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 **(ϕ 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:

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

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),

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

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

Households

- **Utility** function:

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

- **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

σ	β	γ	α	ε	δ	σ_z	ρ_z
1.0	$1.03^{-\frac{1}{4}}$	1.295	0.40	6.0	0.021	0.0078	0.80
τ^w	τ^k	τ^c	g^c/y	g^s/y	ρ_r	ρ_π	π
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 $\alpha_b = 0.15$.

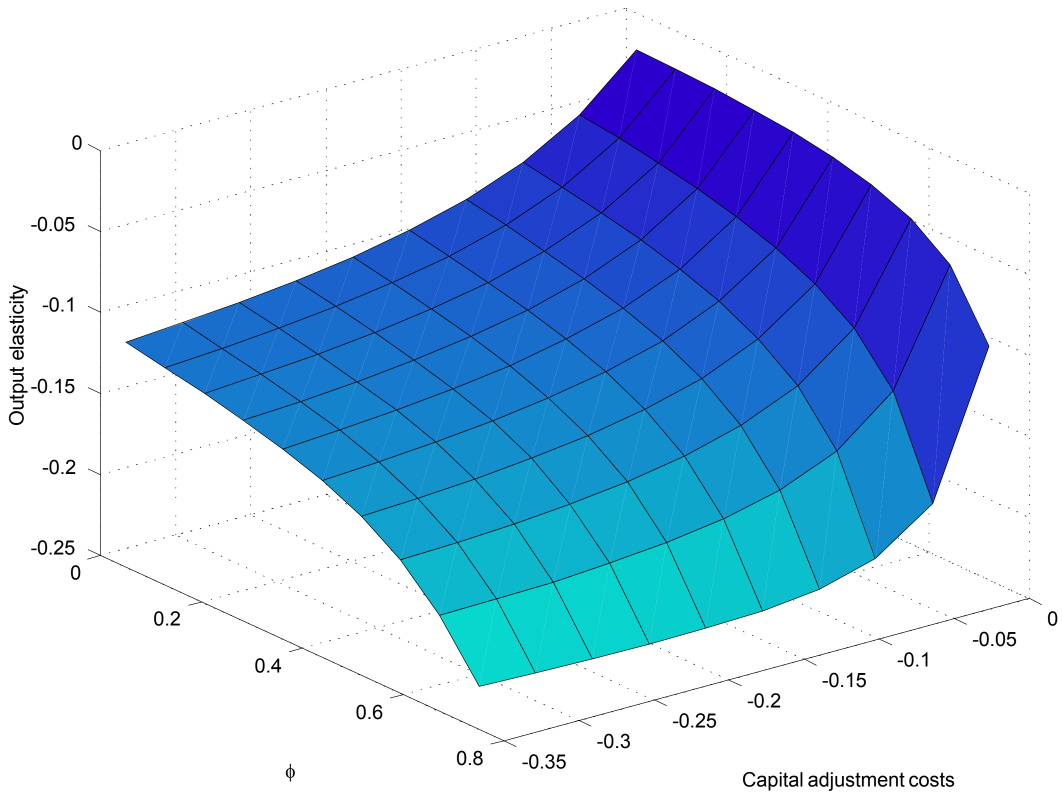
- The case when $\Theta = \phi \simeq 0$ the economy is a **standard RBC** model with no price rigidities or adjustment costs to investment. In this case we obtain results which are similar to Galí's (1994) findings. As government size increases, **output volatility barely changes**.

- Adding **nominal rigidities** and **costs of adjustment** to investment makes the economy **less volatile**.

