UC Riverside
UC Riverside Previously Published Works

Title
Government size and macroeconomic stability: A comment

Permalink
https://escholarship.org/uc/item/0qv5m7m9

Journal
European Economic Review, 50(5)

ISSN
0014-2921

Authors
Guo, Jang-Ting
Harrison, S G

Publication Date
2006-07-01

Peer reviewed

Government Size and Macroeconomic Stability: A Comment[*]

Jang-Ting Guo
University of California, Riverside[†]

Sharon G. Harrison[‡]
Barnard College, Columbia University

February 23, 2005

Abstract

We show that in a standard, technology shock-driven one-sector real business cycle model, the stabilization effects of government fiscal policy depend crucially on how labor hours enter the household's period utility function and the associated labor-market behavior. In particular, as Galí (1994, *European Economic Review* 38, $117 - 132$) has shown, when the household utility is logarithmic in both consumption and leisure, income taxes are destabilizing and government purchases are stabilizing. However, the results are reversed when preferences are instead convex in hours worked. That is, income taxes are now stabilizing and public spending is destabilizing. Furthermore, under both preference specifications, the magnitude of cyclical fluctuations in output remains unchanged when the income tax rate and the share of government purchases in GDP are equal (including laissez-faire).

Keywords: Government Size, Macroeconomic Stability.

JEL Classification: E32, E62.

[†]Corresponding Author. Department of Economics, 4128 Sproul Hall, University of California, Riverside, CA, 92521, (951) 827-1588, Fax: (951) 827-5685, E-mail: guojt@ucr.edu.

[‡]Barnard College, Department of Economics, 3009 Broadway, New York, NY 10027, (212) 854-3333, Fax: (212) 854-8947, E-mail: sh411@columbia.edu.

1 Introduction

Galí (1994) and Fatás and Mihov (2001) present empirical evidence that documents a discernible negative relationship between government size, as measured by the income tax rate or the share of government purchases in GDP, and the magnitude of output fluctuations in OECD countries since 1960. These empirical results illustrate that both income taxes and public spending have been effectively working as "automatic stabilizers" in OECD economies. Motivated by this stylized fact, Galí (1994) analyzes the interrelations between the above-mentioned two fiscal variables and output variability in a canonical one-sector real business cycle (RBC) model with the household's period utility function being logarithmic in both consumption and leisure. It turns out that income taxes are destabilizing, and government purchases are stabilizing under the "log-log" preference specification. In this paper, we examine the robustness of Galí's (1994) theoretical results by considering a preference formulation that is consistent with balanced growth and commonly used in the RBC literature. Specifically, the household utility is also logarithmic in consumption, but convex in hours worked. We show that, contrary to Galí's (1994) findings, income taxes are stabilizing, and government purchases are destabilizing under the "convex in hours" utility specification.

To understand these results, we first note that in Galí's model, a higher income tax rate (public-spending share) lowers (increases) the steady-state employment, which in turn raises (reduces) the labor supply elasticity and enhances (dampens) the response of hours worked to a given technology shock. Therefore, output variability is positively (negatively) related to the income tax rate (public-spending share). However, the labor supply elasticity is a constant, governed by a preference parameter, under our "convex in hours" formulation. In this case, we show that the sign and magnitude of the employment response to a given productivity disturbance are determined by a coefficient that governs the economy's stable branch of the saddle path. Since this coefficient is a complicated function of model parameters and the two fiscal variables, we numerically verify that a higher income tax rate (public-spending share) reduces (raises) the volatility of output through a smaller (stronger) effect on employment. Overall, our analysis demonstrates that in the context of standard one-sector RBC models, the stabilization effects of government fiscal policy depend crucially on how hours worked enter the household's period utility function and the associated labor-market behavior.

