The Structure of Government Spending and the Business Cycle

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Abstract

We explore the role of the composition of government spending for the cyclical properties of fiscal variables and for the volatility of the business cycles. In the U.S., the fraction of mandatory spending in total government outlays increased from around 0.40 to 0.60 during the last 50 years, while the share of total government outlays in national output stayed relatively constant during this period. We distinguish mandatory and discretionary public spending in a standard model of optimal fiscal policy and show that the composition of government spending is able to explain a fraction of the reduction in output volatility during the Great Moderation and an increase in the countercyclicality of fiscal policy in the U.S. This is another argument in support of the "rules-based" fiscal policy rather than fiscal discretion.

Keywords: optimal fiscal policy, mandatory and discretionary public spending, volatility, business cycles.

JEL Classification Numbers: E32, E62, H21, H41.

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1 Introduction

The structure of government spending is an important determinant of the impact of fiscal policy on economic outcomes. For example, defense-oriented government spending is likely to enhance the military industry development, while socially-oriented government outlays are likely to expand the public services sector. These two types of spending differ in their impact on the composition of output and employment. The government decision about the allocations of public funds across different spending categories may have long-lasting consequences for the economy.

In this paper we explore the role of the composition of government spending for the cyclical properties of fiscal variables and for the volatility of the business cycle. We consider classification of total government spending in two components: mandatory and discretionary spending. Discretionary spending is expenditure that is governed by annual or other periodic appropriations (possible examples are defense and public order spending). Mandatory spending is expenditure that is governed by law, rather than by periodic appropriations (possible examples are health care and social security). Different legislative nature of government spending components implies their distinct roles in fiscal policy process. Mandatory spending is taken as given by the government in power (unless the government willingness to enforce the change the laws exceeds the cost of such legislative changes, which we rule out here by assumption). Discretionary spending is a policy tool that can be used by the government in power to maximize its objectives. We incorporate these two government spending components into the neoclassical model with a government that conducts optimal fiscal policy. The model successfully replicates a number of moments from the U.S. data over the period 1962-2014. We use the model to show that: 1) Higher fraction of mandatory public spending in total government spending reduces economic volatility. The historical pattern of mandatory and discretionary government spending in the U.S. can explain 10% of the reduction in output volatility during the Great Moderation. 2) Higher fraction of discretionary spending leads to procyclicality of fiscal policy as documented for developing countries. 3) Higher fraction of mandatory spending leads to acyclicality or countercyclicality of fiscal policy as documented for developed countries. Accounting for a change in the structure of government spending in the U.S. allows to explain a fraction of the increase in the U.S. fiscal policy countercyclicality during the last 50 years. These findings suggest that fiscal policy rules are superior to discretion and should be enhanced by the policymakers.

In our model, both components of public spending are useful. Discretionary spending is decided by the government and delivers utility to the government but not necessarily to the households. Mandatory spending is enjoyed by the households and is taken as given by the government (it is set by the independent legislation outside the model). We model private consumption and mandatory spending as two components of the effective consumption enjoyed by the household.

Our work is related to several streams of research on the sources of volatility and cyclicality of fiscal policy.

First, our work contributes to the discussion on whether government spending, and discretionary spending in particular, stabilizes or destabilizes output. Fatás and Mihov (2003) provide empirical evidence that governments that intensively rely on discretionary spending induce significant macroeconomic volatility which lowers economic growth. The authors emphasize the importance of political factors in the fiscal policy conduct: institutional arrangements that constrain discretion allow to reduce macroeconomic volatility. Andrés, Doménech, and Fatás (2008) analyze how alternative models of the business cycle can replicate the fact that large governments are associated with less volatile economies (as shown, among others, by Fatás and Mihov, 2001). The authors conclude that adding nominal rigidities and costs of capital adjustment to an otherwise standard RBC model can generate a negative correlation between government size and the volatility of output. It this study we are able to generate a negative correlation between a fraction of discretionary spending in total public spending and the volatility of output, given the government size.

Second, our findings add to the literature on the possible causes of the decline in macroeconomic volatility in the mid 1980s – the Great Moderation. Stock and Watson (2003), Bernanke (2004), Summers (2005), and Galí and Gambetti (2009), among many others, discuss three possible explanations of the Great Moderation: structural changes in the economy, better monetary policy, and "good luck". In this work we suggest that better fiscal policy could also have contributed to the decline in the volatility of the U.S. macroeconomic time series.

Third, our results are related to the recent political economy literature, if we admit that the fraction of discretionary public spending depends on the political frictions in the country. For instance, Ilzetski (2011), Tornell and Lane (1999), Alesina, Campante, and

Tabellini (2008) and Woo (2009) use political frictions to explain procyclicality of fiscal policy in developing countries.[1] Azzimonti and Talbert (2014) use the political frictions in the form of political polarization and ideological shifts in the society to explain higher volatility of business cycles in developing economies. We obtain that higher fraction of discretionary public spending in total public spending, other things being equal, leads to both more procyclical fiscal policy and more volatile business cycles.

Fourth, our work is related to the literature on modeling of the cyclical properties of government spending, such as Bachmann and Bai (2013) who match the volatility and persistence of government consumption in the U.S. using a time-consistent model with taste shocks for public consumption and implementation lags and implementation costs in the budgeting process. We do not impose the time-consistency requirement in the model presented in this paper; our robustness checks suggest that the time-consistent policy version (solved under assumptions of Markov strategies by the government and by the representative household) would result in the same qualitative conclusions.

Finally, our results reiterate the theoretical findings by Bowen, Chen and Eraslan (2014) that mandatory spending Pareto dominates discretionary spending under the assumptions generally consistent with characteristics of developed economies.[2] We use a quantitative procedure to show that mandatory spending decreases output volatility and increases countercyclicality of fiscal policy, both of which are usually considered as welfare-enhancing changes.

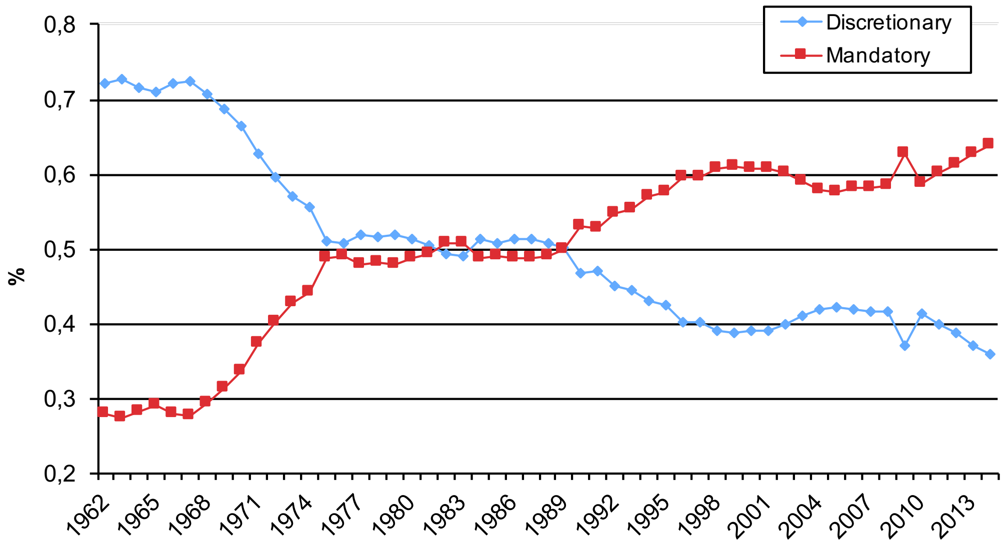
Thus, our contribution to the existing literature is to quantify the role of the composition of public spending for the cyclical properties of fiscal policy and to compare the impact of discretionary and mandatory public spending on macroeconomic volatility.

