left(H + \beta(1-\alpha)^2\right)\gamma^2\kappa^2}{\left(\gamma\kappa^2 - \beta\gamma\kappa^2\alpha^2 + \phi H + \beta\phi H(1-\alpha)^2\right)^3} \sigma_u^2 + \\ 2 \frac{\left(H + \beta(1-\alpha)^2\right)\gamma\kappa}{\left(\gamma\kappa^2 - \beta\gamma\kappa^2\alpha^2 + \phi H + \beta\phi H(1-\alpha)^2\right)^2} \operatorname{cov}(\varepsilon, u) . \tag{18}$$

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

It can be inferred from Equation (18) that the debt rule weakens public spending volatility if the covariance between tax income and aggregate demand shocks is strong. 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 (18) 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:

$$\frac{\gamma\kappa}{\gamma\kappa^2 + \lambda H} < \frac{\gamma\kappa}{\gamma\kappa^2 - \beta\gamma\kappa^2\alpha^2 + \phi H + \beta\phi H(1-\alpha)^2} \quad \text{and} \\ \frac{\gamma\kappa}{\gamma\kappa^2 + \lambda H} \sigma_u^2 < \operatorname{cov}(\varepsilon, u) < \frac{\gamma\kappa}{\gamma\kappa^2 - \beta\gamma\kappa^2\alpha^2 + \phi H + \beta\phi H(1-\alpha)^2} \sigma_u^2 \tag{19}$$

Condition (19) 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 which 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).

For the coinciding values of weights attached to debt and deficit rules, time preferences of the policymaker are crucial for condition (19). More precisely, condition (19) is more likely to hold if the value of the discount factor β is large. In other words, fiscal authorities more concerned with the future take into closer account the future consequences of current deficits and then the debt rule is an effective spending-stabilising device. A government which is careless about the future, does not consider the debt rule as a serious obstacle to conducting a policy marked by an unstable pattern of expenditures. As a result, the debt rule does not constraint the policymaker and condition (19) is likely to be violated.

The conclusions drawn from inequality (19) 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 of the above-mentioned parameters. In contrast, condition (19) 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) collapses to:

$$\frac{\gamma\kappa}{\gamma\kappa^2+\lambda H}<\frac{\gamma\kappa}{\gamma\kappa^2-\beta\gamma\kappa^2\alpha^2+\phi H+\beta\phi H(1-\alpha)^2} \quad \text{and}$$
$$\frac{\gamma\kappa}{\gamma\kappa^2+\lambda H}<\psi<\frac{\gamma\kappa}{\gamma\kappa^2-\beta\gamma\kappa^2\alpha^2+\phi H+\beta\phi H(1-\alpha)^2} \tag{20}$$

The general conclusion drawn in this section is preserved in (20). 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.

Although the assumption of equality between the weights attached to debt and deficit rules provides new insights into the volatility of government spending, it does not contradict the previous result. The special case where $\lambda=\phi$ simplifies condition (19) to:

$$\phi H(1-\alpha)^2<\gamma\kappa^2\alpha^2 \quad \text{and}$$
$$\frac{\gamma\kappa}{\gamma\kappa^2+\phi H}\sigma_u^2<\mathrm{cov}(\varepsilon,u)<\frac{\gamma\kappa}{\gamma\kappa^2-\beta\gamma\kappa^2\alpha^2+\phi H+\beta\phi H(1-\alpha)^2}\sigma_u^2 \tag{21}$$

The covariance of aggregate demand and tax revenues shocks needs to fall within a specified interval to trigger a stabilising and destabilising, respectively, property of debt and deficit rule. This time, however, the likelihood that condition (21) is met depends solely on the value of the discount factor, β. As mentioned before, a government which takes a long-term perspective attempt at avoiding high volatility of its expenditures because of sustained impact of current deficits on current and future debt.