2 The Model

There is a continuum of identical competitive firms in the economy, with the total number normalized to one. Each firm produces output y_t using a constant returns-to-scale Cobb-Douglas production function

$$y_t = z_t k_t^\alpha h_t^{1-\alpha}, \quad 0 < \alpha < 1, \tag{1}$$

where k_t and h_t are capital and labor inputs, respectively. In addition, z_t represents the technology shock that is assumed to evolve according to

$$z_{t+1} = z_t^\lambda \varepsilon_{t+1}, \quad 0 < \lambda < 1 \ \text{ and } \ z_0 \text{ is given}, \tag{2}$$

where ε_t is an i.i.d. random variable with unit mean and standard deviation σ_ε.

Under the assumption that factor markets are perfectly competitive, the firm's profit maximization conditions are given by

$$r_t = \alpha \frac{y_t}{k_t}, \tag{3}$$

$$w_t = (1 - \alpha) \frac{y_t}{h_t}, \tag{4}$$

where r_t is the capital rental rate and w_t is the real wage.

The economy is also populated by a unit measure of identical infinitely-lived households, each endowed with one unit of time. The representative household maximizes its expected lifetime utility

$$E_0 \left[\sum_{t=0}^\infty \beta^t U(c_t, h_t) \right], \quad 0 < \beta < 1, \tag{5}$$

where E is the conditional expectations operator, β is the discount factor, and c_t is consumption. In this paper, we consider the following two additively separable specifications of the period utility function $U(\cdot)$ that are commonly used in the real business cycle literature:

$$U_1 = \log c_t + A \log(1 - h_t), \quad A > 0, \tag{6}$$

and

$$U_2 = \log c_t - B \frac{h_t^{1+\gamma}}{1 + \gamma}, \quad B > 0 \text{ and } \gamma \geq 0, \tag{7}$$

where γ denotes the inverse of the intertemporal elasticity of substitution for labor supply. Notice that U_2 becomes linear in hours worked when $\gamma = 0$, which corresponds to the "indivisible labor" formulation described by Hansen (1985) and Rogerson (1988). Moreover, it is worth emphasizing that U_1, also studied by Galí (1994), is a special case of the non-separable preferences that are consistent with balanced growth (see King, Plosser and Rebelo, 1988, p. 202). As a result, the quantitative results based on U_1, reported in section 3, are qualitatively robust to multiplicatively separable utility functions that exhibit CRRA consumption and are increasing in leisure (see Galí, 1994, p. 119, footnote 4).

The budget constraint faced by the representative household is

$$c_t + i_t + b_{t+1} = (1 - \tau)(w_t h_t + r_t k_t) + \left[1 + (1 - \tau) r_t^b\right] b_t + T_t, \ b_0 \text{ is given,} \tag{8}$$

where i_t is investment, b_t is the one-period riskless government bond, τ is the (constant) income tax rate, r_t^b is the interest rate on risk-free bonds, and T_t is a lump-sum transfer. The law of motion for the capital stock is

$$k_{t+1} = (1 - \delta)k_t + i_t, \ k_0 \text{ is given,} \tag{9}$$

where $\delta \in (0, 1)$ is the capital depreciation rate.

The first-order conditions for the household's optimization problem are given by

$$A \frac{c_t}{1 - h_t} = (1 - \tau) w_t, \tag{10}$$

$$B c_t h_t^\gamma = (1 - \tau) w_t, \tag{11}$$

$$\frac{1}{c_t} = \beta E_t \left\{ \frac{1}{c_{t+1}} \left[1 - \delta + (1 - \tau) r_{t+1}\right] \right\}, \tag{12}$$

$$\frac{1}{c_t} = \beta E_t \left\{ \frac{1}{c_{t+1}} \left[1 + (1 - \tau) r_{t+1}^b\right] \right\}, \tag{13}$$

$$\lim_{t \to \infty} \beta^t \frac{k_{t+1}}{c_t} = 0, \tag{14}$$

$$\lim_{t \to \infty} \beta^t \frac{b_{t+1}}{c_t} = 0, \tag{15}$$

where (10) and (11) are intra-temporal conditions that equate the household's marginal rate of substitution between consumption and leisure, for U_1 and U_2 respectively, to the after-tax real

3

wage. In addition, (12) and (13) are the standard Euler equations for intertemporal choices of consumption and bonds, which imply that the after-tax returns to capital (net of depreciation) and government debt are equalized in each period. Finally, equations (14) and (15) are the transversality conditions.

