# The Stabilizing Role of Government Size

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## Introduction

- In this paper we study how **alternative models** of the business cycle can replicate the stylized fact that economies with **large governments are less volatile.**
- Galí (1994) and Fatás and Mihov (2001): **countries or regions** with large governments display less volatile economies.
- Understanding this correlation is **crucial** to improve on the ability of models to replicate the stylized facts of the business cycle.
- The approach of this paper is to explore **alternative theories** and probe into the **different mechanisms** that can explain this evidence.
- This is a **challenging task**. As shown in Galí (1994) **RBC** models cannot explain this fact.

- We compare the predictions of a standard RBC model to those of models that incorporate **nominal rigidities**, **costs of adjustment** for capital and **rule-of-thumb consumers**.
- **Reasons**:
  - These are models that are more likely to generate the type of **Keynesian effects** observed in the data.
  - They are increasingly being used by researchers who struggle to explain **other puzzles also related to fiscal policy**, e.g., consumption increases in response to exogenous increases in government spending (see Fatás and Mihov, 2002, or Perotti, 2002). This fact has been partially accounted for by Galí , López-Salido and Vallés (2003).

- The **evidence** can lead to the easy temptation of arguing that this is the result of **automatic stabilizers** ..
  ... but we need to **understand** the stabilizing properties of large governments in a **dynamic stochastic general equilibrium model**.

- Our main **findings** are the following:
  - ▶ Adding nominal rigidities and costs of capital adjustment can generate a negative correlation between government size and the volatility of output, but because of a **composition effect**.
  - ▶ In this basic model **private consumption** and investment become **more volatile**, as government size increases.
  - ▶ Introducing **rule-of-thumb consumers** consumption volatility is also **reduced** when government size increases.

- The **structure** of this paper:
  - ▶ Basic empirical evidence
  - ▶ Model with nominal and real rigidities.
  - ▶ Main implications in terms of the relationship between government size and macroeconomic volatility.
  - ▶ We introduce rule-of-thumb consumers
  - ▶ Conclusions

## Empirical evidence

- The **negative correlation** between government size and business cycle volatility has been documented, among others, by Galí (1994) and Fatás and Mihov (2001).
- We measure **government size** by the log of the GDP share of total government expenditures ($\ln G/Y$).
- **Output volatility** for the period 1960-97:
  - ▶ The standard deviation of GDP growth rates ($\Delta \ln Y$)
  - ▶ The standard deviation of the GDP per capita growth rates ($\Delta \ln y$).
  - ▶ The standard deviation of the HP cyclical component of the GDP ($Y^c$).
  - ▶ The standard deviation of the cyclical component of GDP per capita ($y^c$).

- In all cases, the coefficient of government size is **negative and very significant**.
- We have analyzed the inclusion of **some additional regressors**: openness, the log of GDP per capita, the log of GDP (to control for the economy size), and the average rate of growth of GDP per capita ($\overline{\Delta \ln y}$). Their inclusion **does not affect** the significance of the government size coefficient.
- After controlling for **endogeneity** (instrumental variables) the negative correlation is still present.
- Finally in columns (7) and (8) we present the correlation between the volatility of **private consumption growth** ($\Delta \ln c$) and government size.
- We take as given the empirical finding that there is a negative correlation between government size and business cycles.

- This correlation between size of government and volatility has been **refined by several recent studies**: Martinez-Mongay (2002), Martinez-Mongay and Sekkat (2003), Silgoner, Reitschuler, Crespo-Cuaresma (2003).

Table 1
Government size and output volatility

| | Dependent variable: standard deviation of | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | $\Delta \ln Y$ | $\Delta \ln y$ | $\Delta \ln y$ | $Y^c$ | $y^c$ | $y^c$ | $\Delta \ln c$ | $\Delta \ln c$ |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| $\ln(G/Y)$ | -0.0190 | -0.0200 | -0.0115 | -0.0092 | -0.0110 | -0.0080 | -0.0200 | -0.0116 |
| | (4.19) | (3.87) | (2.60) | (3.17) | (2.94) | (3.84) | (2.52) | (2.25) |
| $d$ | | | | | | 0.0082 | -0.0140 | -0.0100 |
| | | | | | | (11.4) | (3.36) | (4.45) |
| $\ln(\frac{X+M}{Y})$ | | | | | | | | |
| $\ln y$ | | | -0.0084 | | | | | -0.0058 |
| | | | (4.02) | | | | | (1.60) |
| $\overline{R}^2$ | 0.3857 | 0.3537 | 0.5875 | 0.1986 | 0.2479 | 0.7029 | 0.3903 | 0.4148 |
| $\frac{\partial \ln \sigma_i}{\partial \ln(G/Y)}$ | -0.7194 | -0.7625 | -0.4463 | -0.6341 | -0.7208 | -0.5579 | -0.7170 | -0.4495 |
| | (4.12) | (3.83) | (2.40) | (3.30) | (3.26) | (3.70) | (2.87) | (2.22) |

## The model

- This empirical evidence **cannot** be explained with a **standard RBC model** (Galí, 1994)
- Simple textbook **IS-LM models** predict that government size is negatively correlated with the volatility of output.
- This invites the inclusion of **Keynesian characteristics** in dynamic general equilibrium models as the one proposed by Andrés and Doménech (2003).