The paper proceeds as follows. Section 2 reviews the pattern of mandatory and discretionary components of government spending and the cyclical properties of several macroeconomic variables in the U.S. before and after the Great Moderation. Section 3 describes the model and its calibration to the U.S. data. Section 4 applies the model to analyze the consequences of a change in the structure of government spending, provides intuition and several robustness checks. Section 5 concludes.

[1]Procyclicality of fiscal policy in developing countries compared to industrial countries was demonstrated, among others, by Lane 2003; Kaminsky et al. 2005; and Talvi and Vegh 2005.

[2]The assumptions include low political polarization, low persistence of power, and patient parties.

Figure 1: Discretionary and mandatory spending as a share of total government spending in the U.S.



Data source: Historical Tables of the United States Government Budget.

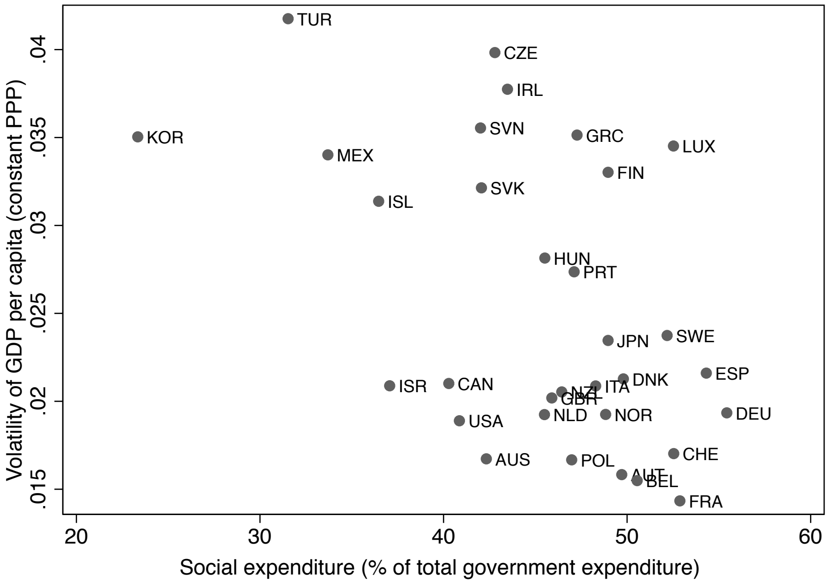
2 The Cyclical Properties of Mandatory and Discretionary Spending

In this section we review the characteristics of mandatory and discretionary government spending in the U.S. and present several correlation coefficients that have motivated us to analyze the role of the structure of public spending in the business cycles volatility.

Figure 1 presents the discretionary and mandatory public spending shares of total government outlays in the U.S. over the period 1962-2014. This data is from the Historical Tables of the United States Government Budget. The share of mandatory spending was around 30% of total outlays in the 1960s; it increased to 50% during 1970-1975; then stayed stable at around 50% in 1980s; and continued increasing reaching around 60% in the late 1990s; it has been fluctuating around 60% since then. At the same time, during 1962-2014, the share of total outlays in the GDP has been fluctuating around a constant value of 18% without significant breaks. The upward shift of the U.S. mandatory spending share after 1980s coincided with a general decline in macroeconomic volatility known as the Great Moderation.

We conjecture that higher fraction of mandatory spending in total government spending could be one of the important components of the "rules-based" macroeconomic policy which

Figure 2: The fraction of "social" expenditures in total government expenditures and output volatility in OECD.



Data source: the OECD statistics.

contributed to macroeconomic stability (similar to the "rule-based" monetary policy as discussed by Taylor, 2012). The tendency for a country to have less volatile output when the share of mandatory public spending is larger seems to hold not only for the United States. Figure 2 presents a scatterplot of the relationship between the GDP volatility over the period 1995-2014 and the average share of the proxy for mandatory spending in total government spending over that period for OECD countries. The proxy for mandatory spending is constructed as the sum of government spending on health, social security and education.[3] These data suggest that countries characterized by lower fraction of mandatory spending in total public spending tend to have higher output volatility.

In further analysis we compare the properties of the U.S. data for the entire period 1962-2014 and for two subperiods – 1962-1984 and 1985-2014 – which reflect pre- and post-Great Moderation years (Stock and Watson, 2003). Table 1 presents some descriptive statistics for the main variables of interest.

The information contained in Table 1 can be summarized as follows:

[3] We have not found the time-series for exact measure of mandatory spending in OECD countries.

Table 1: The cyclical properties of economic variables in the U.S. before and after 1985.

Time	Mean				St. dev. in %				Corr.
period	m/G	G/Y	C/Y	L	Y	G	C	L	(G,Y)
1962-1984	0.40	0.18	0.63	0.32	2.50	4.32	1.94	1.02	-0.17
1985-2014	0.57	0.18	0.67	0.31	1.70	4.28	1.72	0.41	-0.47

For the calculation of standard deviation and correlation the variables are de-trended using differences of logarithms. Data sources: Historical Tables of the United States Government Budget, the World Bank and the OECD statistics.

1. The average fraction of mandatory public spending in total public spending increased after 1985; the average fraction of discretionary public spending in total public spending decreased after 1985.

2. The average share of public consumption does not differ significantly in the periods before and after 1985.

3. Macroeconomic volatility decreased after 1980s (Great Moderation): the standard deviation of real GDP growth rate is 2.50 before 1985, and 1.70 after 1985. Private consumption expenditures and labor hours are also less volatile after 1985.

4. Fiscal policy is more countercyclical after 1980s: correlation of the growth rates of government spending and output is -0.17 before 1985 and -0.47 after 1985.

In this paper we evaluate the importance of facts 1 and 2 for the explanation of facts 3 and 4 with the help of the model presented in the next section.

3 The Model

The model represents a version of the neoclassical model with government and with a distinction between mandatory and discretionary public spending. The government finances public spending with a flat rate income tax and issues of risk-free public bonds. Below, the economy is described in more detail.

3.1 The economic environment

The model economy is inhabited by infinitely-lived households; time is discrete. A representative household derives utility from private consumption, c_t and from (possibly a fraction of) government spending; it dislikes labor, l_t, and is endowed by one unit of time every period. Total government spending, G_t, consists of mandatory spending, m_t, and discretionary spending, g_t. Mandatory spending is governed by legislation and its law of motion is taken as given by the households and by the government. This category of spending may include health, education, and other social benefits. Discretionary spending is governed by periodic appropriations, through the decision of the government as a part of fiscal policy. This category of spending may include expenditures on defence, public order, and justice. Following Fiorito and Kollintzas (2004), we may refer to mandatory spending as "merit goods" and to discretionary spending as "public goods".

The households enjoy consumption of "merit goods" (mandatory spending) as well as their private consumption. In particular, we assume the Cobb-Douglas form for the effective household consumption as follows:[4]

$$C_t = c_t^{\rho} m_t^{1-\rho}, \ \rho \in (0, 1). \tag{1}$$

There are several possible interpretations for the mission of "public goods" (discretionary spending) g_t, which result from the fact that this type of spending can be chosen by the government.

