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VOLATILITY PUZZLE**

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# PARTISAN CYCLES AND THE CONSUMPTION VOLATILITY PUZZLE\*

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## Abstract

Standard real business cycle theory predicts that consumption should be smoother than output, as observed in developed countries. In emerging economies, however, consumption is more volatile than income. In this paper we provide a novel explanation of this phenomenon, the ‘consumption volatility puzzle’, based on political frictions. We develop a dynamic stochastic political economy model where parties that disagree on the size of government (right-wing and left-wing) alternate in power and face aggregate uncertainty. While productivity shocks affect only consumption through responses to output, political shocks (switches in political ideology) change the composition between private and public consumption for a given output size via changes in the level of taxes. Since emerging economies are characterized by less stable governments and more polarized societies, the effects of political shocks are more pronounced. For a reasonable set of parameters we confirm the empirical relationship between political polarization and the ratio of consumption volatility to output volatility across countries.

*JEL Classification:*

*Keywords:* Consumption Volatility Puzzle, Emerging Markets, Public Spending, Markov Equilibrium, Political Cycles, Time Consistency.

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# 1 Introduction

Standard real business cycle theory predicts that consumption should be smoother than output. Agents focus on permanent rather than temporary income when making decisions, so they react to an increase in income by saving part of it for future consumption. This prediction holds for developed countries, where the volatility of consumption is in general smaller than the volatility of output. In emerging economies, however, consumption is more volatile than income (23% at annual frequencies and 40% at quarterly frequencies), a phenomenon known as the ‘consumption volatility puzzle’. In this paper we explore whether the introduction of political frictions into a standard real business cycle model can qualitatively and quantitatively explain this puzzle.

We are motivated by three observations drawn from analyzing stylized facts in emerging versus developed economies. First, there is a positive correlation between the variability of private and public consumption. Second, the relative volatility of consumption is positively correlated with the degree of political polarization (the dispersion in political preferences among the population). Finally, emerging economies tend to be more polarized. Figure 1 illustrates the last two points.

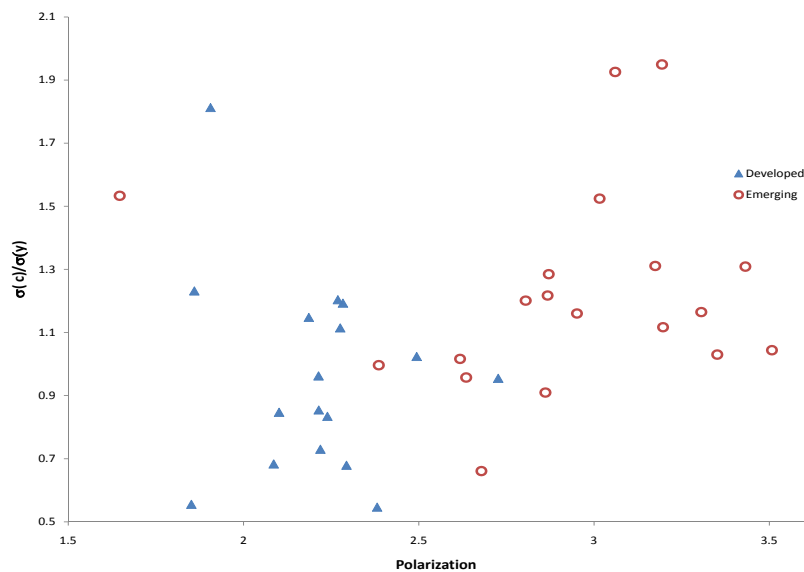


Figure 1: Relative volatility of consumption and polarization.

Our main hypothesis is that fluctuations in economic variables are not only caused by innovations to productivity but also by shifts in ideology regarding the size of government. Countries that are more polarized exhibit larger swings in the level of spending. Because consumption responds more than output to the resulting changes in taxation, these countries will tend to have a larger relative volatility of consumption. We elaborate on this argument in a dynamic political economy model and provide intuition by looking at an example economy for which analytical solutions can

be computed. We then calibrate the more general environment to a set of emerging and developed economies in order to quantify how much of the variability in relative consumption volatility can be explained by the model by varying its degree of political polarization.

Our setup embeds Persson and Svensson's (1989) political economy model of public goods provision in a neoclassical growth framework. Political parties that disagree on the size of the government alternate in power. Left-wing parties place more weight on public spending than right-wing parties and hence tax income at a higher rate in order to finance a larger level of expenditures. This introduces an additional source of volatility for economic variables triggered by changes in government policy, which can be interpreted as *political shocks*. In contrast to total factor productivity (TFP) shocks, a political shock affects consumption immediately through changes in agents' disposable income, while the response of output (caused by changes in investment) is delayed and muted. As a result, consumption volatility can be larger than output volatility in the presence of political shocks. Our mechanism is related to the earlier work of Dotsey (1990) and Baxter and King (1993) who study the effects of exogenous government expenditure shocks on macroeconomic activity. A main departure is that public policy is endogenous in our model. We are able to generate the stylized fact that government spending is more volatile in emerging economies than in developed ones (the average volatility is three times as large, as shown in Table 1) and to provide a reasonable channel by which this happens.<sup>1</sup>