## Nominal inertia

- The economy is populated by $i$ intermediate **firms**

$$y_{it} = y_t \left( \frac{P_{it}}{P_t} \right)^{-\varepsilon} \tag{1}$$

- Each period $1 - \phi$ **firms** set their prices, $\widetilde{P}_{it}$, to maximize the present value of future profits,

$$\max_{\widetilde{P}_{it}} E_t \sum_{j=0}^{\infty} \rho_{it,t+j} (\beta\phi)^j \left[ \widetilde{P}_{it} \overline{\pi}^j y_{it+j} - P_{t+j} mc_{it,t+j} (y_{it+j} + \kappa) \right] \tag{2}$$

- The remaining **($\phi$ per cent) firms** set $P_{it} = \overline{\pi} P_{it-1}$ where $\overline{\pi}$ is the steady-state rate of inflation.
- As **Sbordone** (2002) we assume that capital cannot be instantaneously reallocated across firms.

## Capital and labor demand

- **Cost** minimization process of the firm:

$$\min_{k_{it},l_{it}} \left(r_t k_{it} + w_t l_{it}\right) \tag{3}$$

subject to

$$y_{it} = A_t k_{it}^{\alpha} l_{it}^{1-\alpha} - \kappa \tag{4}$$

- Aggregating the first order conditions of this problem we obtain the **demand for labor** ($l_t$) and **capital** ($k_t$),

$$w_t = mc_t(1-\alpha)Ak_t^{\alpha}l_t^{-\alpha} \tag{5}$$

$$r_t = mc_t \alpha A k_t^{\alpha-1} l_t^{1-\alpha} \tag{6}$$

## Households

- **Utility** function:

$$U(c_t, 1-l_t, g_t^c, g_t^p) = \frac{(c_t(1-l_t)^\gamma)^{1-\sigma} - 1}{1-\sigma} + \Gamma(g_t^c, g_t^p) \tag{7}$$

- **Cash-in-advance** constraint

$$P_t(1+\tau_t^c)c_t \leq M_t + \tau_t^m \tag{8}$$

- **Budget** constraint:

$$M_{t+1} + \frac{B_{t+1}}{(1+i_{t+1})} + P_t(1+\tau_t^c)c_t + P_t e_t \tag{9}$$

$$= P_t(1-\tau_t^w)w_t l_t + P_t(1-\tau_t^k)r_t k_t + B_t + M_t + \tau_t^m + P_t g_t^s + \int_0^1 \Omega_{it} di$$

- **Capital adjustment costs** $\Phi\left(e_t/k_t\right)$

$$k_{t+1} = \Phi\left(\frac{e_t}{k_t}\right)k_t + (1-\delta)k_t \tag{10}$$

## Equilibrium

- The symmetric monopolistic competition equilibrium is **defined** as
  - the set of **quantities** that maximizes the constrained present value of the stream of utility of the representative household and the constrained present value of the profits earned by the representative firm,
  - the set of **prices** that clears the goods markets, the labor market and the money, bonds and capital markets.

- The model is completed with the **rules** of the policy instruments.
- **Monetary policy** is represented by a standard Taylor rule:

$$i_t = \rho_r i_{t-1} + (1-\rho_r)\bar{i} + (1-\rho_r)\rho_\pi(\pi_t - \overline{\pi}) + (1-\rho_r)\rho_y \widehat{y}_t + z_t^i \quad (11)$$

- The theoretical requirements of a Ricardian policy can be satisfied with a **fiscal rule** in lump-sum transfers, which is this basic model do not have any effect upon other variables with the exception of public debt:

$$\widehat{g}_t^s = \alpha_b^s \left(b_t - \overline{b}\right) + \alpha_y^s \widehat{y}_t + \varepsilon_t^s, \qquad \alpha_b \geq 0 \quad (12)$$