First, we could think of discretionary public spending as providing utility to the representative household and of a benevolent government that seeks to maximize households' welfare by choosing the level of discretionary spending.

Second, we could think of discretionary public spending as providing the opportunity to the government to collect private rent. The simplest way to reflect such situation in a model is to assume that "public goods" deliver utility to the government but not to the households. Such political friction caused by weak institutions has been widely discussed in the literature and has been shown to lead to procyclical government spending (see, for example, Alesina, Campante, and Tabellini, 2008).

Third, we could think of the existence of different types of discretionary public spending which provide utility to different groups of households in a society characterized by polarized preferences about the composition of public goods. In order to add such political friction, called political polarization, to the model, we could assume, among other things, that the party in power maximizes the utility of its electorate – the group of households that shares the preferences of that party. Political polarization has been shown to lead to

[4] We discuss a more general form for the effective consumption in the robustness checks.

procyclical government spending (Woo, 2009) and more volatile business cycles (Azzimonti and Talbert, 2014).

The complete models of public rent-seeking or political polarization would require additional assumptions and model ingredients[5] which are not of the main interest in this paper. Therefore, we consider the first interpretation as the baseline but we keep in mind that the second and third interpretations are also relevant. We assume (consistent with all three cases) that the utility from discretionary public spending is separable from the utility from private consumption, mandatory public spending, and leisure, and has a weight $\varphi_g \in [0, 1)$ in the total utility of the household. We use the following function for the total instantaneous utility of the household:

$$u(c_t, m_t, 1 - l_t, g_t) = \varphi_c \frac{(c_t^{\rho} m_t^{1-\rho})^{1-\upsilon_c}}{1 - \upsilon_c} + \varphi_l \frac{(1 - l_t)^{1-\upsilon_l}}{1 - \upsilon_l} + \varphi_g \frac{g_t^{1-\upsilon_g}}{1 - \upsilon_g}, \tag{2}$$

where $\varphi_c, \varphi_l > 0$.

The economy's physical capital stock at period t, k_{t-1}, is owned by the representative household which supplies it together with labor to the competitive firm, receiving interest, r_t, for each unit of capital and wage, w_t, for each unit of labor in return. Physical capital depreciates at rate δ. The household can also save in the form of risk-free government bonds, b_t, which, purchased in period t at price p_t, deliver the amount of b_t of consumption goods in period $t + 1$. The holdings of government bonds involve a quadratic transaction cost proportional to the amount of bonds purchased, ϕb_t^2, $\phi > 0$. This cost is rebated back to the household as a lump-sum transfer (the presence of debt transaction cost rules out non-stationary debt dynamics). We assume, without loss of generality, that the economy starts with zero public debt, $b_{-1} = 0$. The total household income is subject to the proportional income tax, τ_t.

The competitive firm operates the constant returns to scale production function which combines capital and labor to produce output, y_t. In particular, we assume the Cobb-Douglas production function:

$$y_t = A_t k_{t-1}^{a} l_t^{1-a}, \; a \in (0, 1), \tag{3}$$

where A_t denotes stochastic technology which follows the law of motion specified below.

[5]such as the possibility of political turnover and periodic reoptimization of the fiscal plan by the government.

Given government policy, a representative household chooses its consumption, labor, and savings to maximize its expected lifetime utility, given by the sum of expected instantaneous utilities (2), discounted by the impatience parameter $\beta \in (0,1)$, subject to the budget constraint:

$$s.t.: c_t + k_t + p_t b_t + \phi b_t^2 = (1-\tau_t)(w_t l_t + r_t k_t) + (1-\delta)k_{t-1} + b_{t-1}. \tag{4}$$

The optimality conditions corresponding to the household's problem consist of (4) together with the following equations:

$$u_{l,t} + u_{c,t}(1-\tau_t)w_t = 0, \tag{5}$$

$$u_{c,t} - \beta E_t u_{c,t+1}((1-\tau_{t+1})r_{t+1} + 1 - \delta) = 0. \tag{6}$$

$$p_t = \beta E_t \frac{u_{c_{t+1}}}{u_{c_t}} - 2\phi b_t. \tag{7}$$

Given the competitive markets, the prices of capital and labor are equal to their marginal products:

$$r_t = a A_t k_{t-1}^{a-1} l_t^{1-a}, \tag{8}$$

$$w_t = (1-a) A_t k_{t-1}^{a} l_t^{-a}. \tag{9}$$

The resource constraint of the economy is as follows:

$$c_t + k_t + g_t + m_t - (1-\delta)k_{t-1} - y_t = 0. \tag{10}$$

We approximate the exogenous states of the economy, the level of technology A_t and the level of mandatory public spending m_t, by the autoregressive processes of order one (AR(1)). In particular, we assume that the logarithm of technology follows an AR(1) process with mean $ln\bar{A}$, autocorrelation coefficient ρ_A, and volatility σ_A^2:

$$\ln A_t = (1-\rho_A)\ln \bar{A} + \rho_A \ln A_{t-1} + \epsilon_t, \epsilon_t \sim N(0,\sigma_\epsilon^2), \sigma_\epsilon^2 = \sigma_A^2(1-\rho_A^2); \tag{11}$$

and the logarithm mandatory public spending follows an AR(1) process with mean $ln(\bar{m}\bar{G})$, where $\bar{m}$ is the average fraction of mandatory spending in total government spending and $\bar{G}$ is the average total government spending in the economy, autocorrelation coefficient ρ_m, and volatility σ_m^2:

$$\ln m_t = (1-\rho_m)\ln(\bar{m}\bar{G}) + \rho_m \ln m_{t-1} + \varepsilon_t, \varepsilon_t \sim N(0,\sigma_\varepsilon^2), \sigma_\varepsilon^2 = \sigma_m^2(1-\rho_m^2). \tag{12}$$

We can define the *competitive equilibrium* in this economy given the government policy, the initial capital stock, k_{-1}, and the exogenous processes A_t and m_t, as a sequence of prices $\{p_t, r_t, w_t\}$, allocations $\{c_t, l_t\}$, capital stocks k_t, and public bonds issues b_t, such that: given prices, the households maximize their expected lifetime utility subject to their budget constraint (4); competitive firms maximize their profits; and the resource contraint of the economy given by (10) is satisfied.

3.2 The government policy

The problem of the benevolent government is to set the income taxes and the amount of risk-free bonds b_t to issue at time t and be repaid at time $t+1$ in order to finance a stream of government spending, thereby maximizing its objective. As discussed above, we assume that the instantaneous utility of the government coincides with the utility of the households. The law of motion of mandatory public spending is determined outside the model and is taken as given by the government. The amount of discretionary public spending adjusts to equilibrate the government budget, which takes the following form:

$$G_t + b_{t-1} = g_t + m_t + b_{t-1} = \tau_t(w_t l_t + r_t k_{t-1}) + p_t b_t. \tag{13}$$

For simplicity, we assume that the government is able to commit to a fiscal plan developed for the long term[6] and cannot default on its debt obligations. Thus, at the initial period of the economy life, the government chooses the sequence of income taxes (or, equivalently, the level of discretionary expenditures) and issues of risk-free public bonds for every period, given the expectations about the possible states of the economy.