We endogenize public spending by building on a growing literature on political macroeconomics. There are two important frictions borrowed from this literature—in addition to political disagreement—relative to a standard neoclassical economy that are key to our results. The first is that the policymaker lacks commitment. Inefficiencies are introduced because neither party can credibly commit to follow a particular sequence of taxes and spending. This relates to the theories of political failure presented by Persson and Svensson (1989) and Besley and Coate (1998) in two-period models. We focus instead on an infinite horizon economy and characterize time-consistent outcomes as Markov-perfect equilibria following Klein, Krusell and Rios-Rull (2008).

The second friction results from the outcome of future elections being uncertain at the time policy choices are taken, together with market incompleteness, since a set of contingent claims that allow the current policymaker to insure against shocks does not exist. This generates additional inefficiencies because the incumbent party is more short-sighted than its constituency when subject to political uncertainty. This was first pointed out by Alesina and Tabellini (1990) and more recently studied in fully dynamic models by Aguiar and Amador (2010) and Azzimonti (2010).<sup>2</sup> While their environment is completely symmetric, the ideology of the policymaker may change over time, so we analyze equilibria where policy functions are asymmetric. Persson and Svensson (1989) and Cukierman, Edwards and Tabellini (1992) study asymmetric equilibria, but in two-period deterministic models where the emphasis is on manipulation of government policy. In our environment the incumbent party also has incentives to use policy strategically because changes in the tax level, by affecting individual savings, modify the tax base inherited by its successor. The

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<sup>1</sup>Woo (2005) also relies on political shocks of the sort studied here to generate large levels of public consumption volatility, but by assuming that policymakers only care about public goods.

<sup>2</sup>Similar effects have been studied in environments with debt instead of capital by Amador (2008), Caballero and Yared (2008), Devereux and Wen (1998), and Ilzetzki (2010).

interaction of these two frictions gives rise to politically driven business cycles. This is related to an earlier paper on partisan cycles by Alesina (1987). While he focuses on disagreement over inflation and unemployment, our focus is on the effect of public spending and taxation on real macroeconomic variables.<sup>3</sup> In addition to the endogenous partisan business cycle driven by asymmetric policy, we introduce aggregate shocks to productivity in the tradition of the macroeconomics literature which is absent in most of the political economy work. An exception is Barseghyan, Battaglini and Coate (2010), who study fiscal policy over the business cycle in a non standard neoclassical environment. Because they abstract from capital and agents are risk neutral, their model is silent on the effects of these policies on consumption volatility. An important methodological contribution of our work is thus the implementation of global numerical methods to compute stochastic politico-economic equilibria in a neoclassical environment. To the best of our knowledge this has not been done in the past.

This paper also complements two strands of literature that have tried to account for the consumption volatility puzzle. The first one focuses on stochastic productivity trends and is based on the permanent income hypothesis. The idea is that the volatility of permanent income dominates the volatility of transitory shocks to income in emerging economies, as postulated by Aguiar and Gopinath (2007) and studied by Schmitt-Grohe and Uribe (2011). A second explanation relies on the existence of financial frictions and is based on the financing of a firm’s working capital. For example, in Neumeyer and Perri (2005) current interest rate shocks affect labor (and hence output) with a lag, while private savings (and hence consumption) adjust immediately. This creates a larger overall response of consumption to shocks (see also Fernández-Villaverde, Guerrón, Rubio-Ramírez, and Uribe [2009] for more recent work). The emphasis in these models is on real shocks to the economy, either through TFP (transitory vs. permanent) or interest rates. In this paper we propose a novel explanation for the puzzle based on ideological swings of policymakers, which can be interpreted as political shocks.

The paper is organized as follows. Section 2 describes a set of stylized facts that characterize the business cycle properties of emerging and developed economies for a panel of countries. The main assumptions of the model are summarized in Section 3, where the stochastic politico-economic equilibrium is defined. Intuition on how this model helps explain the puzzle is provided in Section 4, where we find tractable analytical expressions and decompose the volatility of consumption between TFP and political shocks. We calibrate the model to the US economy in Section 5 and perform our main experiment by varying the degree of political polarization across countries in Section 5.2. The main business cycle moments for our artificial economy are computed and contrasted with the ones analyzed in Section 2. Conclusions and extensions are contained in Section 6. All proofs are relegated to the Appendix.

