The Stabilizing Role of Government Size
Javier Andrés, Rafael Doménech and Antonio Fatás
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 ($\Delta \ln y$). 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

<table>
<thead>
<tr>
<th>Dependent variable: standard deviation of</th>
<th>$\Delta \ln Y$</th>
<th>$\Delta \ln y$</th>
<th>$\Delta \ln y^c$</th>
<th>$y^c$</th>
<th>$y^c$</th>
<th>$\Delta \ln c$</th>
<th>$\Delta \ln c$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\ln(G/Y)$</td>
<td>-0.0190</td>
<td>-0.0200</td>
<td>-0.0115</td>
<td>-0.0092</td>
<td>-0.0110</td>
<td>-0.0080</td>
<td>-0.0200</td>
</tr>
<tr>
<td></td>
<td>(4.19)</td>
<td>(3.87)</td>
<td>(2.60)</td>
<td>(3.17)</td>
<td>(2.94)</td>
<td>(3.84)</td>
<td>(2.52)</td>
</tr>
<tr>
<td>$d$</td>
<td>0.0082</td>
<td>-0.0140</td>
<td>-0.0100</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(11.4)</td>
<td>(3.36)</td>
<td>(4.45)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\ln\left(\frac{X+M}{Y}\right)$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\ln y$</td>
<td>-0.0084</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-0.0058</td>
</tr>
<tr>
<td></td>
<td>(4.02)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(1.60)</td>
</tr>
<tr>
<td>$\overline{R}^2$</td>
<td>0.3857</td>
<td>0.3537</td>
<td>0.5875</td>
<td>0.1986</td>
<td>0.2479</td>
<td>0.7029</td>
<td>0.3903</td>
</tr>
<tr>
<td>$\frac{\partial \ln \sigma_i}{\partial \ln(G/Y)}$</td>
<td>-0.7194</td>
<td>-0.7625</td>
<td>-0.4463</td>
<td>-0.6341</td>
<td>-0.7208</td>
<td>-0.5579</td>
<td>-0.7170</td>
</tr>
<tr>
<td></td>
<td>(4.12)</td>
<td>(3.83)</td>
<td>(2.40)</td>
<td>(3.30)</td>
<td>(3.26)</td>
<td>(3.70)</td>
<td>(2.87)</td>
</tr>
</tbody>
</table>
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

\[
y_{it} = y_t \left( \frac{P_{it}}{P_t} \right)^{-\varepsilon}
\]  

(1)

• Each period \( 1 - \phi \) firms set their prices, \( \tilde{P}_{it} \), to maximize the present value of future profits,

\[
\max_{\tilde{P}_{it}} E_t \sum_{j=0}^{\infty} \rho_{it,t+j} (\beta \phi)^j \left[ \tilde{P}_{it} \bar{\pi}^j y_{it+j} - P_{t+j} m_{cit,t+j} (y_{it+j} + \kappa) \right]
\]  

(2)

• The remaining \( \phi \) per cent firms set \( P_{it} = \bar{\pi} P_{it-1} \) where \( \bar{\pi} \) 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:

\[
\min_{k_{it}, l_{it}} (r_t k_{it} + w_t l_{it}) \quad (3)
\]

subject to

\[
y_{it} = A_t k_{it}^\alpha l_{it}^{1-\alpha} - \kappa \quad (4)
\]

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

\[
w_t = m c_t (1 - \alpha) A k_t^\alpha l_t^{-\alpha} \quad (5)
\]

\[
r_t = m c_t \alpha A k_t^{\alpha-1} l_t^{1-\alpha} \quad (6)
\]
Households

- **Utility** function:
  \[
  U(c_t, 1 - l_t, g_t^c, g_t^p) = \frac{(c_t(1 - l_t)^\gamma)^{1-\sigma} - 1}{1 - \sigma} + \Gamma(g_t^c, g_t^p)
  \]  
  (7)

- **Cash-in-advance** constraint
  \[
  P_t(1 + \tau_t^c)c_t \leq M_t + \tau_t^m
  \]  
  (8)

- **Budget** constraint:
  \[
  M_{t+1} + \frac{B_{t+1}}{1 + i_{t+1}} + P_t(1 + \tau_t^c)c_t + P_te_t \\
  = P_t(1 - \tau_t^w)w_tl_t + P_t(1 - \tau_t^k)r_tk_t + B_t + M_t + \tau_t^m + P_tg_t^s + \int_0^1 \Omega_{it}di
  \]  
  (9)

- **Capital adjustment costs** \( \Phi\left(\frac{e_t}{k_t}\right) \)
  \[
  k_{t+1} = \Phi\left(\frac{e_t}{k_t}\right)k_t + (1 - \delta)k_t
  \]  
  (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:
  \[ i_t = \rho_r i_{t-1} + (1 - \rho_r) \bar{i} + (1 - \rho_r) \rho_\pi (\pi_t - \bar{\pi}) + (1 - \rho_r) \rho_y \hat{y}_t + z_t^i \]  

(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:
  \[ \hat{g}_t^s = \alpha_b^s (b_t - \bar{b}) + \alpha_y^s \hat{y}_t + \varepsilon_t^s, \quad \alpha_b \geq 0 \]