Table 2
Calibration of baseline model

| $\sigma$ | $\beta$ | $\gamma$ | $\alpha$ | $\varepsilon$ | $\delta$ | $\sigma_z$ | $\rho_z$ |
|---|---|---|---|---|---|---|---|
| 1.0 | $1.03^{-\frac{1}{4}}$ | 1.295 | 0.40 | 6.0 | 0.021 | 0.0078 | 0.80 |
| $\tau^w$ | $\tau^k$ | $\tau^c$ | $g^c/y$ | $g^s/y$ | $\rho_r$ | $\rho_\pi$ | $\pi$ |
| 0.279 | 0.279 | 0.10 | 0.18 | 0.16 | 0.5 | 1.5 | $1.02^{0.25}$ |

## Calibration

- We have obtained a **numerical solution** of the steady state as well as of the log-linearized system.
- The **calibration is relatively standard** since most of the values of the parameters appearing in the different equations are common to many business-cycle models.
- The **baseline model** with technology shocks has been simulated 100 times, producing 200 observations. We take the last 100 observations.

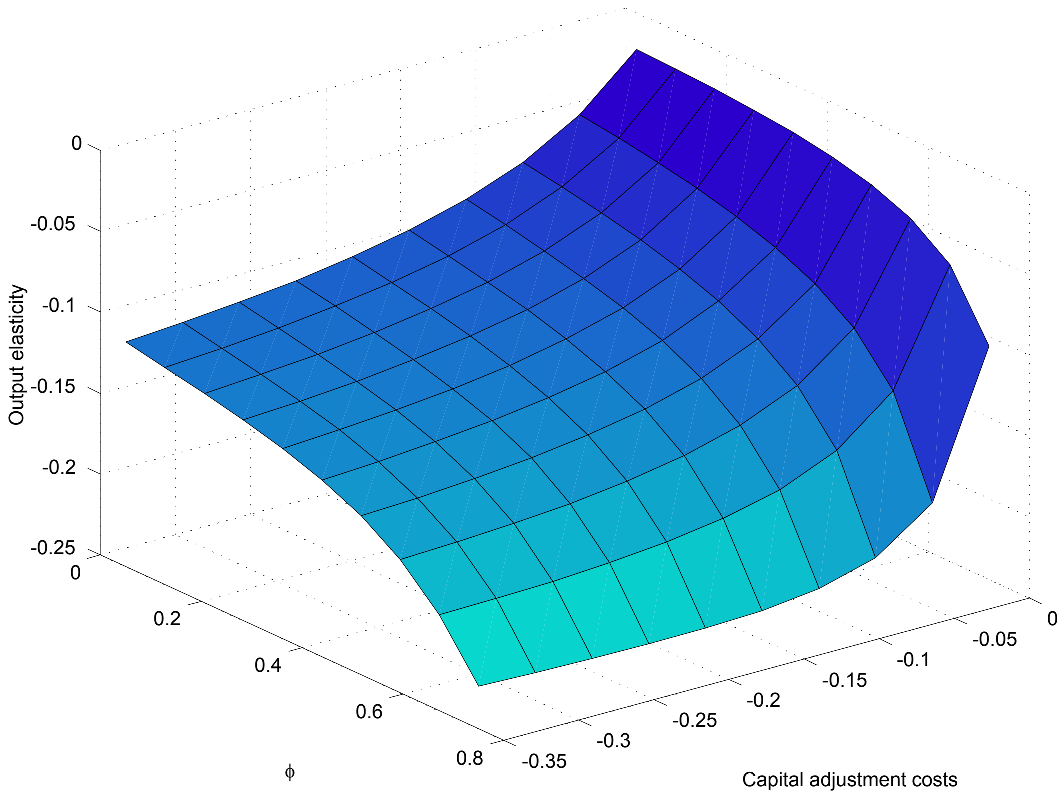
## Government size and output volatility

- We will start with a **baseline economy** ($b$) and we will then look at transformations ($j$) in which government expenditures and tax rates are **proportional**:
$$\tau_j^i = \eta \tau_b^i$$
$$g_j^i / y_j = \eta g_b^i / y_b$$
where $0.5 \leq \eta \leq 1.5$. Finally we set $\alpha_b = 0.15$.
- The case when $\Theta = \phi \simeq 0$ the economy is a **standard RBC** model with no price rigidities or adjustment costs to investment. In this case we obtain results which are similar to Galí's (1994) findings. As government size increases, **output volatility barely changes**.
- Adding **nominal rigidities** and **costs of adjustment** to investment makes the economy **less volatile**.