## 2 Stylized Facts

In this section we present business cycle properties of a broad set of countries and point to some key differences between emerging and developed economies. The countries under study are summarized

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<sup>3</sup>Milesi-Ferretti and Spolaore (1994) and more recently Song (2010) study the effect of strategic manipulation on partisan cycles. See Drazen (2000) for a comprehensive review of data and theory.

in Table 7, Appendix 7.1. Following Aguiar and Gopinath (2007), we use the S&P classification for developed markets for our developed economies and classify all other countries as emerging.<sup>4</sup>

The data are obtained from Kaminsky, Reinhart, and Végh (2004) who compile a comprehensive cross-country panel for our main variables of interest from the IMF World Economic Outlook (WEO) and IMF Government Financial Statistics (GFS) data sets. We compute business cycle moments (volatilities, autocorrelations and correlations) on Hodrick-Prescott filtered (with smoothing parameter 100) natural logs of each (GDP deflated) variable on the available time series for each country. Since data availability is not consistent across the four variables for individual countries, the period studied in each case reflects the longest time span for which we have complete data for that country. Sample lengths for each country are reported in Table 7, Appendix 7.1.

Table 1: Business cycle moments (averages)

Moment	Developed Economies	Emerging Economies
$\sigma(y)$	2.37e-2	4.28e-2
$\sigma(c)/\sigma(y)$	0.96	1.23
$\sigma(I)/\sigma(y)$	3.79	3.85
$\sigma(g_c)/\sigma(y)$	1.41	3.03
$\rho(y)$	0.61	0.56
$\rho(g_c)$	0.60	0.38
$\rho(y, c)$	0.80	0.71
$\rho(y, I)$	0.85	0.62
$\rho(y, g_c)$	0.24	0.22

**Note:** This table contains the average value of moments computed for a set of emerging and developed economies. Relative volatility measures for each country can be found in Table 8 in Appendix 7.1. Data are obtained from Kaminsky, Reinhart and Vegh (2004).

Output in emerging economies is about twice as volatile as output in developed economies with roughly the same autocorrelation. This has previously been documented by Aguiar and Gopinath (2007) for quarterly data in a smaller sample of countries. They also pointed to the striking difference in the volatility of consumption relative to output between the two groups. Consumption is less volatile than output for developed economies but 23% more volatile than income in our sample for emerging economies. There are some exceptions, as can be seen in the first column of Table 8 in Appendix 7.1, which reports the individual values for each country. Much of the focus on cross-country differences in the business cycle properties of government expenditure has centered on the difference in the volatility of government consumption in developed versus emerging economies (see Bachman and Bai [2010] for an analysis of the US economy or Lane [2003] for a comparison across OECD countries). Consistent with this literature, we find that public consumption is much more volatile both absolutely and relative to output volatility in emerging economies. We find that at

<sup>4</sup>Two primary criteria used in defining a country as a developed market are (i) it is located in a high-income country as defined by the World Bank and (ii) its capital markets are highly developed and transparent with large market capitalization.

business cycle frequencies it is more volatile than output by a factor of three, more than double that for developed economies. We also find support for the pro-cyclicality of public spending both in developed and emerging economies.<sup>5</sup>

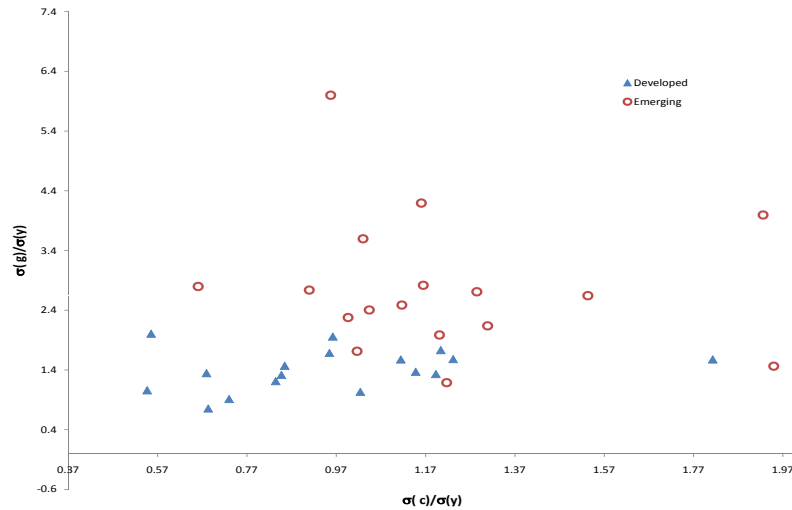


Figure 2: Relative volatility of public and private consumption.

Part of the motivation for our analysis comes from the correlation of government expenditure volatility to consumption volatility. Figure 2 shows that countries with large observed relative volatility of private consumption also tend to have more volatile public expenditure. The correlation of these variables is 0.24. This relationship is important because increases in polarization in the model affect the degree of volatility for both, a channel explored further in succeeding sections. A line of empirical research has studied the effects of the variability of shocks to government expenditures on macroeconomic outcomes. Fatás and Mihov (2003) estimate that for every percent increase in volatility of output driven by volatility of fiscal policy reduces growth by 0.75 percentage point.

The observation that the relative volatility of investment is roughly the same for developed and emerging economies is consistent with findings in the literature. Given the wide differences in consumption and public spending volatilities, this suggests the presence of adjustment costs to investment.