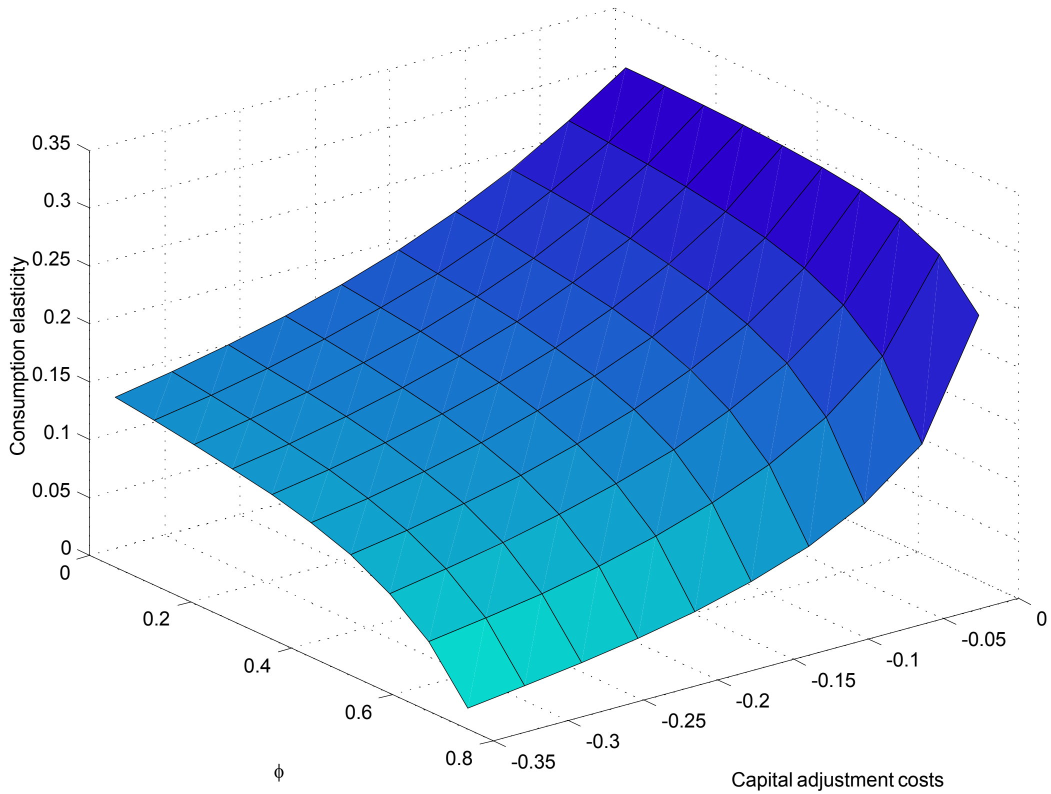
- As we move down through rows 2 to 4, is that the **volatility of output decreases** more and more as we increase government size.
- In the case where $\Theta = 0.25$ and $\phi = 0.75$ the elasticity of output volatility to government size is approximately $1/2$ the estimated elasticity in Table 1.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

Table 3
Government size and output volatility

	Output			Consumption		
	σ_y	σ_y	$\frac{\partial \ln \sigma_y}{\partial \ln(G/Y)}$	σ_c	σ_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		
	σ_y $\eta = 0.5$	σ_y $\eta = 1.5$	$\frac{\partial \ln \sigma_y}{\partial \ln(G/Y)}$	σ_c $\eta = 0.5$	σ_c $\eta = 1.5$	$\frac{\partial \ln \sigma_c}{\partial \ln(G/Y)}$
$\sigma = 2$	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 (λ) 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**