We can define the *Ramsey problem* of the government as a sequence of taxes and public bond issues that maximizes the expected lifetime utility of the government over the competitive equilibria.

It is convenient to formulate the problem of the government in terms of the choice of

[6]The time-consistent solution with the government which reoptimizes its fiscal plan every time period does not change the qualitative conclusions.

household allocations (see appendix for details) as follows:

$$\max_{\{c_t,l_t,k_t,b_t\}_{t=0}^{\infty}} E_0 \sum_{t=0}^{\infty} \beta^t u(c_t, m_t, 1-l_t, y_t + (1-\delta)k_{t-1} - c_t - k_t - m_t) \quad (14)$$

$$s.t. \quad : \quad u_{c_t}(c_t + k_t - \phi b_t^2 - (1-\delta)k_{t-1} - b_{t-1}) + \beta E_t u_{c_{t+1}} b_t + \frac{u_{l,t}}{1-a} l_t = 0, \quad (15)$$

$$u_{c,t} + \frac{a\beta}{(1-a)k_t} E_t(u_{l,t+1} l_{t+1}) - (1-\delta)\beta E_t u_{c,t+1} = 0, \quad (16)$$

where discretionary government spending has been substituted away using (10). The optimality conditions for the government problem are as follows:

$$[c_t] \quad : \quad u_{c,t} - u_{g,t} + \mu_t[u_{cc,t}(c_t + k_t - \phi b_t^2 - (1-\delta)k_{t-1} - b_{t-1}) + u_{c,t}] + \quad (17)$$

$$+\mu_{t-1} u_{cc,t} b_{t-1} + \eta_t u_{cc,t} - \eta_{t-1}(1-\delta)u_{cc,t} = 0, \quad (18)$$

$$[l_t] \quad : \quad u_{l,t} + u_{g,t} y_{l,t} + \frac{u_{ll,t} l_t + u_{l,t}}{1-a}\left(\frac{a\eta_{t-1}}{k_{t-1}} - \mu_t\right) = 0, \quad (19)$$

$$[k_t] \quad : \quad \mu_t u_{c,t} - u_{g,t} + \beta E_t[u_{g,t+1}(y_{k,t+1} + 1 - \delta) - \mu_{t+1}(1-\delta)u_{c,t+1} - \frac{a\eta_t u_{l,t+1} l_{t+1}}{(1-a)k_t^2}] = 0, \quad (20)$$

$$[b_t] \quad : \quad 2\mu_t \phi b_t u_{c,t} + \beta E_t(\mu_{t+1} u_{c,t+1} - \mu_t u_{c,t+1}) = 0, \quad (21)$$

where μ_t and η_t are the Lagrange multipliers associated with constraints (15) and (16), respectively.

In the deterministic steady state, the optimal fiscal policy is to keep public debt at zero and to use tax receipts to finance public spending. In the presence of uncertainty, the government bonds are used to partially smooth fluctuations in the economy. The level of public debt at the stochastic steady state is finite (due to the presence of the debt transaction cost) and can be positive or negative, depending on the utility parameters. The discretionary component of public spending is distortionary: its size (captured by its marginal utility) affects both the levels of allocations and their cyclical properties.

In the next section, we proceed with the calibration of the model economy to evaluate the importance of the structure of government spending for the cyclical properties of macroeconomic variables.

3.3 Calibration

We consider the U.S. data for the period 1962-2014 as the baseline for calibration. Additionally, we split the data in two subperiods, before and after 1985, to account for the change in macroeconomic volatility between these two subperiods. For the model calibration, we distinguish four sets of the model parameters:

(1) α, β – the standard parameters the values for which are well-known from the literature so that there is no need for additional calibration and, if done, calibration of these parameters would not significantly affect the quantitative properties of the model;

(2) ρ_A, σ_ϵ, ρ_m, and σ_ε – the standard parameters characterizing the exogenous stochastic processes in the model economy. We calibrate these parameters to the U.S. data as explained below and obtain the values very similar to the values of these parameters used in the related studies;

(3) $\bar{m}$, $\bar{A}$, δ, φ_c, φ_l, and φ_g – the parameters the values of which can potentially influence the qualitative properties of the model economy and which we calibrate to match the first moments of the data of interest;

(4) v_c, v_l, v_g, ρ, and ϕ – the parameters the values of which can potentially influence the qualitative properties of the economy and which we calibrate to match the second moments of the data under study. There is some ambiguity about the empirical evidence on the values of v_c, v_l, and v_g. In this section we calibrate these parameters by choosing them from a range of values generally accepted in the literature (e.g., [0.5;1.5] for v_g, [2;4] for v_c and v_l). We discuss the alternative sets of these parameters in the robustness checks.

The calibration procedure is as follows.

First, we set the discount factor $\beta = 0.96$ and the capital share $\alpha = 0.36$. We choose ρ_A, σ_ϵ, and ρ_m, σ_ε to match the Solow residual from the production function (3) and the mandatory government spending, respectively, in the U.S. for the period 1962-2014 (both series de-trended using differences of logarithms).

Second, we select the following parameters to match the deterministic steady state in the baseline economy (covering the data for 1962-2014): We choose $\bar{A}$ to normalize the model-generated output at the deterministic steady state to one. We choose δ to match the average share of total government spending in the GDP over 1962-2014, $\bar{G}$. We set $\bar{m} = 0.5\bar{G}$ to match the average share of discretionary spending in the total government spending over the period 1962-2014.

Third, we jointly select the parameters of the utility function and the multiplier of the debt transaction cost as follows: The weights in the utility function φ_c, φ_l, and φ_g are set to match the average consumption share of GDP (C/Y) and the average labor hours per worker (L) in the U.S. over the period 1962-2014 (we impose $\varphi_g = 1 - \varphi_c - \varphi_l$). The remaining parameters - effective consumption elasticity v_c, labor elasticity v_l, public consumption elasticity υ_g, the weight of private consumption in the effective consumption of private and merit goods, ρ, and the debt transaction cost parameter, ϕ, are set to minimize the difference between five model-generated moments and the data. The moments we consider are the correlations with GDP (Y) of five macroeconomic indicators: private consumption (C); government spending (G); discretionary government spending (m), average labor hours per worker (L); and public debt (B).

The logic behind choosing these particular moments as targets in the calibration is as follows. The volatility of variables in the model is defined, to a large extent, by the volatility of the exogenous stochastic processes (A and m) and, therefore, does not change significantly with variation in the other model parameters. Thus, we target the correlations among the variables in the model and in the data; in particular, the linear correlations with output. The model consists of the total of eight endogenous variables (Y, I, C, G, g, L, B, τ). The correlations of investment and consumption move closely together as we change the parameters; therefore, we choose as a target the correlation of one of these variables with output. Our numerical experiments suggest that we cannot replicate the correlation between taxes and output within a plausible set of parameter values. Therefore, we do not target this correlation in our calibration. We are left with C, L, B, G, and g. In the next section we discuss different calibration strategies as a part of the robustness check. In particular, we discuss the role of the utility parameters measuring the inverses of elasticities – υ_c, υ_l, υ_g – in determining quantitative properties of the data.

We de-trend all the variables in the data and in the model using the differences of logarithms. We use the optimality conditions to approximate the model around the steady state (with the help of DYNARE) and rely on the model dynamics around the steady state to compute the moments of interest.