Empirical studies using polarization offer reassuring but ultimately unsatisfying support for our hypothesis that polarization matters for economic stability. Starting with Easterly and Levine

<sup>5</sup>Ilzetzki [2010] and Ilzetzki and Végh (2008) document that government expenditure is pro-cyclical in emerging economies and weakly counter cyclical in developed economies. The cyclicity of government expenditure depends largely on transfers, which we do not directly model, so we focus on the series of *public consumption* rather than on total public expenditures. Ideally, we would want to present business cycle moments of government expenditures net of transfers, but unfortunately data on transfers are not available for most emerging economies. We do have data for the US and Mexico, which will be used in the model's calibration.

(1997) a large literature has developed attributing economic outcomes to ideological differences in the population. However, most of these papers use non partisan heterogeneity in the population; for example, employing ethnic, religious, and linguistic divisions as their polarization measures deliver negative outcomes.<sup>6</sup> Closer to our partisan model Alt and Dreyer Lassen (2000) and Lindqvist and Östling (2007) empirically link political polarization to economic performance using different and more relevant measures of partisan disagreement over the size of government. We adopt the measure from Lindqvist and Östling directly. They use self-reported political preferences from the 1999-2002 World Values Survey (a description of their method can be found in Appendix 7.1). Importantly, they find that political polarization is not endogenous to economic performance, in line with our model assumption. Using this measure, we find the motivating stylized facts mentioned in the introduction, that the relative volatility of both government expenditure and consumption are positively related to polarization and emerging economies, display higher levels of polarization, as shown above in Figure 1.

### 3 Environment

Our setup embeds Persson and Svensson's (1989) political economy model of public goods provision in a neoclassical growth framework.

#### 3.1 Economic environment

Technology is characterized by a Cobb-Douglas production function that uses capital  $k$  and labor  $l$  to produce a single consumption good

$$F(z, k, l) = e^z k^\alpha l^{1-\alpha}.$$

The variable  $z$  represents an aggregate productivity shock that follows an AR(1) process

$$z' = \rho z + \epsilon'$$

where  $\epsilon$  is a draw from an iid normal distribution and  $|\rho| < 1$ . Capital depreciates at rate  $\delta$  and investment is subject to capital adjustment costs  $\Phi(k, k')$

$$\Phi(k, k') = \phi \left( \frac{k'}{k} - 1 \right)^2 k$$

as modeled by Greenwood, Hercowitz and Krusell (2000).

There is also a public good, denoted by  $g$ , that can be produced from the consumption good according to a linear technology. We normalize the time endowment in the economy to 1. Thus, the aggregate resource constraint reads

$$c + g + k' = F(z, k, 1) + (1 - \delta)k - \Phi(k, k').$$

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<sup>6</sup>Alesina and Zhuravskaya (2008) provide a recent novel measure of population heterogeneity and its effect on the quality of government



There are competitive labor and capital markets and competitive production of public goods. The relative price of private and public goods is one in equilibrium. The wage rate is denoted by  $w$  and the rental rate of capital by  $r$ . Firms hire labor and capital in order to maximize profits after observing their productivity shock. Their decision problem is static and deterministic, implying

$$w = F_l(z, k, l) \text{ and } r = F_k(z, k, l). \quad (1)$$

Citizens live forever and discount the future at rate  $\beta < 1$ . They derive utility from the consumption of private and public goods. Political disagreement arises from heterogeneity in agents' preferences regarding the overall size of the government. We assume that there are two types indexed by  $i$ , with  $i \in \{L, R\}$ .

The instantaneous utility of a type  $i$  agent is separable in private and public consumption

$$(1 - \lambda_i)u(c) + \lambda_i v(g)$$

where  $u$  and  $v$  are increasing and concave, and the weights on public consumption satisfy  $\lambda_L = \bar{\lambda} + \xi$  and  $\lambda_R = \bar{\lambda} - \xi$ . Since  $\lambda^R < \lambda^L$ , we can think of  $R$  as right-wing (small government) and  $L$  as left-wing (large government) individuals. The variance of  $\lambda_i$  is determined by  $\xi$ , which can be interpreted as a measure of the degree of political polarization in society. If  $\xi$  was equal to zero, agents would be completely homogeneous. As  $\xi$  increases, views regarding the provision of  $g$  become more conflicting. This parameter will be the key variable governing the volatility of government distortions in cross-country comparisons. Complementarity between private and public consumption would induce a direct co-movement between the two goods and additional volatility in consumption. By assuming separability, we are reducing this degree of freedom.

Citizens finance private consumption and investment with capital and labor income, which are taxed at the proportional rate  $\tau$

$$c_i = (1 - \tau)[wl_i + rk_i + (1 - \delta)k] - k'_i - \Phi(k, k').$$

Since leisure is not valued, the supply of labor is inelastic. The choice of investment  $k'_i$  is inter-temporal and depends on government policy. While the current level of taxes  $\tau$  is known at the time of decision-making, citizens need to form expectations about future policy  $\tau'$ . We postpone a description about how these expectations are formed until the next section. Note that because all agents face the same policy and preferences are additively separable, investment decisions are independent of type. As a result we can focus the analysis on a representative agent that accumulates capital according to a standard Euler equation with adjustment costs

$$u_c(c)(1 + \Phi_{k'}(k, k')) = \beta \mathbb{E} \left[ [(1 - \tau')(r' + 1 - \delta) - \Phi_k(k', k'')] u_c(c') \right].$$

The government is subject to a period-by-period balanced budget constraint

$$\tau f(z, k) = g,$$

where we simplify the notation by defining  $f(z, k) \equiv F(z, k, 1)$ .