(12)
Table 2
Calibration of baseline model

<table>
<thead>
<tr>
<th></th>
<th>(\sigma)</th>
<th>(\beta)</th>
<th>(\gamma)</th>
<th>(\alpha)</th>
<th>(\varepsilon)</th>
<th>(\delta)</th>
<th>(\sigma_z)</th>
<th>(\rho_z)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.0</td>
<td>1.03^{-1}</td>
<td>1.295</td>
<td>0.40</td>
<td>6.0</td>
<td>0.021</td>
<td>0.0078</td>
<td>0.80</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(\tau^w)</th>
<th>(\tau^k)</th>
<th>(\tau^c)</th>
<th>(g^c/y)</th>
<th>(g^s/y)</th>
<th>(\rho_r)</th>
<th>(\rho_{\pi})</th>
<th>(\pi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.279</td>
<td>0.279</td>
<td>0.10</td>
<td>0.18</td>
<td>0.16</td>
<td>0.5</td>
<td>1.5</td>
<td>1.02^{0.25}</td>
</tr>
</tbody>
</table>

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**:

\[
\tau^i_j = \eta \tau^i_b \\
g^i_j/y_j = \eta g^i_b/y_b
\]

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

<table>
<thead>
<tr>
<th></th>
<th>Output</th>
<th>Consumption</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\sigma_y$</td>
<td>$\sigma_y$</td>
<td>$\partial \ln \sigma_y / \partial \ln (G/Y)$</td>
</tr>
<tr>
<td>$\Theta = \phi = 0$</td>
<td>$\eta = 0.5$</td>
<td>2.179</td>
<td>2.134</td>
</tr>
<tr>
<td>$\Theta = 0, \phi = 0.75$</td>
<td>$\eta = 0.5$</td>
<td>2.721</td>
<td>2.358</td>
</tr>
<tr>
<td>$\Theta = 0.25, \phi = 0$</td>
<td>$\eta = 0.5$</td>
<td>1.630</td>
<td>1.437</td>
</tr>
<tr>
<td>$\Theta = 0.25, \phi = 0.75$</td>
<td>$\eta = 0.5$</td>
<td>0.781</td>
<td>0.593</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th></th>
<th>Output Consumption</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\sigma_y$</td>
<td>$\sigma_y$</td>
<td>$\frac{\partial \ln \sigma_y}{\partial \ln (G/Y)}$</td>
</tr>
<tr>
<td>$\eta = 0.5$</td>
<td>0.636</td>
<td>0.483</td>
<td>-0.251</td>
</tr>
<tr>
<td>$\eta = 1.5$</td>
<td>0.931</td>
<td>0.746</td>
<td>-0.202</td>
</tr>
<tr>
<td>$\gamma = 0.63$</td>
<td>0.742</td>
<td>0.510</td>
<td>-0.341</td>
</tr>
<tr>
<td>$\alpha^y = -1$</td>
<td>0.546</td>
<td>0.363</td>
<td>-0.372</td>
</tr>
<tr>
<td>$\sigma = 2$, $\gamma = 2$, $\alpha^y = -1$</td>
<td>0.546</td>
<td>0.363</td>
<td>-0.372</td>
</tr>
</tbody>
</table>
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:

\[
P_t(1 + \tau^c_t)c_{rt} = P_t(1 - \tau^w_t)w_tl_{rt} + P_t\lambda g^s_t
\]
• After the aggregation of the optimality conditions for both types of consumption, the equilibrium includes two new conditions

\[ \begin{align*}
  c_t &= \frac{\lambda}{(1 + \tau_c^t)} \left[ \frac{(1 - \tau_w^t)w_t}{1 + \gamma} + \frac{\lambda g_s^t}{1 + \gamma} \right] + (1 - \lambda)c_{ot} \\
  l_t &= \frac{\lambda}{1 + \gamma} \left[ 1 - \frac{\gamma \lambda g_s^t}{(1 - \tau_w^t)w_t} \right] + (1 - \lambda)l_{ot}
\end{align*} \tag{13} \tag{14}
\]

• Euler equation now changes to

\[ 1 = \beta E_t \left( \frac{(1 + \tau_c^t)c_{ot+1}^{-\sigma}(1 - l_{ot+1})\gamma^{(1-\sigma)}}{(1 + \tau_c^{t+1})c_{ot}^{-\sigma}(1 - l_{ot})\gamma^{(1-\sigma)}} \frac{1 + i_{t+1}}{\pi_{t+1}} \right) \tag{15} \]
Table 5
Government size and output with $\lambda = 0.65$

<table>
<thead>
<tr>
<th></th>
<th>Output</th>
<th>Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\sigma_y$</td>
<td>$\sigma_y$</td>
</tr>
<tr>
<td>$\Theta = \phi = 0$</td>
<td>1.897</td>
<td>1.937</td>
</tr>
<tr>
<td>$\Theta = 0, \phi = 0.75$</td>
<td>2.292</td>
<td>2.181</td>
</tr>
<tr>
<td>$\Theta = 0.25, \phi = 0$</td>
<td>1.591</td>
<td>1.438</td>
</tr>
<tr>
<td>$\Theta = 0.25, \phi = 0.75$</td>
<td>0.864</td>
<td>0.516</td>
</tr>
</tbody>
</table>
• **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**.
• **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 $\eta = 1.5$