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Government size and macroeconomic stability

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We analyze the effects of government size on output variability in the context of a RBC model in which government size is parameterized by the income tax rate and the share of government purchases in output. The model implies that: (i) income taxes are destabilizing, and (ii) for most specifications considered, government purchases are stabilizing. We compare those predictions with the results of simple cross-country regressions using data for 22 OECD countries. The estimated relationship between empirical indicators of government size and measures of GDP variability appears far stronger than the model predicts, and often has the opposite sign.

1. Introduction

The present paper investigates the relationship between government size and macroeconomic stability in the context of a real business cycle (RBC) model. Focus on the previous relationship can be traced back to the traditional Keynesian literature on 'automatic stabilizers' [e.g., Burns (1960), Baily (1978), DeLong and Summers (1986)]. That literature points to the increase in income taxes, government purchases, unemployment insurance benefits and other governmental programs as some of the 'structural changes' underlying the greater stability of the U.S. economy after World War. II. Underlying the notion of automatic stabilizers found in the Keynesian literature there is a framework in which households face some sort of liquidity constraints that link consumption to current disposable income, and where short-run fluctuations are demand-driven. In the present paper we revisit the concept of automatic stabilizers by studying its potential role in the context of the basic RBC model, the central paradigm of modern

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macroeconomics.[1] We pose the following basic question: do income taxes and government purchases behave as automatic stabilizers in the basic, technology shock-driven, RBC model? In other words, can the government alter the intensity of the business cycle by changing its own 'size', when technology shocks are the source of economic fluctuations?

In section 2 we attempt to provide an answer to those questions, by augmenting an otherwise standard RBC model with a government sector. More precisely, we introduce two fiscal parameters in the model: (i) an income tax rate, and (ii) the share of government purchases in output. Then we analyze the effects of variations in the model's fiscal parameters on output variability, as measured by the standard deviation of either percent deviations of output from its steady-state value or output growth rates, depending on the specification.[2] We show that, for most specifications considered, both a low tax rate and a high share of government purchases are associated with low output variability. The magnitude of the predicted effects is, however, very small.

In section 3 we confront those predictions with evidence based on postwar data corresponding to 22 OECD countries. We seek to characterize a possible correlation between (i) average share of government revenues and purchases in GDP (the empirical counterpart to our fiscal variables) and (ii) the standard deviations of GDP growth or detrended log GDP (our measures of output variability). Given the theoretical results of section 2, we view this exercise as an attempt to assess the ability of the basic RBC model to match dimensions of the data other than the time series dimension, e.g. differences in the characteristics of business cycles across countries. Though calibrated versions of simple RBC models are capable of generating time series with properties that roughly match those of actual U.S. macroeconomic time series, the number of stylized facts which current RBC models are able to replicate is very limited and, as Danthine and Donaldson (1993) have emphasized, any progress in modeling must necessarily involve confronting existing models with an increasingly richer set of stylized facts.[3]

The empirical results of section 3 point to the presence of a significant relationship between fiscal variables and measures of GDP variability.

[1]Expositions of the basic RBC model can be found in Prescott (1986). For a survey of the literature see King et al. (1988) and Plosser (1989).

[2]Danthine and Donaldson (1985) and Greenwood and Huffman (1991) contain related exercises involving the effect of changes in tax rates on output variability in a RBC model, but neither paper looks at government purchases. See below for a discussion of their models and results, as well as for other relevant references.

[3]A similar approach underlies some of the recent developments in growth theory, where alternatives to the standard neoclassical growth model have been developed in response to the latter's inability to account for some cross-country evidence (e.g., the lack of convergence of income levels). As Lucas (1988) points out, that critical assessment has taken place despite the fact that the neoclassical model is consistent with most features of long-term U.S. time series, the main aspect of the data it was originally meant to explain.

Nevertheless, the sign and magnitude of the effect detected empirically cannot always be reconciled with the predictions of the standard RBC model. This is true even when we control for policy variability factors which, though ignored by the model, may potentially affect output variability while being correlated with our fiscal measures.

Section 4 discusses the implications of our results and concludes.

2. Government size and macroeconomic stability in a RBC model

In this section we develop a basic one-sector RBC model augmented with a government sector. We assume an infinite-lived representative consumer who seeks to maximize

$$\mathrm{E}_0 \sum_{t=0}^{\infty} \beta^t U(C_t, L_t), \tag{1}$$

where C is consumption and L is leisure. We specify the utility function to be given by $U(C_t, L_t) = \log C_t + \theta \log L_t$.[4]

Our agent has access to a constant-returns technology represented by a Cobb–Douglas production function,[5]

$$Y_t = A_t K_t^{1-\alpha}(X_t N_t)^{\alpha} \tag{2}$$

for $t = 0, 1, 2, \ldots,$ where Y is output, K is physical capital, and N is employment. $\{X_t\}$ represents nonstochastic technical progress, and is given by $X_t = X_0 \gamma^t$. $\{A_t\}$ is the stochastic component of technology; its logarithm, denoted by $\hat{A}_t$ is assumed to follow the AR(1) process $(1-\rho L)\ \hat{A}_t = \varepsilon_t$, where $0 \leqq \rho \leqq 1$, and $\{\varepsilon_t\}$ is an i.i.d. sequence with zero mean and variance v^2.