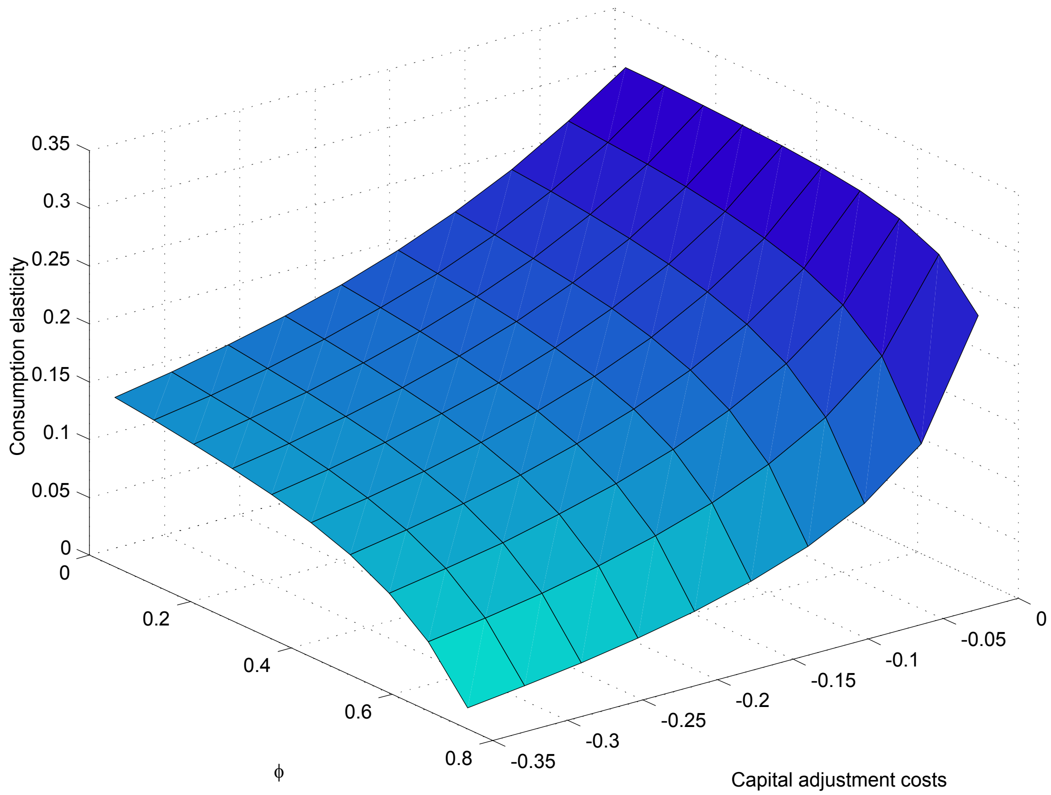
- As we move down through rows 2 to 4, is that the **volatility of output decreases** more and more as we increase government size.
- In the case where $\Theta = 0.25$ and $\phi = 0.75$ the elasticity of output volatility to government size is approximately $1/2$ the estimated elasticity in Table 1.
- In **Figures 1 and 2** we generalized the results of Table 1.

Table 3
Government size and output volatility

| | Output | | | Consumption | | |
|---|---|---|---|---|---|---|
| | $\sigma_y$ | $\sigma_y$ | $\frac{\partial \ln \sigma_y}{\partial \ln(G/Y)}$ | $\sigma_c$ | $\sigma_c$ | $\frac{\partial \ln \sigma_c}{\partial \ln(G/Y)}$ |
| | $\eta = 0.5$ | $\eta = 1.5$ | | $\eta = 0.5$ | $\eta = 1.5$ | |
| $\Theta = \phi = 0$ | 2.179 | 2.134 | -0.020 | 0.949 | 1.412 | 0.362 |
| $\Theta = 0, \phi = 0.75$ | 2.721 | 2.358 | -0.130 | 1.107 | 1.480 | 0.265 |
| $\Theta = 0.25, \phi = 0$ | 1.630 | 1.437 | -0.115 | 1.182 | 1.454 | 0.189 |
| $\Theta = 0.25, \phi = 0.75$ | 0.781 | 0.593 | -0.251 | 0.642 | 0.664 | 0.030 |




The elasticity of output to government size as a function of nominal and real rigidities when public consumption is acyclical.




The elasticity of consumption to government size as a function of nominal and real rigidities when public consumption is acyclical.

## Why do larger governments have less volatile business cycles?

- The volatility of **consumption** increases when government size increases.
- The same effect is present when we look at **investment.**
- So far, larger governments reduce the volatility of output only because of a **composition effect**: because government spending is not volatile and we are increasing the size of the (non-volatile) component of GDP.

- **Why** do consumption and investment volatility increase when $G/Y$ increases?
  - An increase in the **investment multiplier**: greater $G/Y$ implies a lower steady-state level of the capital to output ratio and, therefore, a larger response of investment to changes in productivity.
  - The increase in the volatility of capital (wealth) leads to a greater volatility of consumption.
  - Greater $G/Y$ implies a **lower steady-state level of employment** that makes the response of hours **larger**.