The government sets the tax rate τ and $\{g_t, b_{t+1}, T_t\}_{t=0}^{\infty}$, subject to the following budget constraint:

$$b_{t+1} = \left[1 + (1-\tau)\, r_t^b\right] b_t + T_t + g_t - \tau y_t, \tag{16}$$

where g_t denotes government purchases, which are postulated to be a constant fraction θ of output, that is, $g_t/y_t = \theta$, for all t. Finally, the aggregate resource constraint for the economy is given by

$$c_t + k_{t+1} - (1-\delta)k_t + g_t = y_t. \tag{17}$$

As pointed out by Galí (1994, p. 120), a version of Ricardian equivalence holds in the above model. In particular, given the "constant share" government purchases rule and the initial capital stock, equilibrium allocations $\{c_t, k_{t+1}, g_t, y_t\}_{t=0}^{\infty}$ are completely independent of the infinite many debt/transfer sequences $\{b_{t+1}, T_t\}_{t=0}^{\infty}$ that satisfy the government budget constraint (16) and the transversality condition (15). As a result, our analysis is robust to allowing for a balanced-budget requirement where $b_t = 0$, for all t.

To analyze the model's business cycle properties, we first derive the unique interior steady state, and then take log-linear approximations to the equilibrium conditions in its neighborhood to obtain the following dynamic system:

$$\begin{bmatrix} \hat{k}_t \\ \hat{c}_t \\ \hat{z}_t \end{bmatrix} = J \begin{bmatrix} \hat{k}_{t+1} \\ \hat{c}_{t+1} \\ \hat{z}_{t+1} \end{bmatrix} - \begin{bmatrix} \hat{k}_{t+1} - E_t\left(\hat{k}_{t+1}\right) \\ \hat{c}_{t+1} - E_t\left(\hat{c}_{t+1}\right) \\ \hat{\varepsilon}_{t+1} \end{bmatrix}, \quad \hat{k}_0 \text{ and } \hat{z}_0 \text{ are given,} \tag{18}$$

where hat variables denote percent deviations from their steady-state values, and J is the Jacobian matrix of partial derivatives of the transformed dynamic system.

It is straightforward to show that our model exhibits saddle-path stability, hence two eigenvalues of J lie outside and the other inside the unit circle. To find the unique rational expectations solution to (18), we iterate the "stable" root (inside the unit circle) of J forward to obtain the stable branch of the saddle path, which expresses $\hat{c}_t$ as a linear function of $\hat{k}_t$ and $\hat{z}_t$

4

$$\hat{c}_t = q_1 \hat{k}_t + q_2 \hat{z}_t, \text{ for all } t, \tag{19}$$

where q_1 and q_2 are complicated functions of the model's parameters and the two fiscal variables (τ and θ).

3   Simulation Results

In this section, we compare and contrast the magnitudes of macroeconomic fluctuations generated by two versions of our model economy. Specifically, Model 1 exhibits Galí's (1994) "log-log" period utility function given by (6), whereas the "convex in hours" preference formulation (7) is adopted in Model 2. Each period in the model is taken to be one quarter, and laissez-faire ($\tau = \theta = 0$) is regarded as the benchmark specification. As is common in the real business cycle literature, the capital share of national income, α, is chosen to be 0.3; the discount factor, β, is set equal to 1/1.01; and the capital depreciation rate, δ, is fixed at 0.025. Moreover, following Kydland and Prescott (1982) and Hansen (1985), we choose the persistence parameter for the technology shock, λ, to be 0.95; and the standard deviation of its innovations, σ_ε, to be 0.007.