The government budget constraint is given by $B_{t+1} = B_t[1 + (1-\tau)r_t] + G_t + T_t - \tau Y_t$, for $t = 0, 1, 2, \ldots$ where T denotes lump-sum transfers, B is the outstanding one-period riskless government debt, r is the interest rate on one-period riskless assets, τ is the income tax rate, and G denotes government purchases. In the initial period the policy maker chooses a tax rate τ as well as the *steady-state* share of government purchases in output. That share is denoted by s_g. Two alternative rules for government purchases are considered. Under the first rule, $G_t = s_g\ Y_t$, all t, i.e. government purchases are a constant fraction of output. Under the second rule, $G_t = gX_t$, i.e. government purchases grow at a constant (gross) growth rate γ. Henceforth we refer to those rules as 'constant share' and 'constant growth' rules, respectively.

[4]Such a functional form for U is consistent with a balanced growth bath characterized by a constant L and constant growth for C, Y and K, as argued in King, Plosser and Rebelo (1988). Experimentation with a more general utility function consistent with a balanced growth path did not affect any of the qualitative results reported below.

[5]Alternatively we could have modeled agents as selling labor and capital services in competitive markets to firm with access to the specified technology. As is well known, the two market arrangements yield identical outcomes.

Admittedly, our assumptions on government behavior are highly stylized and somewhat unrealistic, but they allow us to focus on the impact of the government's relative size. From this viewpoint, our analysis can be seen as complementary to certain RBC literature that analyzes the effects of stochastic variations in the tax rate and/or the share of government purchases in GDP [e.g., Christiano and Eichenbaum (1992), Braun (1989), McGrattan (1991), Chari et al. (1993)].

Our consumer–producer maximizes (1) subject to

$$K_{t+1}+B_{t+1}=(1-\delta)K_t+(1-\tau)Y_t+B_t[1+(1-\tau)r_t]+T_t-C_t, \tag{3}$$

$$L_t+N_t=1, \tag{4}$$

for $t=0,1,2,\ldots$, as well as a non-negativity condition for K and C, and the transversality condition $\lim_{T\to\infty}\mathrm{E}_0\{\prod_{t=0}^{T}[1+(1-\tau)r_t]\}^{-1}B_T\geqq 0$. δ in (3) is the rate of depreciation of physical capital. In solving this problem he takes τ, the stochastic sequences $\{G_t\}$, $\{T_t\}$, $\{r_t\}$ and the initial level of capital and government debt as given.

It is useful to transform the model above into a stationary one by dividing all variables (except N and L) by X. The transformed variables are denoted by lower case letters: $c_t\equiv(C_t/X_t)$, $k_t\equiv(K_t/X_t)$, etc. A competitive equilibrium in our economy can then be defined as a sequence $\{c_t,k_t,y_t,N_t,g_t\}_{t=0}^{\infty}$ satisfying the following conditions:

$$\theta c_t=(1-N_t)\alpha(1-\tau)(y_t/N_t), \tag{5}$$

$$\mathrm{E}_t\{(c_t/c_{t+1})[(1-\delta)+(1-\tau)(1-\alpha)(y_{t+1}/k_{t+1})]\}=\gamma\beta^{-1}, \tag{6}$$

$$y_t=A_t k_t^{1-\alpha}N_t^{\alpha}, \tag{7}$$

$$\hat{A}_t=\rho\hat{A}_{t-1}+\varepsilon_t, \tag{8}$$

$$g_t=s_g y_t \text{ ('constant share'),}\quad \text{or}\quad g_t=g \text{ ('constant growth'),} \tag{9}$$

$$\gamma k_{t+1}=(1-\delta)k_t+y_t-g_t-c_t, \tag{10}$$

for $t=0,1,2,\ldots$, and the transversality condition

$$\lim_{T\to\infty}\mathrm{E}_0\beta^T(1/c_T)k_T=0. \tag{11}$$

Given a government purchases rule and an initial capital stock, eqs. (5)–(11) fully characterize the equilibrium path $\{c_t,k_t,y_t,N_t,g_t\}_{t=0}^{\infty}$ independently of the transfer/debt sequence $\{t_t,b_t\}_{t=0}^{\infty}$ chosen by the government among the infinite number of sequences satisfying $\gamma b_{t+1}=b_t[1+(1-\tau)r_t]+g_t+t_t-\tau y_t$, for $t=0,1,2,\ldots$, and the transversality condition $\lim_{T\to\infty}\mathrm{E}_0\beta^T(1/c_T)b_T=0$. In other words, a version of Ricardian equivalence holds in the model above.

To further characterize the economy's competitive equilibrium we use the log-linear, certainty equivalence methods described in King et al. (1988). The idea is to solve for the perfect-foresight equilibrium path and to linearize the latter around the economy's balanced-growth path, replacing future $\hat{A}$ values in that solution with their expected values. Further details can be found in the above reference. That approach can be used to generate univariate processes describing the fluctuations of different variables around their stationary values. Given the purpose of the exercise we focus on the univariate representation for output implied by the model, which takes the form

$$(1-\rho L)(1-\mu L)\hat{y}_t = \phi_0 \varepsilon_t + \phi_1 \varepsilon_{t-1},$$