### 3.2 Political environment

There are two political parties  $L$  and  $R$  representing each group in the population. The incumbent party is chosen at the beginning of a period and sets policy in order to maximize the utility of its constituency. Agents and firms then choose allocations taking as given current policy and expectations of future policy. Parties alternate in power following an exogenous Markov process, where  $p$  denotes the type-independent probability of retaining office in the next period. Despite the fact that there are two symmetric parties, the re-election probability may be larger than 0.5 due to incumbency advantage effects. The micro-foundations of this specification come from a probabilistic voting model as shown in Azzimonti (2010).

A key feature of the environment is the government's lack of commitment; tax and spending policy promises are not credible unless they are ex-post efficient. The party in power plays a game against the opposition, taking their policy as given. Alternate realizations of history (defined by the sequence of policies and realizations of productivity shocks up to time  $t$ ) may result in different current policies. In principle, this dynamic game allows for multiple subgame perfect equilibria that can be constructed using reputation mechanisms. We will rule out such mechanisms and focus instead on Markov perfect equilibria (MPE), defined as a set of strategies that depend only on the current payoff-relevant states of the economy:  $k$  and  $z$ . Because parties have different objectives, their policy choices differ in equilibrium, so strategies are functions of their type.

The two key equilibrium objects are the spending rule of incumbent  $i$ ,  $\mathcal{G}_i(z, k)$  and the investment decision of our representative citizen  $\mathcal{H}_i(z, k)$ . Note that the latter is a function of the identity of the party in power due to the effect of tax policies on savings behavior. The tax rule  $\mathcal{T}_i(z, k)$  is trivially determined from the government's budget constraint. The value function of a citizen type  $i$  when his group is in power will be denoted by  $V_i(z, k)$  and when his group is out of power by  $W_i(z, k)$ .

### 3.3 Political equilibrium

An incumbent party chooses the provision of public good  $g$  knowing that it might be replaced by a different policymaker with probability  $p$ . Suppose that a left-wing government  $L$  is elected. Given the stock of public capital  $k$  and the current realization of the shock  $z$ , the incumbent's objective function today is given by

$$\max_g (1 - \lambda_L)u(c) + \lambda_L v(g) + \beta \mathbb{E}_z [pV_L(z', k') + (1 - p)W_L(z', k')]$$

where the consumption of its constituency satisfies

$$c = f(z, k) + (1 - \delta)k - g - k' - \Phi(k, k') \equiv \mathcal{C}(z, k, k', g).$$

Private savings  $k'$  given current spending  $g$  satisfies the Euler equation

$$u_c(c)(1 + \Phi_{k'}(k, k')) = \beta \mathbb{E}_{zL} [((1 - \tau_j) [F_k(z', k') + 1 - \delta] - \Phi_k(k', k''))u_c(c')] \quad (2)$$

where  $c' = \mathcal{C}(z', k', \mathcal{H}_j(z', k'), \mathcal{G}_j(z', k'))$  and future taxes satisfy the government budget constraint  $\tau_j' = \frac{\mathcal{G}_j(z', k')}{F(z', k')}$ . Expectations  $\mathbb{E}_{zL}$  are taken with respect to productivity  $z'$  and political shocks  $j$  (i.e., the identity of tomorrow's incumbent), given that  $L$  is currently in power and the current realization of TFP is  $z$ .

The functional equation (2) determines future capital as a function of current capital, productivity, and public spending,  $k' = H_L(z, k, g)$ . It summarizes an agent's optimal reaction to a one-period deviation of  $g$  from the equilibrium rule that an incumbent would follow in the Markov-perfect equilibrium,  $\mathcal{G}_L(z, k)$ . Agents expect tomorrow's incumbent of type  $j$  to follow the equilibrium strategy  $g_j' = \mathcal{G}_j(z', k')$ , and capital to satisfy  $k'' = \mathcal{H}_j(z', k')$  under such policy. Consistency requires that  $\mathcal{H}_i(z, k) = H_i(z, k, \mathcal{G}_i(z, k))$  for all  $i$ .