The parameters of the model and the calibration targets are summarized in Table 2; the model-generated moments together with corresponding moments for the U.S. data are reported in Table 3. The model successfully captures the sign of the correlations with output for all the variables except of the tax receipts (which are acyclical in the data and countercyclical in the model). Moreover, the strength of the relationship among the variables measured by the absolute value of the correlation is also accounted by the model fairly well.

Table 2: The model parameters, calibration targets, and values.

Parameter	Value	Target	in Model	in Data
α	0.36	–	–	–
β	0.96	–	–	–
ρ_A	0.93	autocor(Δ lnA_t)	0.93	0.93
σ_ϵ	0.01	var(Δ lnA_t)	0.01	0.01
ρ_m	0.92	autocor(Δ lnm_t)	0.92	0.92
σ_ε	0.05	var(Δ lnm_t)	0.05	0.05
$\bar{m}$	0.5	mean(m/G)	0.50	0.50
$\bar{A}$	1.37	mean(Y)	1.00	–
δ	0.06	mean(G/Y)	0.18	0.18
φ_c	0.02	mean(C/Y)	0.65	0.65
φ_l	0.77	mean(L)	0.32	0.32
υ_c	3.80	cor($\Delta \ln C, \Delta \ln Y$)	0.72	0.87
υ_l	3.35	cor($\Delta \ln L, \Delta \ln Y$)	0.55	0.45
υ_g	0.87	cor($\Delta \ln G, \Delta \ln Y$)	-0.43	-0.27
ρ	0.59	cor($\Delta \ln g, \Delta \ln Y$)	0.03	0.03
ϕ	10^{-4}	cor($\Delta \ln B, \Delta \ln Y$)	-0.13	-0.37

The targets values in the data are obtained from the U.S. data over the period 1962-2014. Data sources: The U.S. Budget Historical Tables (Y, G, g, m, B); the World Bank (I, C); the OECD Statistics (L). The targets values in the model are obtained from the model simulations around the steady state.

The volatility of the model-generated variables is lower than the volatility of these variables in the data. The relative volatilities are captured by the model relatively well for investment (about three times more volatile than output both in the model and in the data) and total government spending (2.8 times more volatile than output in the model and 2.2 times more volatile that output in the data). The volatility of public debt is much lower than in the data and the volatility of labor hours is twice as high as in the data.

Given that the model relatively successfully replicates the pattern of the moments of interests (in particular, the correlation between G and Y and the relative variances of the data), we proceed by applying this model to the analysis of the effect of a change in the structure of government spending which occurred in the U.S. during the 1980s and which is reported in Figure 1.

Table 3: Simulated model moments and the U.S. data moments over 1962-2014.

Mean(X)			Cor(Δ lnX,$\Delta \ln Y$)			VarΔ ln(X), %		
X	Model	Data	X	Model	Data	X	Model	Data
Y	1.00	–	Y	1.00	1.00	Y	1.39	2.10
I/Y	0.16	0.23	I	0.57	0.84	I	4.21	7.11
C/Y	0.65*	0.65*	C	0.72*	0.87*	C	2.71	1.83
G/Y	0.18*	0.18*	G	-0.43*	-0.27*	G	3.88	4.32
g/G	0.50	0.50	g	0.03*	0.03*	g	2.25	4.63
m/G	0.50*	0.50*	m	-0.59	-0.39	m	5.86	5.98
L	0.32*	0.32*	L	0.55*	0.45*	L	1.28	0.63
b/Y	0.00	0.38	b	-0.12*	-0.37*	b	1.48	6.46
τ	18.0	20.5	τ	-0.79	0.00	τ	1.61	4.07

The model moments are obtained from the model simulations around the steady state given the parameter values reported in Table 2. The data moments are calculated from the U.S. data over the period 1962-2014. The moments targeted in calibration are presented with *. Data sources: The U.S. Budget Historical Tables (Y, G, g, m, B); the World Bank (I, C); the OECD Statistics (L, τ).

4 Results

We use the model described in the previous section to analyze the role of discretionary and mandatory government spending for macroeconomic volatility and for the cyclical properties of fiscal policy. In particular, we evaluate the consequences of the change in the fraction of mandatory public spending in total public spending in the U.S. over the period 1962-2014, observed from Figure 1. This fraction increased since 1980s: mandatory spending accounted, on average, for around 40% of total government outlays before 1985 and for around 60% of total government outlays after 1985. At the same time, the total government spending as a share of GDP remained relatively constant during this period. We ask whether these facts, incorporated in the model, can account for the change in the characteristics of the U.S. data described in Section 2.

In order to evaluate the role of the structure of public spending in these observations, we simulate the model by setting $\bar{m} = 0.4\bar{G}$ and $\bar{m} = 0.6\bar{G}$, keeping $\overline{G/y}$ constant to match the respective data in the U.S. before and after 1985. Table 4 present the results generated by the model and corresponding moments in the data.

Table 4: Simulated model moments and the U.S. data moments before and after 1985.

X	Model 1962-1984	Data 1962-1984	Model 1985-2014	Data 1985-2014	X	Model 1962-1984	Data 1962-1984	Model 1985-2014	Data 1985-2014
				Mean(X)					
Y	0.91	–	1.00	–	m/G	0.41	0.40	0.61	0.57
I/Y	15.9	0.24	16.0	0.22	L	0.30	0.32	0.33	0.31
C/Y	0.66	0.63	65.4	0.67	B/Y	1.35	0.30	1.12	0.45
G/Y	0.19	0.18	0.19	0.18	τ	0.17	0.22	0.19	0.20
	Corr($\Delta\ln(X)$,$\Delta\ln Y$)					Var(Δ ln(X)) in %			
Y	1.00	1.00	1.00	1.00	Y	1.42	2.50	1.36	1.70
I	0.54	0.85	0.61	0.82	I	4.27	8.27	4.16	6.08
C	0.74	0.81	0.72	0.95	C	2.70	1.94	2.73	1.72
G	-0.42	-0.17	-0.46	-0.47	G	3.53	4.32	4.23	4.32
g	-0.04	0.21	0.09	-0.21	g	2.26	4.79	2.24	4.57
m	-0.60	-0.47	-0.57	-0.47	m	5.86	6.01	5.86	5.76
L	0.58	0.47	0.53	0.53	L	1.34	0.73	1.22	0.53
b	-0.13	-0.08	-0.12	-0.62	b	1.37	5.91	1.60	6.67
τ	-0.78	-0.20	-0.80	0.07	τ	1.40	2.99	1.85	4.46

The model moments are obtained from the model simulations around the steady state given parameter values reported in Table 2 for $\bar{m} = 0.4\bar{G}$ and $\bar{m} = 0.6\bar{G}$ for periods 1962-1984 and 1985-2014, respectively. The data moments are calculated from the U.S. data over the periods 1962-1984 and 1985-2014, respectively. Data sources: The U.S. Budget Historical Tables (Y, G, g, m, B); the World Bank (I, C); the OECD Statistics (L, τ).