- Nevertheless, this effect is the **weakest** for the economies where **rigidities are the largest**.
- **More rigidities lead a to lower response of investment** to productivity shocks and this response (the multiplier) is also less responsive when $G/Y$ increases. The response of **consumption** follows that of investment.
- **Sensitivity** tests in Table 4. In all cases, the main results barely change.
- These preliminary results show that the model with real and nominal rigidities is **only partially** able to account for the empirical evidence about volatility and government size.

Table 4
Sensitivity to parameter changes

| | Output | | | Consumption | | |
|---|---|---|---|---|---|---|
| | $\sigma_y$ | $\sigma_y$ | $\frac{\partial \ln \sigma_y}{\partial \ln(G/Y)}$ | $\sigma_c$ | $\sigma_c$ | $\frac{\partial \ln \sigma_c}{\partial \ln(G/Y)}$ |
| | $\eta = 0.5$ | $\eta = 1.5$ | | $\eta = 0.5$ | $\eta = 1.5$ | |
| $\sigma = 2$ | 0.636 | 0.483 | -0.251 | 0.339 | 0.327 | -0.034 |
| $\gamma = 0.63$ | 0.931 | 0.746 | -0.202 | 0.759 | 0.813 | 0.062 |
| $\alpha^y = -1$ | 0.742 | 0.510 | -0.341 | 0.666 | 0.717 | 0.067 |
| $\sigma = 2, \gamma = 2, \alpha^y = -1$ | 0.546 | 0.363 | -0.372 | 0.330 | 0.315 | -0.043 |

## Introducing rule-of-thumb consumers

- By looking at consumers that cannot borrow or lend but simply spend all their current income, we are able to **uncouple the dynamics of wealth** from that of **consumption**.
- The response of **consumption** for those individuals might **mimic** closer that of **GDP**.
- We introduce rule-of-thumb consumers in the **usual** fashion: a proportion ($\lambda$) of consumers will spend all of their **current income** as consumption while the rest will follow the same optimizing behavior as in the previous version of the model.
- Rule-of-thumb consumers **maximize** their **utility** subject to a **current** budget restriction:

$$P_t(1+\tau_t^c)c_{rt} = P_t(1-\tau_t^w)w_t l_{rt} + P_t \lambda g_t^s$$

- After the aggregation of the optimality conditions for both types of consumption, the equilibrium includes **two new conditions**

$$c_t = \frac{\lambda}{(1+\tau_t^c)} \left[ \frac{(1-\tau_t^w)w_t}{1+\gamma} + \frac{\lambda g_t^s}{1+\gamma} \right] + (1-\lambda)c_{ot} \tag{13}$$

$$l_t = \frac{\lambda}{1+\gamma} \left[ 1 - \frac{\gamma \lambda g_t^s}{(1-\tau_t^w)w_t} \right] + (1-\lambda)l_{ot} \tag{14}$$