The description of the problem is completed by defining the functions  $V_L(z, k)$  and  $W_L(z, k)$ :

$$V_L(z, k) = (1 - \lambda_L)u(\mathcal{C}_L(z, k)) + \lambda_L v(\mathcal{G}_L(z, k)) + \beta \mathbb{E}_z[pV_L(z', k') + (1 - p)W_L(z', k')] \quad (3)$$

and

$$W_L(z, k) = (1 - \lambda_L)u(\mathcal{C}_R(z, k)) + \lambda_L v(\mathcal{G}_R(z, k)) + \beta \mathbb{E}_z[(1 - p)V_L(z', k') + pW_L(z', k')] \quad (4)$$

where  $\mathcal{C}_i(z, k) = \mathcal{C}(z, k, \mathcal{H}_i(z, k), \mathcal{G}_i(z, k))$ . The main difference between equations (3) and (4) is that spending levels in the second equation are chosen by a right-wing party and hence do not maximize the objective of incumbent  $L$ . A second difference comes from the expectation over political shocks since  $p$  denotes the probability of retaining power for a given incumbent.

The political uncertainty, combined with the conflict over the provision of public goods, creates incentives to act strategically. This becomes clear when analyzing incumbent  $L$ 's first order condition,

$$(1 - \lambda_L)u_c(-1 - H_g(1 + \Phi_{k'})) + \lambda_L v_g + \beta \mathbb{E}_z[pV'_{k,L} + (1 - p)W'_{k,L}]H_g = 0.$$

When choosing  $g$ , the decision maker trades off the current benefit of larger government expenditures given by the increase in  $v(g)$  to the current cost of financing this increase via taxes, which lowers today's consumption  $c$ . In addition, it takes into account the dynamic effects of this policy change, since larger taxes reduce current savings by  $H_g$ . This affects continuation utilities  $V$  and  $W$  directly by reducing future income and indirectly by lowering future spending of incumbent  $j$ . By controlling the level of investment—via changes in the tax system—an incumbent party can affect the spending level of future policymakers through changes to tomorrow's tax base. This form of manipulation has been extensively studied in the political economy literature in the context of optimal debt management pioneered by Persson and Svensson (1989), but received less attention in economies where private rather than public savings are affected.

**Definition 3.1 (MPE)** *A Markov-perfect equilibrium satisfies*

- i. Given current policy and expectations on future policy, agent's and firm's decisions are a competitive equilibrium.*

ii. Given equilibrium allocations and expectations on future policy, current policy solves incumbent  $i$ 's problem.

iii. The incumbent party's choices are consistent with private expectations,

$$g = \mathcal{G}_i(z, k).$$

This definition imposes consistency between citizens' and government's decisions. Additionally it implies that private expectations are correct and no incumbent has incentive to deviate from the MPE. A theoretical characterization of the MPE is non trivial in general, but under some restrictive assumptions on the primitives of the economy it is possible to find an analytical characterization. This will allow us to shed some light on how the main mechanism driving the volatility of output, consumption and expenditures operates in this environment.

## 4 Example Economy

Political shocks affect economic variables differently than standard innovations to productivity. In particular, consumption reacts instantaneously to a political shock while output changes with a one-period lag. Keeping TFP constant, this results in consumption volatility being larger than output volatility. To illustrate this further it is useful to analyze an example economy.

**Assumption 4.1** *Suppose that (i) preferences over private and public consumption,  $u$  and  $v$ , are logarithmic, (ii) productivity innovations follow a 2-state Markov process:  $z_s$  with  $s \in \{H, L\}$ , (iii) there is full depreciation  $\delta = 1$  and (iv) there are no adjustment costs  $\phi = 0$ .*

Under these assumptions we can show that private investment is proportional to output  $y_z = e^z k^\alpha$  and decreasing in public spending,  $H(z, k, g) = \alpha\beta y_z - g$ . Because private consumption is also linear in output, we guess that government spending follows a linear and type-dependent rule. This guess is verified in the following proposition.

**Proposition 4.1** *Under Assumption 1, the MPE satisfies*

$$\begin{aligned} \mathcal{G}_i(z, k) &= \lambda_i \eta e^z k^\alpha, \quad \mathcal{H}_i(z, k) = \alpha\beta(1 - \lambda_i \eta) e^z k^\alpha, \quad \text{and} \\ \mathcal{C}_i(z, k) &= (1 - \alpha\beta)(1 - \lambda_i \eta) e^z k^\alpha \quad \text{where} \quad \eta = \frac{1 - 2\alpha\beta p - \alpha^2 \beta^2 (1 - 2p)}{1 + \alpha\beta(1 - 2p)}. \end{aligned}$$

**Proof 4.1** *See Appendix 7.3*

The marginal propensity of right-wing governments to spend on public goods  $\lambda_R \eta$  is smaller than that of left-wing incumbents. The model thus predicts a smaller size of the government under an  $R$  incumbent party and a lower tax burden on the private sector. Since disposable income is larger, individuals choose higher consumption and investment than when a left-wing party is in power. This has interesting implications regarding the underlying dynamics of the model.