The results suggest that the distinction between mandatory and discretionary public spending in the optimal fiscal policy model allows to account for a fraction of the reduction in output volatility during the Great Moderation in the U.S.: volatility of output decreases by 47% in the data and by 4.4% in the model. The volatility of most of the remaining variables in the model also follows the trend in the data: investment, discretionary spending, and labor hours are less volatile when mandatory public spending is higher, while the volatility of public debt and taxes increases with higher fraction of mandatory spending in total government spending. The exceptions are the private consumption and the total government spending: their volatility decreases (for C) or stays constant (for G) in the data but increases in the model. One possible reason for the contradictory prediction regarding the public spending volatility is that the mandatory spending by construction is equally volatile in the model before and after 1985, while in the data its volatility decreases after 1985. Imposing a smaller variance on the mandatory spending process after 1985 would enhance the decline in macroeconomic volatility (in particular, it would reduce the volatility of output, private consumption, and discretionary public spending).

The model also accounts for a rise in the countercyclicality of total government spending: comparing the periods before and after an increase in the fraction of mandatory spending (before and after 1985) the correlation between G and Y decreases from -0.17 to -0.47 in the data and from -0.42 to -0.46 in the model.

Intuitively, the cyclicality of total government spending depends on the cyclical properties of its components: discretionary and mandatory spending. A rise in mandatory public spending act as a negative shock to output: more resources have to be devoted to mandatory government consumption, and less to the other spending components including discretionary spending and investment in physical capital. Thus, mandatory spending and output are negatively correlated and a larger fraction of mandatory spending in total government spending decreases procyclicality (or increases countercyclicality) of fiscal policy.

Discretionary public spending distorts equilibrium allocations, reducing the ability of the other government tools to smooth the effect of fluctuations on the economy. This can be seen from the optimality conditions to the government problem, presented in the appendix: reducing the fraction of distortionary public spending is equivalent to reducing the marginal utility from public spending (through a reduction in the parameter reflecting preferences for distortionary spending captured by φ_g), which in turn reduces the public-effective household consumption wedge and labor-public consumption wedge, increasing the ability of the government to use taxes to smooth consumption, labor, and, consequently, capital accumulation. The latter implies an important result: Keeping total government share of GDP constant and increasing mandatory spending leads to higher consumption, labor, capital, and output at the new stochastic steady state.[7] Our numerical experiments suggest that the parameters capturing the inverses of elasticities, v_c, v_l, and v_g, influence the first moments in a non-trivial way. In particular, more elastic public consumption (lower v_g) is

[7] If we shut down all the shocks, in a deterministic economy higher fraction of mandatory spending increases labor, taxes, and output, but the private consumption and capital at the steady state are unaffected.

more distortionary, in the sense that it leads to lower output at the stochastic steady state, other things being equal. In contrast, more elastic effective private consumption (lower v_c) implies that discretionary public spending is less distortionary, leading to greater output at the stochastic steady state, other things being equal. Together, the relative elasticities of the utility components define, in a highly nonlinear way, the cyclical properties of fiscal variables (see Grechyna, 2015 for the related discussion of the cyclical properties of a model economy without physical capital).

The results presented in Table 4 suggest that the model-generated investment share, private consumption share, and the labor hours do not replicate the pattern observed in the U.S. data: the change in the average values of these variables in the data before and after 1985 is opposite to their change in the model when we compare the economies with $\bar{m} = 0.4$ and $\bar{m} = 0.6$. One reason for this discrepancy could be that the model abstracts from any type of structural change that could affect the growth rates and the allocation of output among the spending categories.

Returning to the characteristics of the U.S. data over 1962-2014, summarized in four facts in Section 2, we can conclude that incorporating facts 1 and 2 in a standard neoclassical model of optimal fiscal policy allows to replicate facts 3 and 4. Next, we provide some intuition behind these results and analyze whether they can withstand some modifications of the assumptions underlying the model economy.

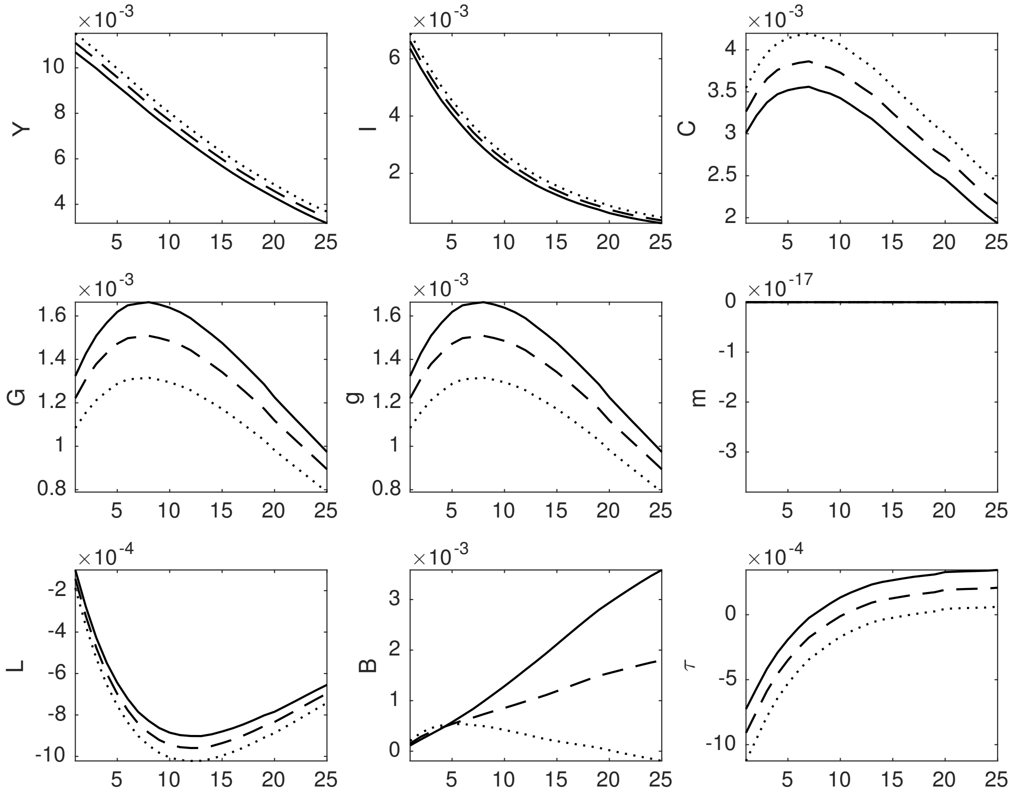
4.1 Intuition and Robustness Checks

In order to gain more insights into the dependence of the model outcomes on model assumptions, we consider the role of the main building blocks of the model in more detail.

The Role of the Shocks

First, we analyze the role of the exogenous shocks. Figures 3 and 4 present the impulse-response functions to one standard deviation positive shock to technology and mandatory government spending, respectively. Each of the two shocks leads to a fall in labor hours and taxes, and a rise in total government spending, discretionary spending, and public debt. The effect on output, private consumption, and investment is positive for a technology shock and negative for a government spending shock, as expected. An increase in the fraction of mandatory spending reduces the effect of each of the shocks on output, investment,

Figure 3: Impulse responses to 1 st.dev. shock to technology A_t.



The graphs show the responses in the model economies with $\bar{m} = 0.4\bar{G}$ (solid line), $\bar{m} = 0.5\bar{G}$ (dashed line), and $\bar{m} = 0.6\bar{G}$ (dotted line).

and private consumption – reflecting a reduction in the distortionary component of public spending.