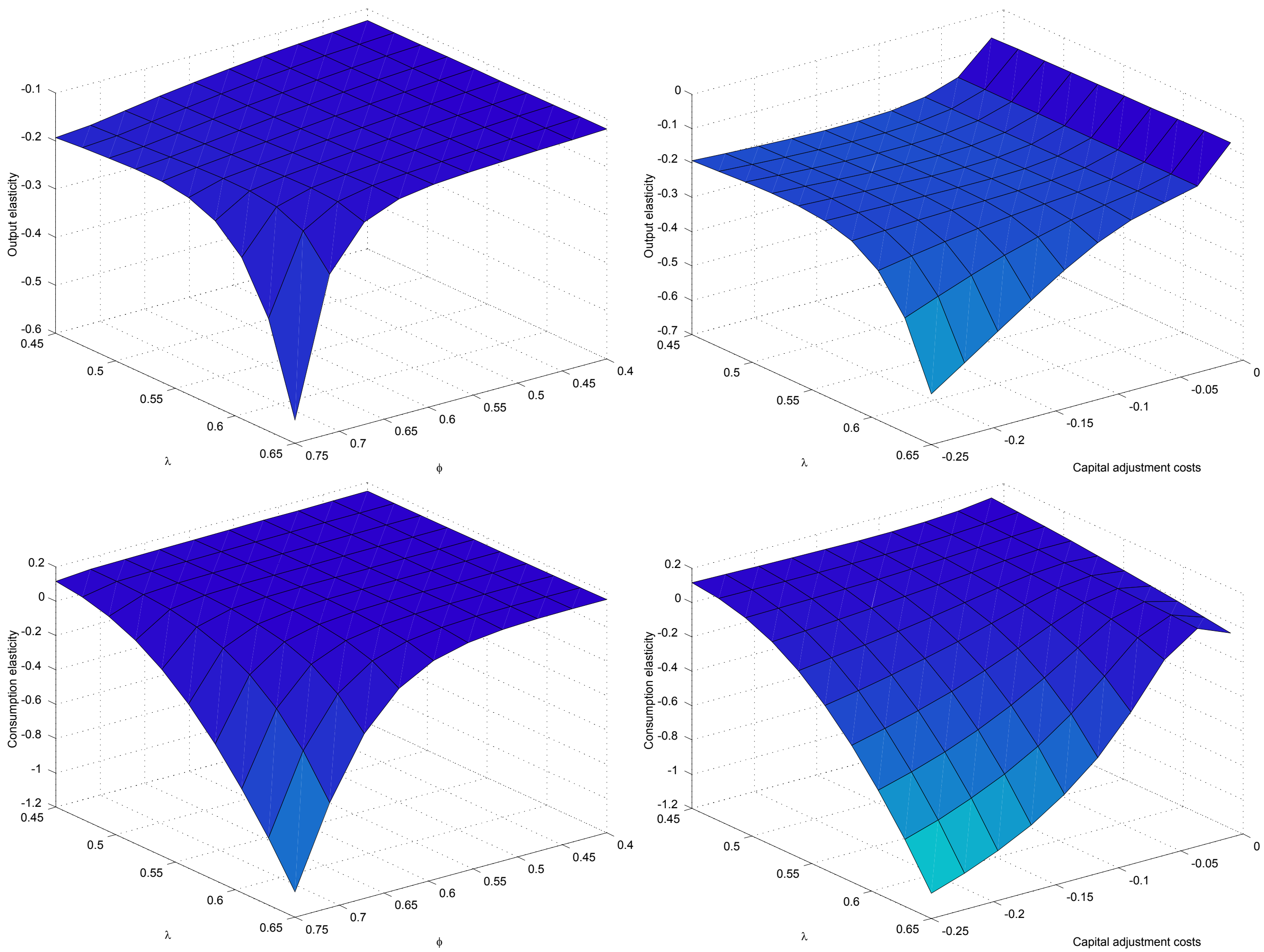
- **Euler equation** now changes to

$$1 = \beta E_t \left( \frac{(1+\tau_t^c)c_{ot+1}^{-\sigma}(1-l_{ot+1})^{\gamma(1-\sigma)}}{(1+\tau_{t+1}^c)c_{ot}^{-\sigma}(1-l_{ot})^{\gamma(1-\sigma)}} \frac{1+i_{t+1}}{\pi_{t+1}} \right) \tag{15}$$

Table 5
Government size and output with $\lambda = 0.65$

| | Output | | | Consumption | | |
|---|---|---|---|---|---|---|
| | $\sigma_y$ | $\sigma_y$ | $\frac{\partial \ln \sigma_y}{\partial \ln(G/Y)}$ | $\sigma_c$ | $\sigma_c$ | $\frac{\partial \ln \sigma_c}{\partial \ln(G/Y)}$ |
| | $\eta = 0.5$ | $\eta = 1.5$ | | $\eta = 0.5$ | $\eta = 1.5$ | |
| $\Theta = \phi = 0$ | 1.897 | 1.937 | 0.027 | 1.009 | 1.308 | 0.236 |
| $\Theta = 0, \phi = 0.75$ | 2.292 | 2.181 | -0.045 | 1.460 | 1.495 | 0.022 |
| $\Theta = 0.25, \phi = 0$ | 1.591 | 1.438 | -0.092 | 1.208 | 1.439 | 0.159 |
| $\Theta = 0.25, \phi = 0.75$ | 0.864 | 0.516 | -0.469 | 1.337 | 0.482 | -0.928 |

- **Table 5**: there is a stabilizing effect of government size on consumption.
- The overall **stabilizing effect on output** becomes even **larger** and close to the empirical estimates of Table 1.
- **Figure 3** illustrates some interesting additional results:
  - A **low share** of this class of consumers barely affects the volatility of output
  - In a **RBC** model the value of $\lambda$ **does not affect** the standard deviation of private consumption.
  - The presence of rule-of-thumb consumers only makes a difference in economies with **strong nominal and real rigidities**.