Next, the preference parameters, A in (6), together with B and γ in (7), are calibrated so that the steady-state labor hours, denoted as $\bar{h}$, is equal to 0.3 in both economies. We also calibrate the two models to display the same labor supply elasticity. Setting $A = 2.079$ in Model 1 results in the desired steady-state hours worked; and the associated labor supply elasticity, given by $\frac{1-\bar{h}}{\bar{h}}$, is equal to 2.333. It follows that $B = 4.975$ and $\gamma = 0.4286$ in Model 2. Finally, we simulate each model, driven by an identical sequence of productivity disturbances, for $2,000$ periods.

Table 1 presents the simulation results for Model 1. The numbers reported are standard deviations of $\hat{y}_t$, defined as the percent deviation of output from its steady-state value, under different τ and θ configurations. As in Galí (1994), we find that holding the share of government purchases in GDP constant, a higher tax rate raises the volatility of output $\left(\frac{\partial \sigma_{\hat{y}}}{\partial \tau} > 0\right)$. By contrast, holding the tax rate constant, a higher income share of public spending leads to a reduction in output variability $\left(\frac{\partial \sigma_{\hat{y}}}{\partial \theta} < 0\right)$. In sum, when the period utility function is logarithmic in both consumption and leisure, income taxes are destabilizing and government purchases are stabilizing.

Table 1: Output Variability $\sigma_{\hat{y}}$ in Model 1

τ / θ	0	0.1	0.2	0.3	0.4
0	3.880	3.835	3.774	3.694	3.585
0.1	3.919	3.880	3.829	3.758	3.661
0.2	3.953	3.923	3.880	3.821	3.737
0.3	3.983	3.960	3.928	3.880	3.811
0.4	4.007	3.992	3.969	3.934	3.880

To understand the results in Table 1, we first note that the expressions for the steady-state hours worked and labor supply elasticity are given by

$$\bar{h} = \frac{1 - \alpha}{A \left(\frac{1-\theta}{1-\tau} \right) + 1 - \alpha - \frac{\alpha \delta A}{\rho + \delta}}, \quad \text{where } \rho = \frac{1}{\beta} - 1, \tag{20}$$

and $\frac{1-\bar{h}}{\bar{h}}$, respectively. Therefore, an increase in τ lowers the steady-state employment through its negative effect on the after-tax real wage. This in turn raises the labor supply elasticity and enhances the employment response to a given technology shock (the *employment effect*). As a result, output volatility is positively related to the tax rate, i.e., income taxes behave as *automatic destabilizers*. On the other hand, since government spending does not contribute to either production or the household utility, an increase in θ is equivalent to a pure resource drain that reduces the household's consumption and leisure through the negative wealth effect. This causes the steady-state labor hours to rise and the labor supply elasticity to fall, thereby resulting in a smaller employment effect. Consequently, output variability is negatively related to the share of public spending in GDP, i.e., government purchases behave as *automatic stabilizers*.

Table 2 presents the standard deviations of $\hat{y}_t$ for Model 2, using the same values of τ and θ as in Table 1. Notice that the results are now qualitatively opposite to those in Model 1. That is, when the household utility is logarithmic in consumption and convex in hours worked, income taxes are stabilizing $\left(\frac{\partial \sigma_{\hat{y}}}{\partial \tau} < 0 \right)$ and government purchases are destabilizing $\left(\frac{\partial \sigma_{\hat{y}}}{\partial \theta} > 0 \right)$.

Table 2: Output Variability $\sigma_{\hat{y}}$ in Model 2

τ / θ	0	0.1	0.2	0.3	0.4
0	3.880	3.889	3.900	3.914	3.930
0.1	3.873	3.880	3.890	3.903	3.919
0.2	3.866	3.872	3.880	3.891	3.906
0.3	3.860	3.864	3.871	3.880	3.893
0.4	3.855	3.858	3.863	3.870	3.880

To understand the results in Table 2, we substitute (1) and (4) into (11), and then log-linearize around the steady state to obtain

$$\hat{h}_t = \frac{1}{\alpha + \gamma}\hat{z}_t + \frac{\alpha}{\alpha + \gamma}\hat{k}_t - \frac{1}{\alpha + \gamma}\hat{c}_t. \tag{21}$$