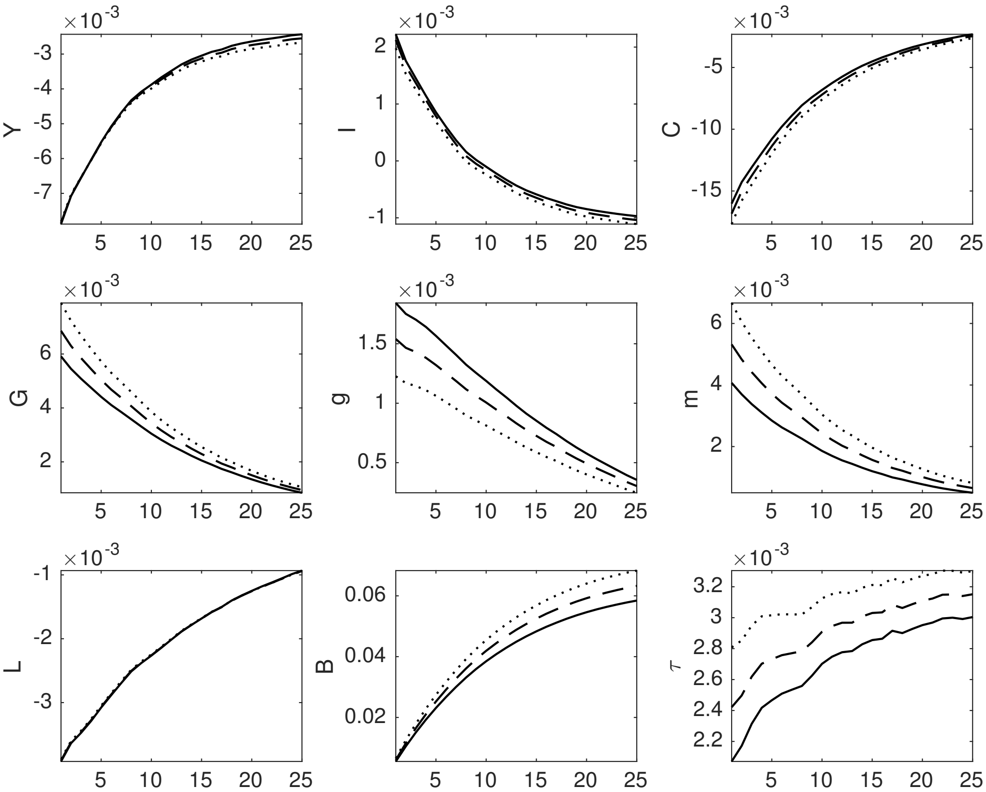
In order to investigate which shock has more importance for the cyclical properties of fiscal variables, we consider two sub-versions of the baseline economy, which we denote by M_0, as follows:

$M_{0,A}$: the model with $\sigma_\varepsilon = 0$, and all the other parameter values from Table 2. This model has only one exogenous shock – shock to technology.

$M_{0,m}$: the model with $\sigma_\epsilon = 0$, and all the other parameter values from Table 2. This model has only one exogenous shock – shock to mandatory public spending.

We compare the change in the volatility and correlations of the variables generated by models $M_{0,A}$ and $M_{0,m}$ as we move from $\bar{m} = 0.4$ to $\bar{m} = 0.6$. The signs of the changes in these moments are reported in the third and fourth rows of Table 5. The first two

Figure 4: Impulse responses to 1 st.dev. shock to mandatory spending m_t.



The graphs show the responses in the model economies with $\bar{m} = 0.4\bar{G}$ (solid line), $\bar{m} = 0.5\bar{G}$ (dashed line), and $\bar{m} = 0.6\bar{G}$ (dotted line).

rows of this table report the signs of the corresponding changes in the data and in the baseline model M_0, respectively. The comparison of the outcomes of the three models suggests that removing the mandatory spending shock does not have any consequences for the direction of the changes in volatility when the average fraction of mandatory spending in the economy changes. The changes in the correlations are more affected: removing the government spending shock leads to higher correlation between total government spending and output as $\bar{m}$ increases, opposite to what occurs in the data. Thus, we conclude that both the level and the presence of variation in mandatory public spending are important for replication of the empirical facts listed in Section 3.

The Role of the Utility Parameters

In the baseline model we calibrated the parameters capturing the elasticities of substi-

Table 5: The signs of the changes in the volatility and correlation as $\bar{m}$ increases from 0.4 to 0.6., for different sub-versions of the model.

	ΔVarΔ ln(X)								ΔCorΔ ln(X,Y)							
X	Y	I	C	G	g	L	B	τ	I	C	G	g	m	L	B	τ
Data	-	-	-	=	-	-	+	+	-	+	-	-	=	+	-	+
M_0	-	-	+	+	-	-	+	+	+	-	-	+	+	-	+	-
$M_{0,A}$	-	-	+	+	-	-	+	+	+	+	+	+	+	-	+	-
$M_{0,m}$	-	-	+	-	+	=	-	+	+	-	-	+	+	=	-	-
M_1	+	+	+	+	+	+	+	+	+	-	-	+	-	+	+	+
M_2	-	-	+	+	-	-	+	+	+	-	-	+	+	-	+	-
M_3	-	+	+	+	+	+	+	+	-	-	-	-	+	+	+	-
$M_{4,1}$	+	+	+	+	+	+	+	+	+	-	-	+	-	+	+	-
$M_{4,2}$	-	+	-	+	-	-	+	+	+	-	-	+	+	-	+	+

tution in the utility function. We have chosen to do this to bring the model correlations closer to those in the data. Here we consider alternative values for v_c, v_l, and v_g and their role in shaping the quantitative and qualitative features of the model.

We consider several variations of these parameters, usually applied in the literature (with the values of all the remaining parameters set as described in Table 2):

M_1: $v_c = v_l = v_g = 1$. This is the case of utility logarithmic in all the arguments.

M_2: $v_c = 2.5$, $v_l = 3$, $v_g = 1$. These are the typical parameter values for CRRA utility of the form considered in this paper. The parameter for public consumption is set given that its estimates in developed countries vary between 0.8 and 1.1 (Debortoli and Nunes, 2013).

Table 5 (rows 5 and 6) report the signs of the changes in the volatility and correlations of the variables generated by these versions of the model economy as $\bar{m}$ increases from 0.4 to 0.6. While the change in the correlations is almost unaffected relative to the baseline, the volatility of all the variables increases for M_1 as the fraction of mandatory spending increases. For M_2, the signs of the changes in the volatility are equivalent to those from the baseline model, for all the variables. However, the absolute values of the second moments (not reported) are further from the data in comparison with the baseline model. Thus, the calibration strategy chosen in section 3 is not innocent: the utility parameters play an important role in the ability of the model to replicate the empirical facts.

The Role of the Effective Consumption Function

We evaluate the importance of non-separability between private consumption and mandatory spending for the cyclical properties of the model economy by considering the following sub-version of the model (with the values of all the remaining parameters set as described in Table 2):

M_3: $\rho = 1$. In this case the utility from private consumption is independent from the mandatory spending. The only way this spending influences the economy is through the resource constraint. Table 5 (row 7) reports the results of the simulations of this version of the model. The changes in volatility are very different from those in the data and in the baseline economy. Therefore, the non-separability between private and mandatory public consumption is crucial for replication of the empirical facts.