Output elasticity
λ
ϕ
Output elasticity
λ
Capital adjustment costs
Consumption elasticity
λ
ϕ
Consumption elasticity
λ
Capital adjustment costs

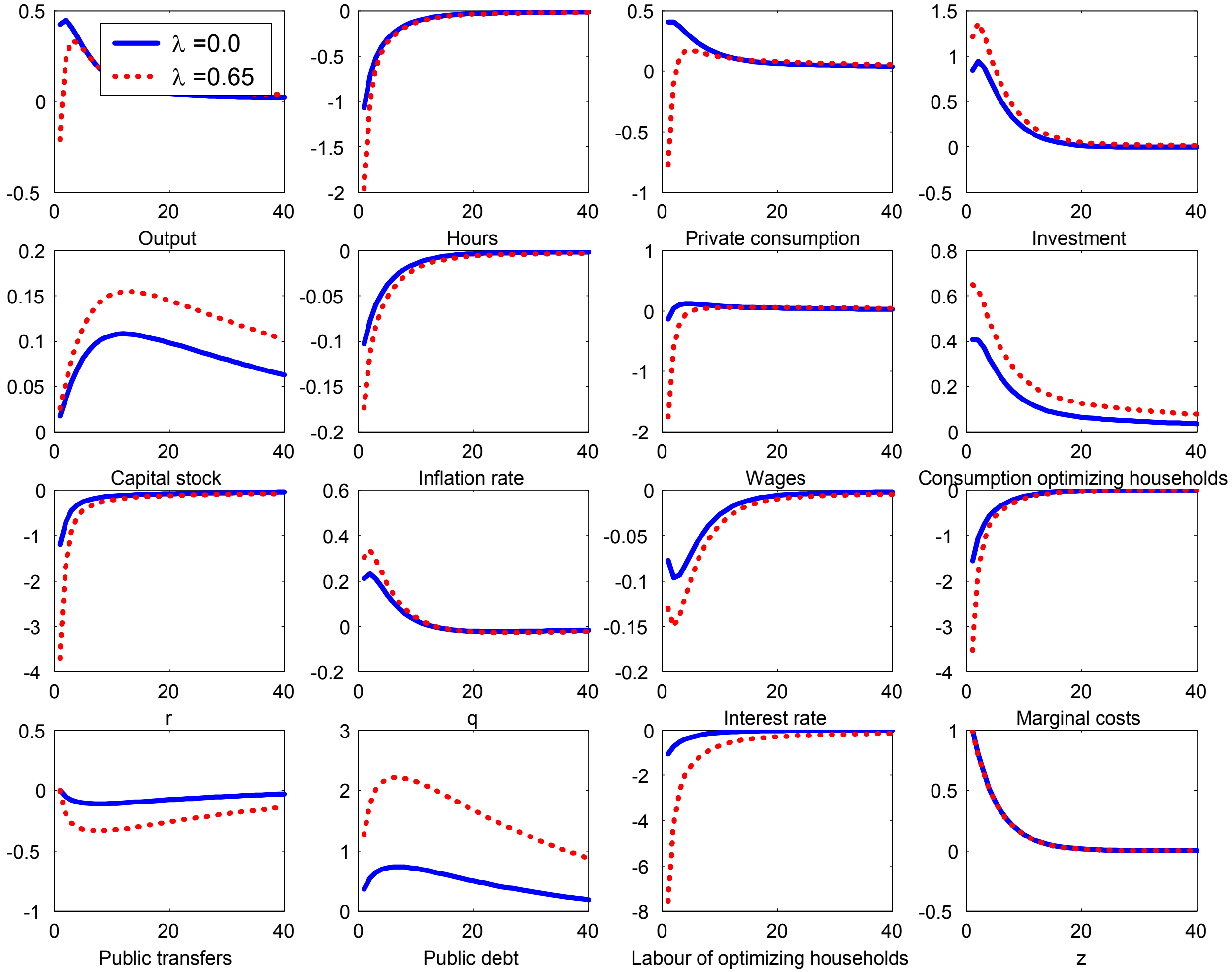
- **Understanding** the intuition behind these result is **crucial**.
- The **empirical** evidence establishes that **hours** tend to **fall** on impact following a positive technology shock.
- **Gali** (1999) argues that this is a puzzling result in a standard **RBC model** but it comes out naturally from an optimizing model with significant **nominal rigidities**:

  When **prices** are almost **constant** in the short run firms face a **constant demand**. For a higher level of productivity employment has to go down.
- Consumption should not fall if consumers are **forward looking** since permanent income rises as a result of the technology shock.