## 4.1 Long-run dynamics

To make the exposition simpler, ignore TFP shocks for the moment, focusing only on the political dimension. Figure 3 depicts private investment as a function of the current stock of capital. Keeping  $z = z_H$ , the line  $\mathcal{H}_L(z_H, k)$  represents tomorrow's value of capital assuming that  $L$  is currently in power. If there was no political turnover (that is,  $L$  was in power forever) capital would eventually converge to  $k_{LH}^*$ . If instead a right-wing party was in power forever, steady state capital,  $k_{RH}^*$ , would be larger. Moreover, the speed of convergence for a given value of  $z$ , defined as

$$\gamma_{iz} = \alpha\beta(1 - \lambda_i\eta)e^z k^{\alpha-1},$$

is higher under  $i = R$ . That is, growth is faster and the economy converges to a larger steady state level of capital under governments that have a smaller weight on public consumption. The intuition relies on the fact that a left-wing party prefers a larger share of output to be devoted to public goods provision. Because financing this good is costly under proportional taxation, inefficiencies are more pronounced than under an  $R$ -type government and have long-term distortionary consequences in the economy.

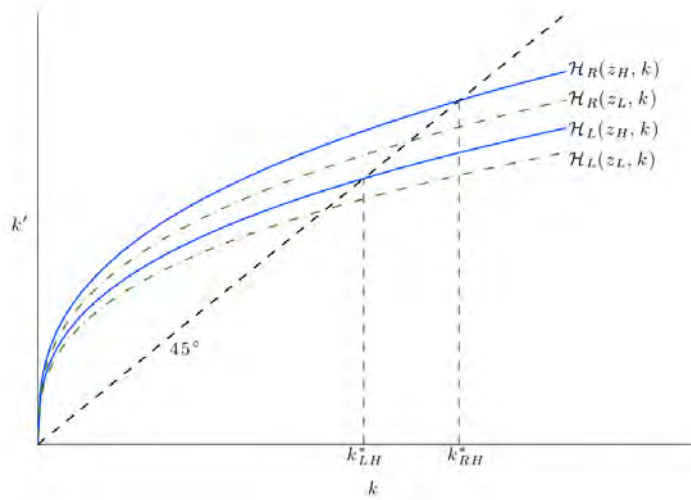


Figure 3: Evolution of capital

## 4.2 Short-run dynamics

Now consider the response of the economy to a political shock, starting from the steady state attained under a left-wing government. Suppose that party  $R$  gains power for only one period and  $L$  regains control of the government forever after. The impulse-response function of consumption and output is depicted in Panel A of Figure 4. The main difference in both variables lies in the timing of responses: Consumption reacts immediately, while output only jumps upward with a

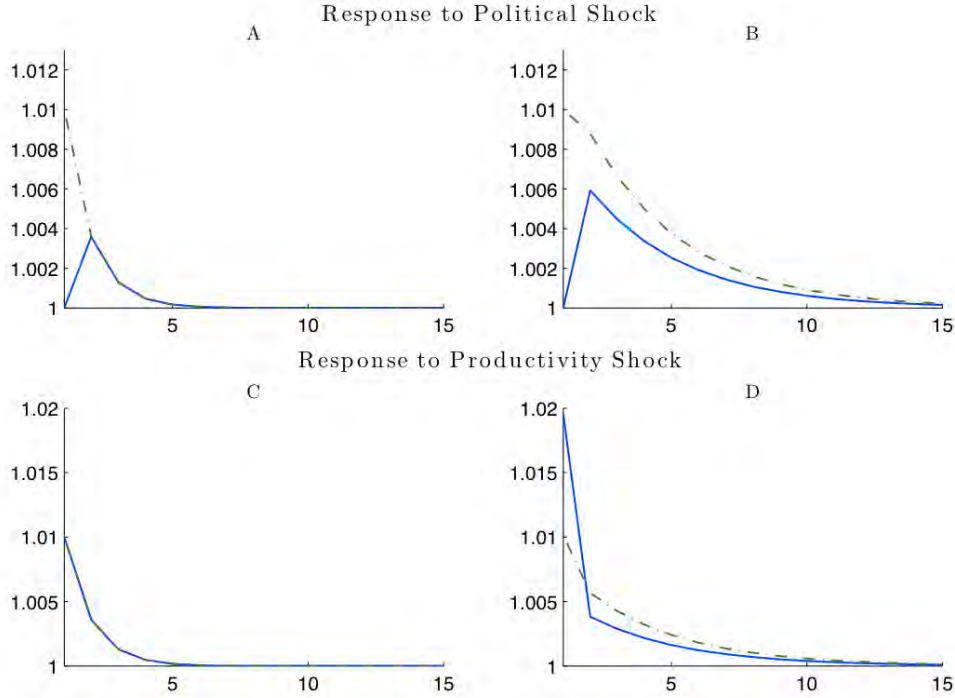


Figure 4: Impulse response to productivity and political shocks (– consumption and - output)

one-period lag. The reason is the following: The switch in political ideology generates a reduction in public spending and taxes, which triggers an increase in current consumption. Output remains unchanged due to the fact that capital is given and labor is inelastic. Individuals also increase investment in response to the change in regime, since lower taxes behave similarly to a positive income shock. The larger stock of capital in the second period increases production at that point. As time goes by the effects of the shock dissipate slowly until the economy converges to the original steady state.