Finally, we consider the effective consumption of CES form: $C_t = (\rho c_t^\gamma + (1-\rho) m_t^\gamma)^{\frac{1}{\gamma}}$, with $\gamma < 1$. This form of effective consumption is less restrictive than the Cobb-Douglas form considered in the baseline model; it allows to evaluate the importance of the degree of substitutability/complementarity between private consumption and mandatory public spending. We consider two subcases (with the values of all the remaining parameters set as described in Table 2):

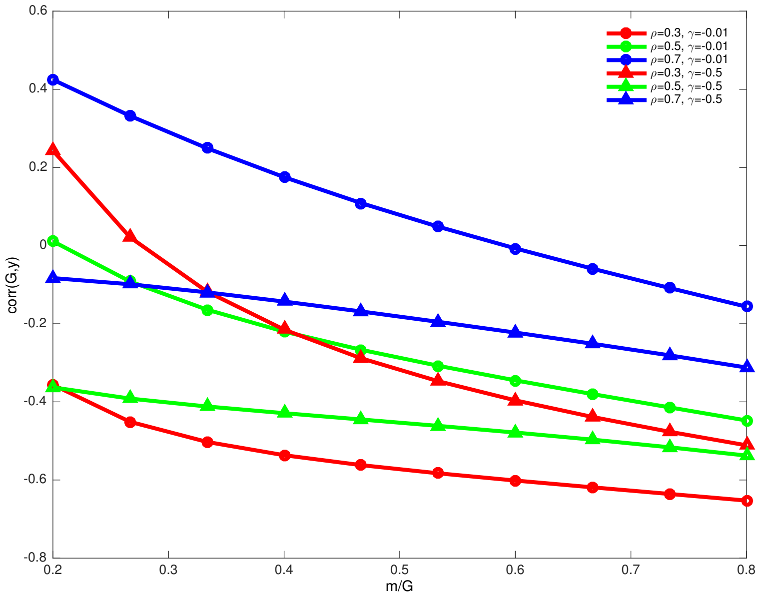
$M_{4,1}$: $\gamma = 0.5$ (private and public consumption are substitutes).

$M_{4,2}$: $\gamma = -0.5$ (private and public consumption are complements).

The behavior of the second moments is summarized in Table 5, rows 8 and 9. The substitutability assumption ($M_{4,1}$) results in an increase in all of the variances as $\bar{m}$ increases from 0.4 to 0.6, while the complementarity between private and mandatory consumption ($M_{4,2}$) delivers the responses in line with those observed in the data (for majority of the variables).

The CES effective consumption function adds another parameter to the model, γ, and allows to generate a wider range of the values for the correlations between total government spending and output. In particular, varying γ (in the range $\gamma < 0$, to generate the moments consistent with the data) allows to achieve various degrees of pro- or countercyclicality of fiscal policy. Intuitively, a rise in the mandatory public spending act as a negative government spending shock: more resources have to be devoted to government

Figure 5: The correlation between total government spending and output in the model as a function of the fraction of mandatory public spending, for different values of CES effective consumption parameters.



consumption, thus output decreases. Given that mandatory spending is complementary to private consumption, private consumption declines in response to a negative shock to mandatory spending. Therefore, a larger fraction of mandatory spending in total government spending decreases procyclicality (or increases countercyclicality) of fiscal policy and reduces positive correlation between consumption and output. In Figure 5 we plot the model-generated correlation between the total government spending G and output y (both series detrended by the differences of logarithms) as a function of the degree of complementarity and the weight attached to the private consumption. The higher the complementarity between private consumption and mandatory spending (captured by the parameter γ) is, the lower the correlation between output and public spending is. Keeping the complementarity parameter constant, the higher the share of private consumption in total effective household consumption (captured by the parameter ρ) is, the higher the correlation between output and public spending is. By varying these two parameters of the effective consumption, we can achieve any correlation level, which in principle could match the cyclical properties of fiscal policy in any country given the fraction of mandatory public spending in the country. In particular, we can generate procyclical fiscal policies when ρ is high (mandatory spending does not contribute much to the household utility) and countercyclical fiscal policy when ρ is relatively low.

5 Conclusions

In this paper we presented a stylized model of optimal fiscal policy with a distinction between mandatory and discretionary public spending. We showed that higher fraction of mandatory spending in total government spending leads to less volatile business cycles and reduces procyclicality of fiscal policy. Our findings reiterate on the importance of "rules-based" policy for economic stability and welfare.

We have considered several variations of the model economy described in this paper; our conclusions remain robust. In particular, the absence of public debt or the absence of government commitment to its fiscal plan does not affect the qualitative features of the model economy described in this paper.

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Appendix

Deriving the statement of the government problem

Substitute taxes and bond price from (5) and (7) into (4) to obtain:

$$c_t + k_t + \beta E_t \frac{u_{c_{t+1}}}{u_{c_t}} b_t - \phi b_t^2 = -\frac{u_{l,t}}{u_{c,t} w_t}(w_t l_t + r_t k_{t-1}) + (1-\delta)k_{t-1} + b_{t-1}, \tag{22}$$

also substitute taxes into (6) to obtain:

$$u_{c,t} - \beta E_t u_{c,t+1}\left(-\frac{u_{l,t+1}}{u_{c,t+1} w_{t+1}} r_{t+1} + 1 - \delta\right) = 0. \tag{23}$$

The last two equations summarize four households optimality conditions. The resource constraint defines the level of discretionary spending that equilibrates the budget.

Simplifying these equations obtains:

$$u_{c_t}(c_t + k_t - \phi b_t^2 - (1-\delta)k_{t-1} - b_{t-1}) + \beta E_t u_{c_{t+1}} b_t + \frac{u_{l,t} l_t}{1-a} = 0, \tag{24}$$

$$u_{c,t} + \frac{a\beta}{(1-a)k_t} E_t(u_{l,t+1} l_{t+1}) - (1-\delta)\beta E_t u_{c,t+1} = 0. \tag{25}$$

Then, the problem of the government (Ramsey problem) can be formulated as follows:

$$\max_{\{c_t,l_t,k_t,b_t\}_{t=0}^{\infty}} E_0 \sum_{t=0}^{\infty} \beta^t u(c_t, m_t, 1-l_t, g_t) \tag{26}$$

$$s.t. \quad : \quad (10), (24), (25). \tag{27}$$

The optimality conditions for the government problem

We reformulate government problem (26)-(27) using the approach suggested by Marcet and Marimon (2011) as follows:

$$\min_{\{\mu_t,\eta_t\}_{t=0}^{\infty}} \max_{\{c_t,l_t,k_t,b_t\}_{t=0}^{\infty}} E_0 \sum_{t=0}^{\infty} \beta^t \{u(c_t, m_t, -l_t, y_t + (1-\delta)k_{t-1} - c_t - k_t - m_t) -$$
$$-\mu_t[u_{c_t}(c_t + k_t - \phi b_t^2 - (1-\delta)k_{t-1} - b_{t-1}) + \frac{u_{l,t}}{1-a} l_t] -$$
$$-\mu_{t-1} u_{c,t} b_{t-1} + \eta_t u_{c,t} + \eta_{t-1} \frac{a u_{l,t} l_t}{(1-a)k_{t-1}} - \eta_{t-1} u_{c,t}(1-\delta)\},$$
$$\mu_{-1} = 0, \eta_{-1} = 0, k_{-1}, b_{-1} - given.$$

This formulation lead to the optimality conditions presented in the main text.