In the next section we show that condition (19), which embraces both special cases (20) and (21), 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: $\frac{\gamma\kappa}{\gamma\kappa^2+\lambda z}<\frac{\gamma\kappa}{\gamma\kappa^2-\beta\gamma\kappa^2\alpha^2+\phi z+\beta\phi z(1-\alpha)^2}$		
$\frac{\gamma\kappa}{\gamma\kappa^2+\lambda z}\sigma_u^2<\mathrm{cov}(\varepsilon,u)<\frac{\gamma\kappa}{\gamma\kappa^2-\beta\gamma\kappa^2\alpha^2+\phi z+\beta\phi z(1-\alpha)^2}\sigma_u^2$	+	–
$\mathrm{cov}(\varepsilon,u)>\frac{\gamma\kappa}{\gamma\kappa^2-\beta\gamma\kappa^2\alpha^2+\phi z+\beta\phi z(1-\alpha)^2}\sigma_u^2$	+	+
$\mathrm{cov}(\varepsilon,u)<\frac{\gamma\kappa}{\gamma\kappa^2+\lambda z}\sigma_u^2$	–	–
Case 2. Critical condition does not hold: $\frac{\gamma\kappa}{\gamma\kappa^2-\beta\gamma\kappa^2\alpha^2+\phi z+\beta\phi z(1-\alpha)^2}<\frac{\gamma\kappa}{\gamma\kappa^2+\lambda z}$		
$\frac{\gamma\kappa}{\gamma\kappa^2-\beta\gamma\kappa^2\alpha^2+\phi z+\beta\phi z(1-\alpha)^2}\sigma_u^2<\mathrm{cov}(\varepsilon,u)<\frac{\gamma\kappa}{\gamma\kappa^2+\lambda z}\sigma_u^2$	–	+
$\mathrm{cov}(\varepsilon,u)>\frac{\gamma\kappa}{\gamma\kappa^2+\lambda z}\sigma_u^2$	+	+
$\mathrm{cov}(\varepsilon,u)<\frac{\gamma\kappa}{\gamma\kappa^2-\beta\gamma\kappa^2\alpha^2+\phi z+\beta\phi z(1-\alpha)^2}\sigma_u^2$	–	–

3. Fiscal rules and fiscal policy volatility.

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

3.1 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 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 several fiscal variables, including government consumption spending.

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

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 collected 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 use HP filter to extract the trend of real public consumption expenditure, 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 throughout discussion of this issue. In choosing the form of the reaction function, we follow Lane (2003), and estimate a simple equation for each country in the sample:

$$\Delta(\ln(g_{i,t})) = \alpha_i + \beta_i \Delta(\ln(y_{i,t})) + e_{i,t}, \tag{22}$$

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. 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. The standard deviation of the error term constitutes the second measure of fiscal policy volatility, denoted σ_e. Since output may be an endogenous variable, when estimating (22), we use two stages least squares method and instrument output with its lags.

Both measures of fiscal policy volatility: σ_{HP} and σ_e are calculated for a wide selection of developed and developing countries. The data on general government consumption expenditure and GDP per capita (both in constant prices) have been compiled for the period 1980-2006 from 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.

3.2. Regression analysis.

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

Among the explanatory variables are dummy variables related to fiscal rules. 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].

We used two proxies for 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 budget deficit. 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:

$$\ln(Policy\_volatility)_i = \alpha_i + \beta_{1i}(debt\_rule_i) + \beta_{2i}(budget\_rule_i) + \sum_{n=3}^{k} \beta_{in} \ln(X_{ni}) + \gamma_i . \quad (23)$$

Policy_volatility is measured either by σ_e or σ_{HP}; i.e. respectively, by the standard deviation of the error term from regression equation (22) or by the standard deviation of the unsystematic component extracted using HP filter.

The dummy variable *debt_rule* equals one, if in a given country a constraint on public debt[2] exists. The dummy *budget_rule* is equal to one if a budget balance rule[3] exists.

The vector X is a set of control variables. It includes: GDP per capita in constant 2000 US\$ *(GDP);* GDP volatility, calculated as a standard deviation of annual GDP per capita growth *(Vol);*and public debt to GDP ratio *(Debt).* All these variables have been taken from World Bank, WDI (2008) database. They are averages of series between years 1995-2006. Following the approach of Furceri and Poplawski Ribero (2009), additional control variables have also been introduced. Among them are: the average size of population between 1995-2006, taken from World Bank, WDI (2008) *(pop);* a set of the Worldwide Governance Indicators produced by Kaufmann, Kraay and Mastruzzi (2008), including an average index of overall governance

[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.

quality, calculated for each country as the average value of all indicators (i.e.: 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 (*govern*) and average values of indicators referring more directly to the quality of the government: Government Effectiveness (*gov_eff*), Regulatory Quality (*reg_qual*) and Control of Corruption (*corr*) – all averaged over years 1996-2008; proportion of countries' land lying in geographical tropics (*tropicar*), from the Gallup, Sachs and Mellinger (1999) database and a set of dummy variables, also from the Gallup, Sachs and Mellinger (1999): a dummy for Sub-Saharan Africa (*safri*) and a dummy for transition countries (*transit).* Other control variables were also used, including a full set of governance indicators and a richer set of geographical characteristics. Yet, the results remained unaltered and these variables proved to be insignificant, hence to save space, the results are not reported, but are available from the authors on request.