where $\hat{y}_t \equiv \log(y_t/y)$ is the percent deviation of output from its steady state value y. μ, ϕ_0 and ϕ_1 are complicated functions of the model's parameters.[6] Given values for the parameters characterizing technology $(\gamma, \alpha, \rho, v)$, preferences (β, θ), and fiscal policy (τ, s_g, and a rule for government purchases) we can compute the coefficients of the above ARMA(2, 1) process and determine the implied unconditional standard deviation of $\hat{y}$. In order to do that, we calibrate the model in a way consistent with some stylized features of the postwar U.S. economy. We let $\gamma = 1.02$, roughly the average (gross) growth rate in per capita income in the postwar period. Under perfect competition, α corresponds to the labor income share, which we set at 0.75. Following King et al. (1988) we use the average return to equity for the postwar period (6.5%) as r's empirical counterpart. As in other studies a value of 0.10 is assumed for δ, the annual depreciation rate. A benchmark value for τ is 0.3, roughly the average ratio of government revenues to GDP, s_g is assigned a benchmark value of 0.2, the average share of government purchases in GDP. Given our assumptions on γ, τ, and r, and exploiting the fact that $\beta = \gamma/[1+(1-\tau)r]$ must hold in the steady state, we set $\beta = 0.975$. We experiment with two alternative values for parameter θ: (i) $\theta = 1.6014$, which, under our benchmark fiscal settings, is consistent with a steady-state value for N equal to 1/3, the latter being the average fraction of time allocated to production [Prescott (1986)], and (ii) $\theta = 0$, which corresponds to an inelastic labor supply ($N_t = 1$). Finally, v and ρ are chosen in each case so that, under the benchmark values for the policy parameters, the standard deviation and the first-order autocorrelation of $\hat{y}$ predicted by the model equal 3.57 and 0.74, their respective sample counterparts our U.S. data set.[7]

Table 1 reports the implied standard deviations of $\hat{y}$, for alternative τ and s_g settings, under the assumptions of a 'constant growth' rule for government purchases and transitory shocks ($|\rho| < 1$). The model predicts that, holding s_g

[6] μ corresponds to the stable eigenvalue of the linearized dynamical system for $\hat{k}_t$ and $\hat{c}_t$. Again, we refer the reader to the King et al. (1988) paper for details.

[7] The statement does not apply to the simulation reported in table 4, for which ρ is no longer a free parameter. See discussion below.

Table 1

Transitory shocks, constant growth rule.[a]

	$s_g=0.00$	$s_g=0.10$	$s_g=0.20$	$s_g=0.30$	$s_g=0.40$
$\tau=0.00$	3.33	3.20	3.06	2.92	2.76
$\tau=0.15$	3.58	3.44	3.29	3.13	2.96
$\tau=0.30$	3.88	3.73	3.57	3.40	3.22
$\tau=0.45$	4.27	4.11	3.95	3.76	3.56
$\tau=0.60$	4.78	4.62	4.45	4.26	4.04

[a]For each pair (τ, s_g) the table shows the standard deviation of $100\hat{y}$ (i.e. the percent deviations of output from trend) predicted by the RBC model under a 'constant growth' rule for government purchases and the following parameter settings: $\rho=0.62$, $v=0.0132$, $\gamma=1.02$, $\alpha=0.75$, $\delta=0.10$, $\theta=1.601$, and $\beta=0.975$.

Table 2

Transitory shocks, constant share rule.[a]

	$s_g=0.00$	$s_g=0.10$	$s_g=0.20$	$s_g=0.30$	$s_g=0.40$
$\tau=0.00$	3.36	3.21	3.05	2.87	2.69
$\tau=0.15$	3.61	3.45	3.27	3.09	2.89
$\tau=0.30$	3.91	3.74	3.57	3.36	3.14
$\tau=0.45$	4.30	4.13	3.94	3.73	3.49
$\tau=0.60$	4.81	4.64	4.45	4.24	3.99

[a]For each pair (τ, s_g) the table shows the standard deviation of $100\hat{y}$ (i.e. the percent deviations of output from trend) predicted by the RBC model under a 'constant share' rule for government purchases and the following parameter settings: $\rho=0.63$, $v=0.0132$, $\gamma=1.02$, $\alpha=0.75$, $\delta=0.10$, $\theta=1.601$, and $\beta=0.975$.

constant, variations in τ generate changes in the same direction in our measure of output variability. Thus, and given $s_g=0.2$, a reduction in the tax rate from 30 percent to zero *lowers* the standard deviation of $\hat{y}$ by 51 basis points. Doubling the tax rate to 60 percent actually *increases* the variability of $\hat{y}$ by 88 basis points. In other words, higher taxes appear to be destabilizing in the model, though the effect is relatively small. That basic result carries over to a version of the model with a 'constant share' for government purchases (table 2), as well as a version with inelastic labor supply (table 3). We also consider the case of permanent technology shocks, in which the technology parameter is specified to follow a random walk ($\rho=1$). In that case, equilibrium (log) output is a nonstationary process, so we use the standard deviation of output *growth rate* as a variability measure.[8] We calibrate v so that the implied standard deviation of output growth under benchmark values for τ and s_g matches its U.S. sample counterpart (2.26). The corresponding results, reported in table 4, are

[8]The latter specification excludes the possibility of a 'constant growth' rule for government purchases consistent with a constant steady state share, so the analysis in that case was restricted to the 'constant share' rule case.