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

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

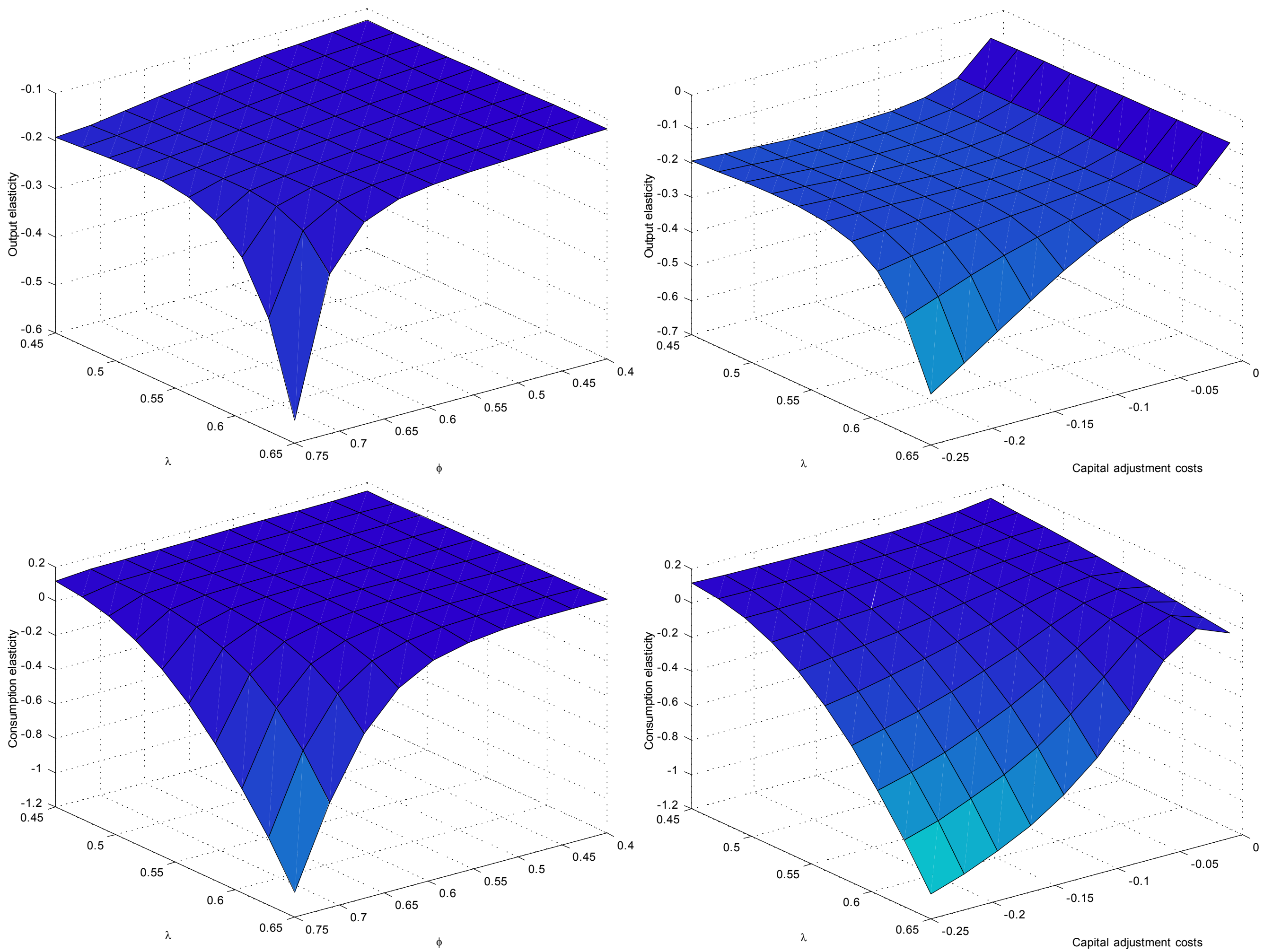
- **Euler equation** now changes to

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

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

	Output			Consumption		
	σ_y	σ_y	$\frac{\partial \ln \sigma_y}{\partial \ln(G/Y)}$	σ_c	σ_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 λ **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