The lack of time dimension related to our measures of fiscal rules has also posed a problem for calculating our dependent variable. In order to calculate σ_e 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 (22), we used time-series data from the years 1980-2006. Again, the time period was chosen 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 many countries fiscal rules have been introduced in the second half of 1990's (see for example Kopits, 2001), hence the database captures rules which have been effective over the course of the last 10 years. To that end, the value of both σ_e and σ_{HP} has been calculated using the observations on errors e_{it} from Equation (22) or unsystematic component of public spending (extracted with the help of the HP filter) only from years 1995-2006 (hence, when we calculated the standard deviations σ_e and σ_{HP}, we have omitted the observations from years 1980-1994). Nevertheless, to check the robustness of our results, we have also calculated both the σ_e and σ_{HP} using observations on errors or unsystematic parts of public expenditures from the whole 1980-2006 period. The results were similar (to save space, we do not show these results, but they are available upon request). Table 2 describes characteristics of the variables compiled and constructed for our regression analysis.

Table 2. Descriptive statistics.

	Mean	Std. deviation
σ_e	0.077	0.133
σ_{HP}	0.035	0.039
GDP	7291.35	9530.431
Vol	3.711	4.213

Regressions were estimated using OLS, with 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, Kraay, 2000). To check that the results were not driven by outliers, we additionally run the regressions using least absolute deviations (LAD). Table 3 presents the main results.

Table 3. Fiscal rules and volatility of public consumption expenditures; for years1995-2006.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	σ_e OLS	σ_e IV	σ_e LAD	σ_e OLS	σ_e OLS	σ_{HP} OLS	σ_{HP} IV	σ_{HP} LAD	σ_{HP} OLS	σ_{HP} OLS
GDP	-0.0326*** (0.0103)	-0.0244** (0.0109)	-0.0169*** (0.0024)	-0.0348 (0.0318)	-0.0420 (0.0353)	-0.0114*** (0.00182)	-0.00851*** (0.00290)	-0.00891*** (0.000889)	-0.00400 (0.00922)	-0.00835 (0.00567)
Vol	0.0297** (0.0147)	0.0734* (0.0422)	0.0162*** (0.0059)	0.0438** (0.0214)	0.0300 (0.0195)	0.0155** (0.00686)	0.0321*** (0.0105)	0.00641*** (0.00214)	0.0215*** (0.00706)	0.0168*** (0.00610)
Budget_rule	0.0872** (0.0426)	0.0908*** (0.0326)	0.0338*** (0.0086)	0.0808* (0.0413)	0.0762* (0.0394)	0.0198** (0.00767)	0.0204** (0.00848)	0.0174*** (0.00333)	0.0245*** (0.00810)	0.0227*** (0.00798)
Debt_rule	-0.104** (0.0468)	-0.103*** (0.0294)	-0.0371*** (0.0081)	-0.0938** (0.0441)	-0.0858* (0.0429)	-0.0150* (0.00763)	-0.0154** (0.00770)	-0.0150*** (0.00307)	-0.0139* (0.00746)	-0.0117 (0.00729)
Pop				0.00666 (0.0147)	0.00856 (0.0159)				-0.00466 (0.00335)	-0.00411 (0.00291)
Tropicar				-0.0152 (0.0327)	-0.00431 (0.0293)				-0.000985 (0.0130)	-0.00447 (0.0140)
Govern				0.0184 (0.0423)					-0.00585 (0.0138)	
Govt_eff					0.00964 (0.0805)					0.000385 (0.0164)
Reg_qual					-0.0970 (0.0830)					-0.0282* (0.0167)
Corrupt					0.0822 (0.0588)					0.0166 (0.0108)
Transit				-0.0278 (0.0281)					0.00941 (0.0109)	
Safri				0.0411 (0.0396)					0.0170 (0.0155)	
Constant	0.310*** (0.0891)	0.208* (0.119)	0.180*** (0.0232)	0.193 (0.155)	0.244* (0.130)	0.106*** (0.0208)	0.0707** (0.0312)	0.0911*** (0.00842)	0.112 (0.0832)	0.151*** (0.0566)
Observ.	69	68	69	66	66	72	70	72	69	69
R-squared	0.419	0.377	.	0.438	0.476	0.566	0.508	.	0.626	0.652

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Columns 1 to 5 show the results for σ_e as the dependent variable and columns 6 to 10 show the results for σ_{HP} as the regressand. Columns 1, 4, 5,6, 9 and 10 presents results calculated using OLS, columns 2 and 7 contain results obtained with instrumental variables estimates, columns 3 and 8 – 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. This suggest that in presence of debt rules attenuates fiscal policy volatility.

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. Aside from the reported regressions, several other were also estimated, with a different set of control variables, yet the main results remained unaltered. Therefore these results seem robust.

4. Conclusions

Volatility of government spending is an undesirable feature of fiscal policy. Smooth time profile of government spending enhances economic growth and justifies the quest for institutional solutions conducive of 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 government's objective function and the strength of covariance of shocks hitting aggregate demand and fiscal revenues, and fiscal authorities' time preferences are critical in this context. In particular, the deficit and the debt rules can have contradictory impact, 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.

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