Table 3

Transitory shocks, constant growth rule, inelastic labor supply.[a]

	$s_g=0.00$	$s_g=0.10$	$s_g=0.20$	$s_g=0.30$	$s_g=0.40$
$\tau=0.00$	3.40	3.42	3.44	3.47	3.51
$\tau=0.15$	3.45	3.47	3.49	3.53	3.57
$\tau=0.30$	3.51	3.53	3.57	3.60	3.65
$\tau=0.45$	3.59	3.62	3.66	3.70	3.76
$\tau=0.60$	3.70	3.74	3.79	3.84	3.92

[a]For each pair (τ, s_g) the table shows the standard deviation of $100\hat{y}$ (i.e. the percent deviations of output from trend) predicted by the RBC model under a 'constant growth' rule for government purchases and the following parameter settings: $\rho=0.59$, $v=0.0239$, $\gamma=1.02$, $\alpha=0.75$, $\delta=0.10$, $\theta=0.00$, and $\beta=0.975$.

Table 4

Permanent shocks, constant share rule.[a]

	$s_g=0.00$	$s_g=0.10$	$s_g=0.20$	$s_g=0.30$	$s_g=0.40$
$\tau=0.00$	2.19	2.15	2.11	2.07	2.02
$\tau=0.15$	2.26	2.22	2.17	2.12	2.07
$\tau=0.30$	2.35	2.30	2.26	2.19	2.14
$\tau=0.45$	2.47	2.42	2.36	2.30	2.23
$\tau=0.60$	2.64	2.58	2.52	2.45	2.38

[a]For each pair (τ, s_g) the table shows the standard deviation of $100\Delta\hat{y}$ (i.e. the percent output growth rates) predicted by the RBC model under a 'constant share' rule for government purchases and the following parameter settings: $\rho=1.00$, $v=0.0086$, $\gamma=1.02$, $\alpha=0.75$, $\delta=0.10$, $\theta=1.601$, and $\beta=0.975$.

qualitatively very similar to the ones discussed above: higher tax rates tend to increase the variability of output growth rates in this case, i.e. they behave as *automatic destabilizers.*

Somewhat related results can be found in other authors' work. Danthine and Donaldson (1985) introduce a capital income tax in a RBC model with inelastic labor supply, i.i.d. shocks, and one-hundred percent depreciation of physical capital. Under the previous assumptions the equilibrium dynamics can be solved for explicitly. Using the Danthine–Donaldson formulas for steady state y and $\mathrm{var}(y_t)$ it is straightforward to show that, under their assumptions, $\mathrm{var}(\hat{y})$ $[\cong(1/y^2)\,\mathrm{var}(y_t)]$ is independent of the tax rate level. Our analysis thus shows that the Danthine–Donaldson result depends heavily on their strong assumptions, and does not carry over to a more general RBC setup. Greenwood and Huffman (1991) introduce capital and labor income taxes in a somewhat nonstandard RBC model.[9] When evaluating the effects of tax changes on macroeconomic stability, their findings are similar to ours: lower taxes lead to a reduction in volatility.

[9]Their model has a variable rate of capital utilization, and technology shocks affect only the 'efficiency' of new additions to the capital stock (but not that of the capital stock in place).

What is the economic mechanism underlying the destabilizing effects of taxes? Much of the observed effect results from the increase in the labor supply elasticity brought about by a higher tax rate, through its negative impact on steady state employment.[10] The higher labor supply elasticity enhances the response of employment to a given technology shock, leading in turn to a larger response of both output and investment (and thus future output). Yet, the previous mechanism cannot be the only one at work, for (qualitatively) similar results are observed when we assume an inelastic labor supply (see table 3). In that case, the magnitude of the output reponse to a given technology shock $\hat{A}_t$ depends on the size of the multiplier $(\partial \hat{k}_{t+1}/\partial \hat{A}_t)$, but the latter is positively related to the steady-state output/capital ratio which is, in turn, increasing in τ.[11] It follows that higher income tax rate will imply a larger multiplier $(\partial \hat{y}_{t+1}/\partial \hat{A}_t)$, thus explaining the output variability effects observed in table 3.

Tables 1 to 4 can also be used to examine the effects on output variability of changes in the steady-state share of government purchases s_g, holding the tax rate constant. The sign of those effects is no longer robust across specifications. In all the specifications considered with $\theta > 0$ – see tables 1, 2, and 4 – the government spending share s_g appears to be inversely related to the standard deviation of output. Thus, for instance, under the calibration corresponding to table 1, a reduction of s_g from 20 percent to zero leads to an increase of 31 basis points in our output variability statistic, given $\tau = 0.30$. Raising s_g from 20 to 40 percent reduces the same statistic by 35 basis points. In other words, government spending behaves as an *automatic stabilizer* under those specifications. That result carries over to the calibrations corresponding to tables 2 and 4. The basic mechanism responsible for those results is essentially the same as in the tax rate case, though now it works in the opposite direction: an increase in s_g leads to a higher steady-state employment and, consequently, a lower labor supply elasticity, and a smaller reponse of employment and output to a technology shock.[12] On the other hand, when we set $\theta = 0$ – thus making labor supply perfectly

[10]In our model a higher income tax rate reduces steady-state employment through its negative effect on (after tax) labor productivity, which more than offsets the wealth effect working in the opposite direction. The reduction in N leads to a higher labor supply elasticity, which can be shown to be given by $(1-N)/N$.

[11]Some intuition for this result can be obtained by noticing that the (absolute) change in output in response to a technology shock is given by $y\hat{A}_t$. Letting ϕ_t denote the *marginal* investment share (i.e., the fraction of the change in output that is allocated to investment) it follows that $\hat{k}_{t+1} = \phi_t \; (y/k) \; \hat{A}_t$. Though ϕ_t also depends on the tax rate (as well as other parameters) in a complicated way, the positive effect of higher tax rates on (y/k) is dominant under all the calibrations considered.