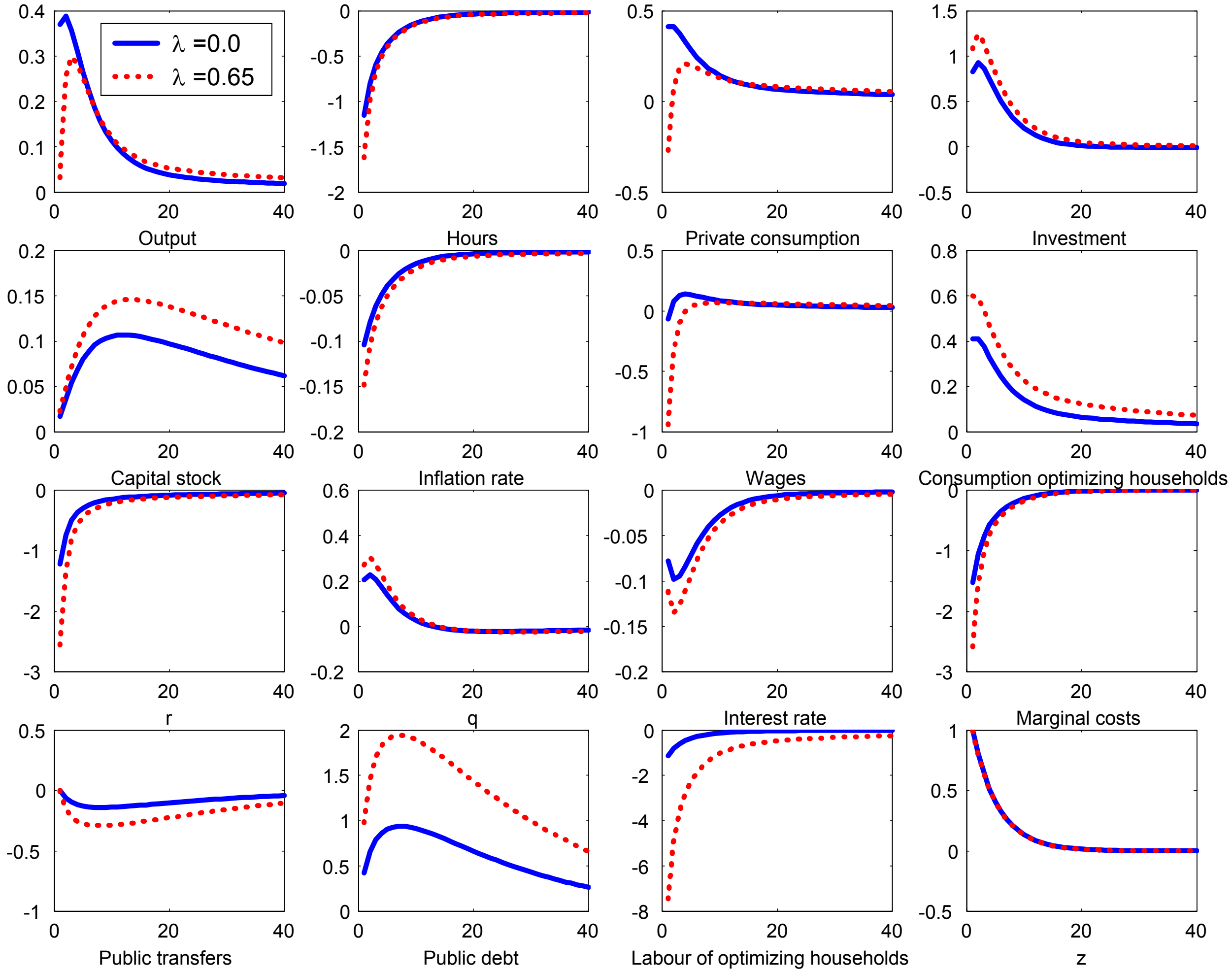
- As the size of **government increases**, the marginal rate of labour taxes augments making **labour supply of more elastic**.
- This implies a lower response of **wages and labour income.**
- **Rule-of-thumb consumers** reduce their consumption along with their current labour income. Larger governments help to **smooth** the income of consumers.
- By **moderating the fall** in labor income of the rule-of-thumb consumers, it also moderates the fall in their consumption and, as a result, consumption becomes **less volatile**.
- This explains why consumption expenditures of this type of households is **less sensitive to technology shocks** as the **size** of the government **increases**, thus reducing the volatility of aggregate consumption.

## Conclusions

- We have analyzed which type of **models** can explain the **negative correlation** between government size and volatility.
- A variety of **frictions** are necessary to replicate the evidence.
- The volatility of output falls with the rise of government size provided that the economy features enough **nominal and real rigidities**, via a **composition effect**.
- To explain the lower volatility of **consumption** when government size increases, we introduce **rule-of-thumb consumers**.
- In this case $\sigma_y$ and $\sigma_c$ **fall** with the rise of the government size.
- Models with **Keynesian features** can replicate the **empirical evidence** on the effects of fiscal policy on the volatility of output fluctuations.




Impulse-response when $\eta = 1$




# Impulse-response when $\eta = 1.5$