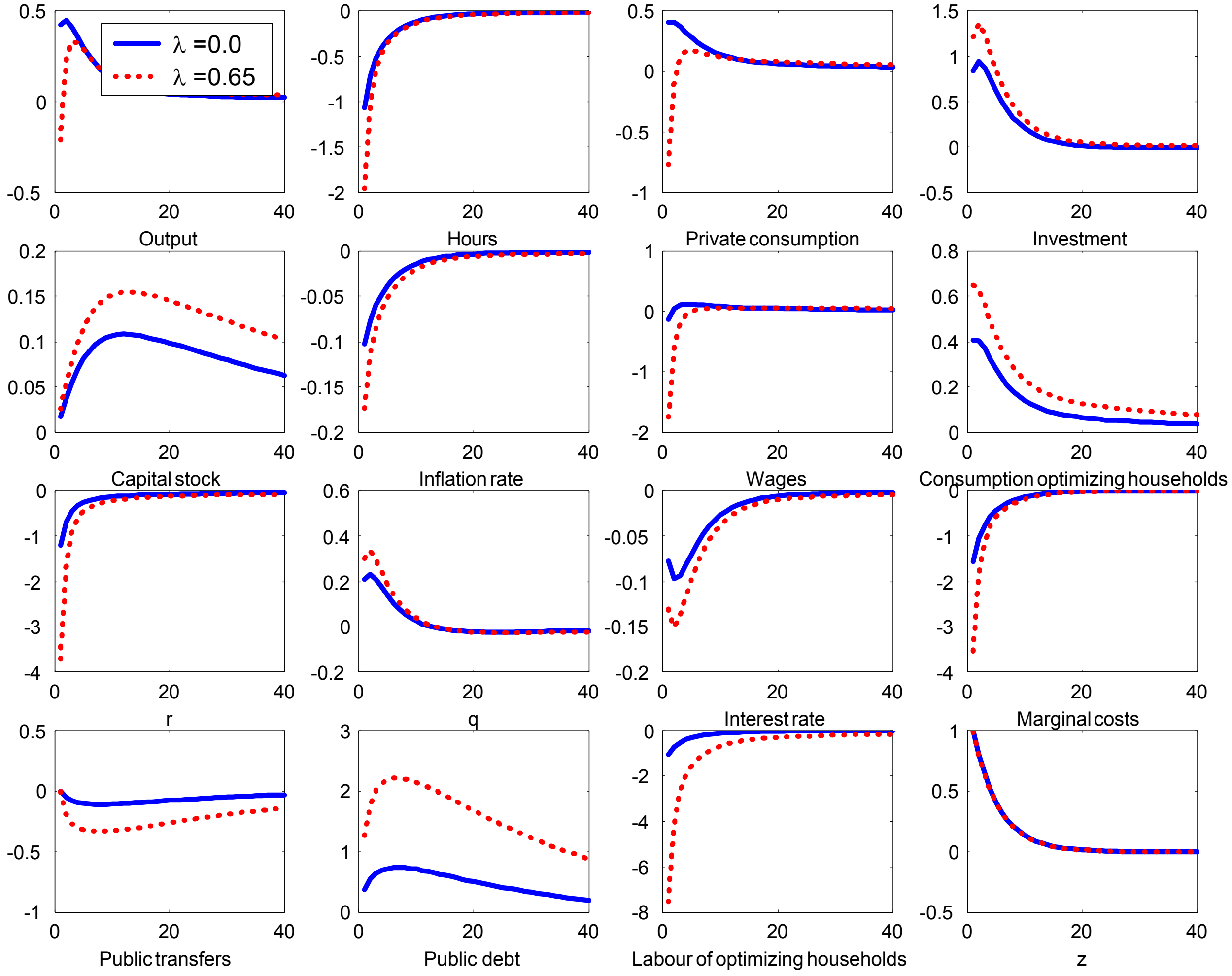
- **Understanding** the intuition behind these result is **crucial**.
- The **empirical** evidence establishes that **hours** tend to **fall** on impact following a positive technology shock.
- **Gali** (1999) argues that this is a puzzling result in a standard **RBC model** but it comes out naturally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