[12]In contrast with the case of distortionary taxation, a change in s_g does not affect labor productivity and thus, has no substitution effects on employment. The positive relationship between s_g and N arises from the negative wealth effect of higher government purchases (which lead to a lower consumption of leisure).

inelastic – the opposite results obtains (see table 3): output variability increases with s_g, though, quantitatively, the effect is very small.[13]

Doubling the value of both the income tax rate and the purchases share *simultaneously* (from 30 to 60 percent and from 20 to 40 percent, respectively) leads to *greater* output variability in all the cases considered. Alternatively, when, starting from the benchmark fiscal settings, we eliminate the government altogether, the standard deviation of output goes down. Given the findings discussed above, this is not surprising in the $\theta=0$ case. However, in all the other cases the net effects of such a rescaling of both τ and s_g could not be predicted a priori. The results suggest that the stabilizing effect of a higher spending share is more than offset by the destabilizing effects of a proportional increase in the tax rate. Quantitatively, however, the net effect is very small: for the specification corresponding to table 1, a simultaneous increase in τ and s_g of 20 and 30 percentage points, respectively, increases the standard deviation of output by less than half a percentage point. When shocks are permanent (table 4) a similar rescaling of fiscal variables leads to an increase in the standard deviation of output growth of just 0.12 percentage points. In the following section we confront some of these predictions with the data.

3. Government size and macroeconomic stability: The evidence

In this section we present some econometric evidence bearing on the role of income taxes and government purchases as automatic stabilizers. Table 5 reports several statistics related to those fiscal variables, as well as measures of output variability, for 22 OECD countries. All the data are annual, covering the 1960–1990 sample period, and were obtained from the OECD database.

As proxies for τ and s_g we use the tax revenues/GDP ratio and the government purchases/GDP ratio, respectively.[14] Their average values for each country over the 1960–1990 sample period are reported under $\bar{\tau}$ and $\bar{s}_g$ in table 5. In the same table we also report three indicators of 'policy variability' for each country: the standard deviation of both the tax revenues/GDP and government purchases/GDP ratios ($s[\tau]$ and $s[s_g]$), as well as their correlation with both the (linearly) detrended and first-differenced logarithm

[13]Again, with constant employment the initial response of capital to a technology shock is given by $\hat{k}_{t+1}=\phi_t\ (y/k)\ \hat{A}_t$ with ϕ_t being the marginal investment share. Even though an increase in s_g does not affect (y/k), it causes the marginal investment share to go up in all our calibrated models, thus amplifying the response of capital and output.

[14]The model in section 2 treats all government purchases symmetrically, as nonproductive expenditures absorbing part of private sector output. This symmetric treatment is extended to our empirical measure of government purchases which includes both public consumption and public investment. In a way also consistent with our theoretical model, our measure of government purchases does not include government transfers.

Table 5

Basic statistics.[a]

Country	$\bar{\tau}$	$s[\tau]$	$\rho[\tau, \hat{y}]$	$\rho[\tau, \Delta y]$	s_g	$s[s_g]$	$\rho[s_g, \hat{y}]$	$\rho[s_g\, \Delta y]$	$s[\hat{y}]$	$s[\Delta y]$
U.S.A.	29.2	1.97	−0.01	−0.29	19.7	0.78	0.07	−0.17	3.57	2.26
Japan	24.8	5.22	−0.31	−0.65	14.8	1.63	0.12	−0.79	11.9	3.31
Germany	41.4	3.86	0.11	−0.43	22.8	2.07	0.43	−0.58	5.21	2.14
France	41.4	4.14	−0.31	−0.69	20.4	1.65	−0.17	−0.80	6.77	1.80
U.K.	37.9	3.74	−0.17	−0.28	23.3	2.04	0.09	−0.40	3.08	2.04
Italy	33.5	3.99	−0.36	−0.41	18.7	1.90	−0.35	−0.59	5.59	2.37
Canada	34.5	4.92	0.08	−0.45	21.5	2.01	0.22	−0.49	5.15	2.21
Austria	42.7	4.22	0.01	−0.55	22.6	1.92	0.28	−0.62	6.23	1.97
Belgium	41.7	9.34	−0.01	−0.62	18.5	2.87	0.43	−0.65	6.54	2.12
Denmark	45.0	10.6	0.02	−0.48	25.8	4.25	0.18	−0.053	4.82	2.38
Finland	35.9	3.85	0.01	−0.42	20.9	2.52	−0.25	−0.42	3.72	2.35
Greece	28.2	4.42	−0.18	−0.63	15.2	3.42	−0.29	−0.67	11.5	3.59
Iceland	32.5	2.41	0.93	−0.46	21.9	3.49	0.09	−0.29	6.55	4.27
Ireland	35.2	6.20	−0.04	−0.23	20.8	2.86	0.49	−0.31	3.71	2.17
Luxembourg	43.5	9.27	−0.027	−0.25	19.0	3.99	−0.31	−0.38	4.28	3.05
Netherlands	49.6	4.24	−0.61	−0.71	21.5	1.19	0.29	−0.064	7.77	2.26
Norway	46.5	7.30	0.28	−0.29	21.8	2.60	0.31	−0.26	3.31	1.82
Portugal	27.3	7.19	−0.17	−0.43	17.0	3.64	−0.16	−0.47	8.43	3.19
Spain	25.4	6.20	−0.67	−0.49	15.5	2.97	−0.75	−0.50	10.3	2.94
Sweden	50.7	9.71	−0.03	−0.64	28.4	4.12	0.19	−0.63	5.03	1.85
Switzerland	29.6	4.65	−0.20	−0.48	11.7	1.39	−0.27	−0.53	6.42	2.73
Australia	28.7	3.73	−0.10	−0.29	18.8	2.40	0.10	−0.42	5.32	2.12
Mean	36.6	5.51	−0.09	−0.46	20.1	2.53	0.03	−0.51	6.15	2.50
Maximum	50.7	10.6	0.93	−0.23	28.4	4.25	0.49	−0.17	11.9	4.27
Minimum	24.8	1.97	−0.67	−0.71	11.7	0.78	−0.75	−0.80	3.08	1.80