Next, plugging the stable branch of the saddle path (19) into (21), and totally differentiating both sides yields

$$\frac{d\hat{h}_t}{d\hat{z}_t} = \left(\frac{\alpha - q_1}{\alpha + \gamma}\right)\frac{d\hat{k}_t}{d\hat{z}_t} + \frac{1 - q_2}{\alpha + \gamma}, \tag{22}$$

where $\frac{d\hat{k}_t}{d\hat{z}_t} = 0$ because k_t is predetermined at period $t-1$. Therefore, the sign and magnitude of $\frac{d\hat{h}_t}{d\hat{z}_t}$ depend crucially on q_2. As mentioned earlier, q_2 is a complicated function of the model's parameters and the two fiscal variables, thus we numerically verify that

$$0 < q_2 < 1, \ \frac{\partial q_2}{\partial \tau} > 0, \ \text{and} \ \frac{\partial q_2}{\partial \theta} < 0, \tag{23}$$

for all the (τ, θ) settings under consideration. Combining (22) and (23) shows that (i) labor hours respond procyclically to technology shocks $\left(\frac{d\hat{h}_t}{d\hat{z}_t} > 0\right)$; (ii) a higher income tax rate reduces the volatility of output through a smaller response of employment to a given productivity disturbance; and (iii) in contrast, a higher share of public spending in GDP raises output variability because of a stronger employment effect. In sum, other things being equal, income taxes behave as *automatic stabilizers*, and government purchases behave as *automatic destabilizers* in Model 2.

We also find that in both Tables, the magnitude of cyclical fluctuations in output remains unchanged along the diagonal. Intuitively, identical changes in τ and θ do not affect the steady-state hours worked (see equation 20) or the labor supply elasticity in Model 1; and generate offsetting impacts on q_2 (see equation 23) in Model 2. As a result, when $\tau = \theta$, the employment response to a given technology shock and the resulting volatility in output are both independent of government size (including laissez-faire). It follows that in this special case, neither model is able to account for the observed negative relationship between government size and output variability found by Galí (1994) and Fatás and Mihov (2001).

Finally, we note that the effects of government size on changes in output variability generated in Model 1 are quantitatively weaker than those in Galí's (1994) formulation, which in turn are far smaller than the empirical evidence illustrates (see Galí, 1994, and Fatás and Mihov, 2001). These differences are attributable to (i) Galí uses an annual parametrization in

7

his simulations, whereas ours is quarterly; and (ii) we use a smaller standard deviation of the innovations to technology shocks. Moreover, the predicted changes in the magnitude of output volatility are even smaller in Model 2. This is due to the fact that unlike in Model 1, the labor supply elasticity remains fixed as government size changes, resulting in a smaller variability effect. We have verified that using a smaller value of γ (thus raising the labor supply elasticity) in Model 2 leads to a stronger impact of fiscal changes. In conclusion, it would be worthwhile to develop real business cycle models that are able to account for, both qualitatively and quantitatively, the stabilization effects of government fiscal policy as observed in the data.

References

[1] Fatás, A. and I. Mihov, "Government Size and Automatic Stabilizers: International and Intranational Evidence," *Journal of International Economics*, 55(2001), 3-28.

[2] Galí, J., "Government Size and Macroeconomic Stability," *European Economic Review*, 38(1994), 117-132.

[3] Hansen, G.D., "Indivisible Labor and the Business Cycle," *Journal of Monetary Economics*, 16(1985), 309-327.

[4] King, R.G., C.I. Plosser and S.T. Rebelo, "Growth and Business Cycles I. The Basic Neoclassical Model," *Journal of Monetary Economics,* 21(1988), 195-232.

[5] Kydland, F. and E. Prescott, "Time to Build and Aggregate Fluctuations", *Econometrica*, 50(1982), 1345-1370.

[6] Rogerson, R., "Indivisible Labor, Lotteries, and Equilibrium," *Journal of Monetary Economics*, 21(1988), 3-16.