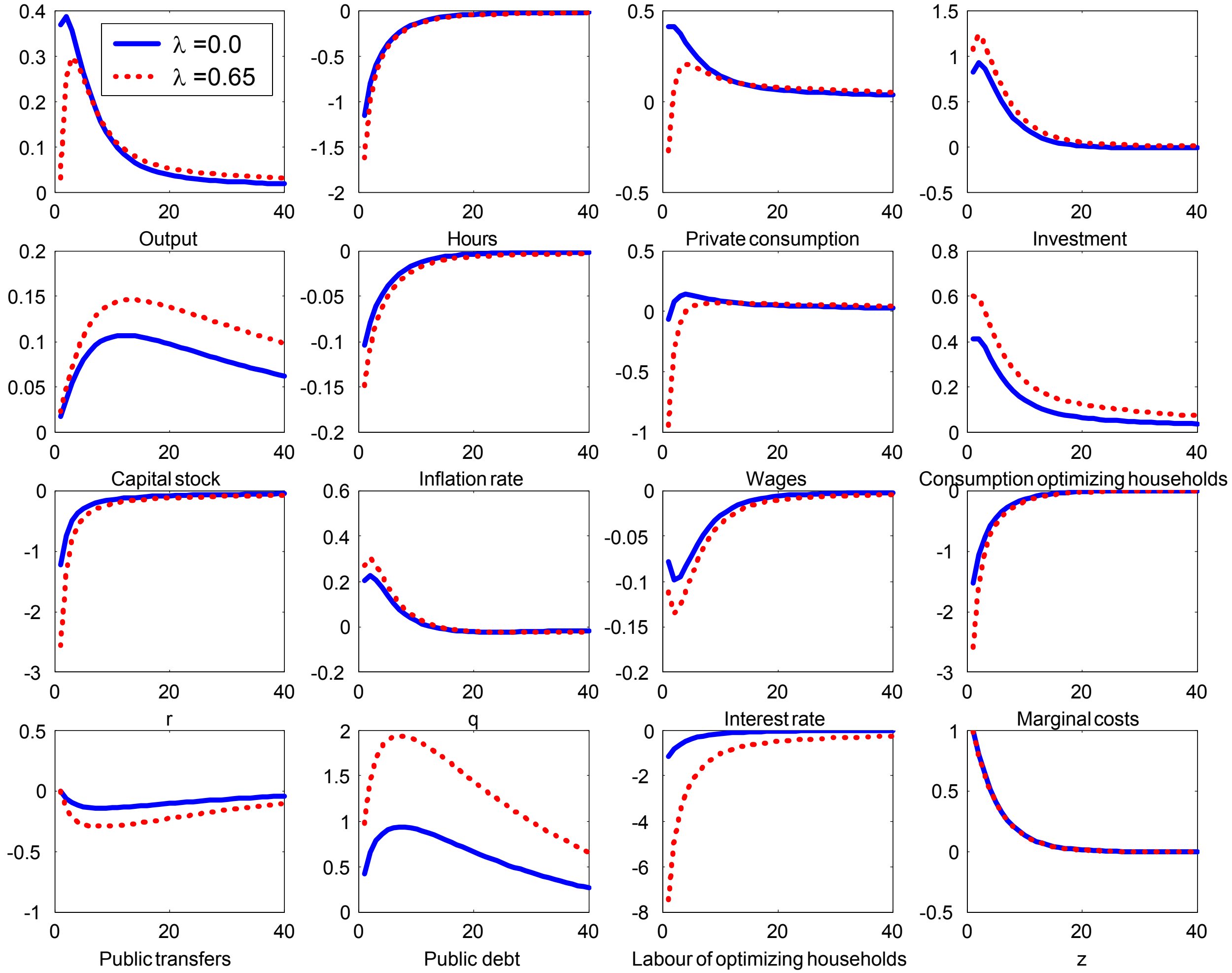
- As the size of **government increases**, the marginal rate of labour taxes augments making **labour supply of more elastic**.
- This implies a lower response of **wages and labour income.**
- **Rule-of-thumb consumers** reduce their consumption along with their current labour income. Larger governments 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 σ_y and σ_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 $\eta = 1.5$