[a] τ is the government revenues/GDP ratio. s_g is the government purchases/GDP ratio. An upper bar denotes the average over the period 1960–1990. $\hat{y}$ is the percent deviation of per capita GDP from trend. Δy is the growth rate of per capita GDP. $s[\ ]$ and $\rho[\cdot]$ are the standard deviation and the correlation coefficient.

of GDP ($\rho[\tau, \hat{y}]$, $\rho[\tau, \Delta y]$, $\rho[s_g, \hat{y}]$ and $\rho[s_g, \Delta y]$).[15] Finally, the last two columns of table 5 contain two measures of output variability for each country: the standard deviation of linearly detrended log GDP ($s[\hat{y}]$), and the standard deviation of GDP growth ($s[\Delta y]$).

At the bottom of table 5 we report the mean and both the maximum and minimum values taken by each variable in our cross section of countries. We want to stress here the large observed variability in $\bar{\tau}$ and $\bar{s}_g$. We take that feature as being the result of different tastes and/or historical and political experiences, and exogenous to the phenomenon of macroeconomic instability. In particular, we find it reasonable to assume that the degree to which policy makers pursue active 'countercyclical' policies (reflected in short term variations in τ and s_g) is not systematically related to the size of government.

In addition to the large differences in fiscal parameters, the substantial variation across countries in our two measures of GDP variability, $s[\hat{y}]$ and $s[\Delta y]$, stands out as an important feature of the data, as becomes clear by looking at the corresponding columns of table 5. To what extent can those differences be accounted for by the differences in $\bar{\tau}$ and $\bar{s}_g$? We address this issue by estimating several cross-country regressions, using the data shown in table 5. We discuss the results of that exercise in the remainder of this section.

Table 6 reports the estimated coefficients in regressions with $s[\hat{y}]$ as a dependent variable and alternative combinations of fiscal policy statistics as regressors. Standard errors are reported in brackets. The estimates in the first two regressions point to the presence of a significant negative correlation between $s[\hat{y}]$ and each of our government size measures, $\bar{\tau}$ and $\bar{s}_g$. Interpreting the coefficient estimates as partial derivatives, the estimated effects appear to be quantitatively large: an increase of 10 percentage points in $\bar{\tau}$ (without controlling for other variables) is associated with a reduction of 1.5 percentage points in the standard deviation of detrended output. The latter value is even higher (3.9 percentage points) in the case of an analogous increase in $\bar{s}_g$. Because of the high correlation between $\bar{\tau}$ and $\bar{s}_g$ across countries, when both variables are included as regressors the individual coefficients estimates become insignificant [see regression (3)], though they remain negative. Neverthless, they are still highly jointly significant, as indicated by the F-statistics.

The high collinearity between the two regressors, makes it difficult to evaluate the importance of each factor as a stabilizing force. Yet, estimates of some linear combinations of the coefficients are still precise. Consider, for instance, an increase of 30 percentage points in $\bar{\tau}$ accompanied by a simultaneous increase of 20 percentage points in $\bar{s}_g$, a change well within the

[15]Similar results were obtained when we used $\rho[\Delta\tau, \hat{y}\}$, $\rho[\Delta\tau, \Delta y]$, $\rho[\Delta s_g, \hat{y}]$ and $\rho[\Delta s_g, y]$ as indicators of the extent of fiscal policy variability. For the sake of saving space we do not report those additional results.

Table 6

Cross-country regressions, dependent variable: $s[\hat{y}]$.[a]

	$\bar{\tau}$	$s(\tau)$	$\rho(\tau,\hat{y})$	s_g	$s(s_g)$	$\rho(s_g,\hat{y})$	R^2	F	Δ
(1)	−0.159* (0.063)	–	–	–	–	–	0.22	–	–
(2)	–	–	–	−0.394* (0.122)	–	–	0.34	–	–
(3)	−0.026 (0.089)	–	–	−0.353 (0.187)	–	–	0.35	5.02*	−7.865* (2.505)
(4)	−0.162* (0.069)	0.150 (0.225)	−2.400 (1.528)	–	–	–	0.35	–	–
(5)	–	–	–	−0.432* (0.161)	0.517 (0.525)	−0.029 (1.843)	0.38	–	–
(6)	−0.012 (0.114)	−0.054 (0.351)	–	−0.412 (0.220)	0.609 (0.799)	–	0.38	5.18*	−8.622* (2.684)
(7)	−0.056 (0.099)	–	−1.695 (1.838)	−0.257 (0.219)	–	0.149 (1.965)	0.38	2.62	−6.844* (3.110)
(8)	−0.015 (0.111)	−0.453 (0.419)	−3.856 (2.256)	−0.415 (0.237)	1.720 (1.052)	2.527 (2.375)	0.48	3.66*	−8.794* (3.259)

[a] τ is the government revenues/GDP ratio. s_g is the government purchases/GDP ratio. An upper bar denotes the average over the sample period, 1960–1990. $\hat{y}$ is the percent deviation of per capita GDP from trend. $s[\ ]$ and $\rho[\cdot]$ are the standard deviation and the correlation coefficient, respectively. Each row reports the coefficient estimates of a cross-country regression of $s[\hat{y}]$ on a constant term and the listed regressors. The F statistic corresponds to the null hypothesis that the coefficients of $\bar{\tau}$ and $\bar{s}_g$ are jointly zero. Δ is the linear combination 30 ($\bar{\tau}$ *coefficient*) + 20 ($\bar{s}_g$ *coefficient*). Standard errors are reported in brackets. An asterisk denotes significance at the 5% level.

range of the observed variability of $\bar{\tau}$ and $\bar{s}_g$ in our sample of countries. This experiment is conceptually analogous to the comparative dynamics exercise described in the previous section. Here, we estimate the effect of such a change by looking at the statistic $\Delta \equiv 30\ (\partial s[\hat{y}]/\partial\tau) + 20\ (\partial s[\hat{y}]/\partial s_g)$, while using the individual coefficient estimates to approximate the partial derivatives. Our results from regression (3) imply that such a 'rescaling' of fiscal variables is associated with a reduction of 7.8 percentage points (*s.e.* = 2.5) in $s[\hat{y}]$. This stands in contrast with the increase of less than 0.5 percentage points predicted by our benchmark model (see table 1). The results just discussed, corresponding to regressions (1)–(3) of table 6, embed the key finding of the paper: the estimated relationship between empirical measures of government size and output variability appears to be far stronger than the standard RBC model predicts and, at least in the case of tax effects, it has the opposite sign. The remaining results in tables 6 and 7 confirm the robustness of the previous finding under alternative regression specifications. We briefly discuss them next.

Regressions (4) to (8) aim to overcome a potential source of bias in the

Table 7

Cross-country regressions, dependent variable: $s[dy]$.

	$\bar{\tau}$	$s(\tau)$	$\rho(\tau, \Delta y)$	$\bar{s}_g$	$s(s_g)$	$\rho(s_g, \Delta y)$	R^2	F	Δ
(1)	−0.045* (0.015)	–	–	–	–	–	0.31	–	–
(2)	–	–	–	−0.080* (0.033)	–	–	0.22	–	–
(3)	−0.037 (0.023)	–	–	−0.022 (0.048)	–	–	0.32	4.41*	−1.569* (0.648)
(4)	−0.052* (0.017)	0.036 (0.055)	−0.817 (0.818)	–	–	–	0.36	–	–
(5)	–	–	–	−0.106* (0.031)	0.320* (0.118)	−0.383 (0.677)	0.46	–	–
(6)	−0.001 (0.021)	−0.176* (0.064)	–	−0.099* (0.040)	0.624* (0.147)	–	0.67	8.25*	−2.004* (0.493)
(7)	−0.039 (0.023)	–	−2.934* (1.480)	−0.026 (0.048)	–	2.360 (1.351)	0.45	5.63*	−1.719* (0.628)
(8)	−0.010 (0.020)	−0.149* (0.061)	−2.379* (1.067)	−0.089* (0.038)	0.579* (0.138)	1.611 (0.984)	0.76	10.5*	−2.100* (0.461)

Note: τ is the government revenues/GDP ratio, s_g is the government purchases/GDP ratio. An upper bar denotes the average over the sample period. Δy is the percent growth rate of per capita GDP. $s[\ ]$ and $\rho[\cdot]$ are the standard deviation and the correlation coefficient, respectively. Each row reports the coefficient estimates of a cross-country regression of $s[\Delta y]$ on a constant term and the listed regressors. The F statistic corresponds to the null hypothesis that the coefficients of $\bar{\tau}$ and $\bar{s}_g$ are jointly zero. Δ is the linear combination 30 ($\bar{\tau}$ *coefficient*) + 20 ($\bar{s}_g$ *coefficient*). Standard errors are reported in brackets. An asterisk denotes significance at the 5% level.

results just discussed. That bias would arise if, contrary to our exogeneity assumption, government size was systematically related to some feature of the time series variation in τ and/or s_g which had a dominant influence in determining the variability of output.[16] Regressions (4)–(8) in table 6 attempt to control for that potential bias by including several combinations of the policy variability statistics introduced in table 5 as regressors, in addition to $\bar{\tau}$ and/or $\bar{s}_g$. Notice that, with the exception of (7), the $\bar{\tau}$ and $\bar{s}_g$ coefficients in the augmented regressions are always either individually or jointly significant and have a negative sign. Furthermore, the Δ statistic described above still points to a large (and significant) negative effect on output variability of a simultaneous increase in $\bar{\tau}$ and $\bar{s}_g$.

Table 7 reports the results of a similar exercise, now using the standard deviation of GDP growth, $s[\Delta y]$, as a measure of output variability. Qualitatively, the results are similar to those discussed above. Taking

[16]For instance, one might argue that the estimated negative correlation between τ and $s[\hat{y}]$ could be reflecting, say, the possibility that countries with higher average tax/GDP ratios tend to engage more in (successful) short-term countercyclical fiscal policies.

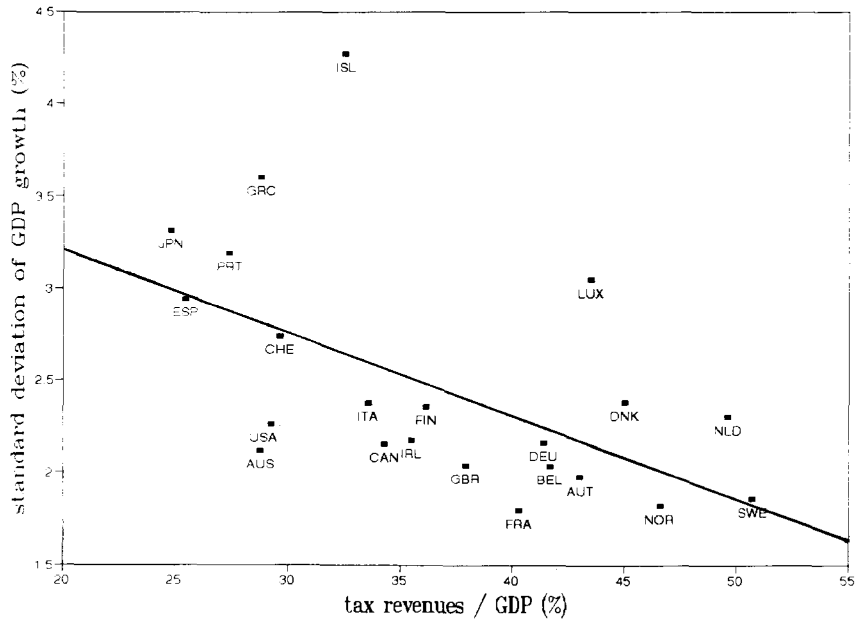

Fig. 1

regression (3) as a benchmark, we see that the estimated effect of the government rescaling described above is a reduction of 1.56 percentage points ($s.e. = 0.648$) in the standard deviation of output growth (as measured by the Δ statistic), in contrast with the increase of 0.12 percentage points predicted by the model (see table 4). Even stronger results obtain for the other regressions.[17]

Our basic finding of this section is illustrated graphically by fig. 1, which plots the position of each OECD country in the $(\bar{\tau}, s[\Delta y])$ plane, together with a fitted regression line.[18] The picture's message is clear: economies with 'large governments' (e.g., Norway, Sweden, Netherlands) have experienced milder economic fluctuations than economies with 'small governments' (e.g., Japan, Spain, Portugal). Our regression analysis suggests that such a conclusion is robust to the use of alternative measures of output variability and government size, and is not altered when we control for a possible policy variability effect.

[17]Notice also that some of the proxies for fiscal policy variability are significant in regressions (5)–(8) of table 7 in contrast with the results reported in the previous table. This does not affect any of our conclusions.

[18]A similar picture emerges when we use other combinations of output variability and government size measures.

4. Summary and concluding comments

Our results in section 3 suggest that both taxes and government purchases seem to be effectively working as 'automatic stabilizers', a theme often found in some of the Keynesian literature cited above. We do not view any of those findings as having a normative content, even if consumers value macroeconomic stability, for large tax rates and government purchases are likely to have important welfare-reducing *steady-state* effects.[19] Despite that lack of normative value, we find the results above useful to the extent that they point to a dimension of the data – the role of taxes and government purchases as automatic stabilizers – which the canonical RBC model fails to match. In all the specifications of that model analysed in section 2 income taxes effectively behave as 'automatic destabilizers'; in contrast, all the evidence points to the presence of a negative relationship between output variability and the tax/GDP ratio. Such a negative relationship is also found in the data when we look instead at the government purchases/GDP ratio as a measure of government size, but that empirical finding appears to be (qualitatively) consistent with at least some specifications of the RBC model. A more striking contrast between theory and evidence emerges when we focus on the magnitude of the effects: the variability effects of government size predicted by the model (regardless of their sign) is far smaller than those detected in the data.

We interpret those results as suggesting that some factors responsible for the stabilizing effects of government size observed in the data are not accounted for in standard versions of the RBC model. To the extent that those factors play a significant role in economic fluctuations and, more specifically, in determining the response of the economy to changes in policy variables, many of the conclusions drawn from the RBC model may be misleading. This will generally be true no matter how well calibrated versions of the model fit time-series data.

What are some of the possible elements that are missing in the canonical RBC model, and whose absence is responsible for the model's counterfactual predictions? It is tempting to point to our stylized modelling of the fiscal sector as the main culprit. One can certainly argue that neither taxes nor government purchases show the kind of stable behavior assumed in our model. Yet, we believe little progress would be made if we were to allow for time variation in τ or s_g, unless we were willing to assume some systematic relationship between the time series properties of those fiscal parameters and

[19]In our model of section 2 government purchases are wasteful, i.e. they absorb part of the economy's output without increasing consumers' utility or private sector productivity. Since there are no other market imperfections the optimal government size in our model is zero, in which case the model's equilibrium allocation is efficient, and any policy that manages to limit the fluctuations induced by technology shocks is welfare reducing. This point was forcefully argued in Kydland and Prescott (1980).

their average values. Furthermore, none of our empirical findings were significantly affected when we controlled for some policy variability measures, suggesting that *average* values of tax/GDP and government purchases/GDP ratios are themselves correlated with output variability, independently of their variations. A more fruitful avenue of inquiry, though one that falls beyond the scope of this paper, would augment our government sector model by allowing for possible effects of government purchases on utility [e.g., Christiano and Eichenbaum (1992)] or private sector productivity [e.g., Baxter and King (1990)].

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