A positive TFP shock has the same effects on economic variables as those found in a standard real business cycle (RBC) model. In particular, current output increases immediately as the economy becomes more productive. The positive income effect induces a concurrent increase in consumption, which individuals smooth out over time by also raising investment. Under logarithmic utility it turns out that a 1% increase in output results in exactly 1% rise in consumption. This can be seen clearly in Panel C of Figure 4 where the size of the response to the shock coincides for both variables.

The previous discussion makes it clear that while both positive TFP shocks (increases in  $z$ ) and political shocks (power switches from  $L$  to  $R$ ) increase agents' disposable income, they have very different implications for output dynamics. An immediate testable implication of the model is that

consumption boosts that are observed leading GDP booms are associated to changes in ideological views of the government (i.e., on government spending), rather than innovations in productivity. Traditional TFP shocks result in coincidental movements in private consumption instead.

Proposition 4.2 presents a decomposition of the volatility of consumption due to each type of shock.

**Proposition 4.2** *Suppose that  $p > 0.5$ . Let  $\hat{c}_t = \ln c_t$ ,  $\hat{y}_t = \ln y_t$ , and  $\hat{x}_t = \ln(1 - \lambda_i \eta)$ , then the variance of (log) consumption satisfies*

$$\text{Var}(\hat{c}_t) = \text{Var}(\hat{y}_t) + \text{Var}(\hat{x}_t) + 2\text{Cov}(\hat{y}_t, \hat{x}_t) \quad (5)$$

where  $\text{Cov}(\hat{y}_t, \hat{x}_t) = \sum_{k=1}^t \alpha^k 0.5^2 (2p - 1)^k (\hat{x}_L - \hat{x}_R)^2$ .

This proposition illustrates the consumption volatility puzzle that arises under the lens of a traditional neoclassical framework. Because political shocks are abstracted from  $\text{Var}(\hat{x}_t) = \text{Cov}(\hat{y}_t, \hat{x}_t) = 0$ , so consumption is predicted to be as volatile as output. When the model is augmented to include volatility in political ideology then  $\text{Var}(\hat{c}_t) > \text{Var}(\hat{y}_t)$  as the covariance between political and economic shocks is positive (as long as  $p > 0.5$ , which is the empirically relevant domain for the probability of re-election). Also, the larger the degree of polarization the bigger the second and third terms in equation (5).

An obvious question is whether the model can generate  $\text{Var}(\hat{c}_t) < \text{Var}(\hat{y}_t)$  under some specification. A partial answer can be found in panels B and D of Figure 4, where we depict the impulse responses of our model under less than full depreciation, setting  $\delta = 0.1$ . While consumption still increases more than output when there is a switch from  $L$  to  $R$ , its response to TFP shocks is much smaller; a one percent change in output results in less than a one percent increase in consumption. It is then reasonable to expect that, depending on the relative strength of these two shocks, we could observe economies where  $\text{Var}(\hat{c}_t) \leq \text{Var}(\hat{y}_t)$ . Whether the predictions of the model are consistent with the stylized facts observed in the data is then a quantitative question. We address this by analyzing a more general environment where some of the restrictive assumptions of this section are relaxed.

Notice also from Figure 4 that the relative volatility of consumption will be decreasing as aggregate volatility due to the TFP process increases. If emerging economies simply had more volatile TFP processes while holding the political process constant; the effects of Panel D would dominate the effects of Panel B, leading to *less* volatile consumption relative to income. It is not enough in a standard RBC model to simply alter the productivity process because more volatility due to politics is required to generate higher  $\sigma(c)/\sigma(y)$ .

## 5 Quantitative Analysis

In this section we calibrate our benchmark model and test whether its quantitative implications are in line with stylized facts from the US economy. We then analyze how some key moments change as we modify the degree of political polarization using our empirical measure of this variable. In

particular, our aim is to quantify how much of the difference in the relative volatility of consumption to output can be explained by the mechanisms outlined in previous sections. The numerical procedure used to solve the model involves finding a fixed point in equilibrium policy rules. Details of this approach are described Appendix 7.4. Computation is non trivial because it is necessary to guess four functions: the savings rules for individuals under a left and right government  $\mathcal{H}_L(z, k)$  and  $\mathcal{H}_R(z, k)$ , and the spending rules of each party  $\mathcal{G}_L(z, k)$  and  $\mathcal{G}_R(z, k)$ . In addition, we need to solve for the savings function under a one-period deviation  $H(z, k, g)$ .

## 5.1 Calibration

Because we are building on the neoclassical framework, many of the parameters are standard. A time period represents a year, so the discount factor is  $\beta = 0.95$ . The share of capital  $\alpha$  is set to 0.36 and the depreciation rate  $\delta$  is 0.1. Preferences are logarithmic.

There are six parameters that still need to be determined. One of them sets adjustment costs,  $\phi$ . Two of them,  $\rho$  and  $\text{vol}(\epsilon)$ , govern the behavior of TFP shocks. The remaining three,  $p$ ,  $\xi$ , and  $\bar{\lambda}$ , set the behavior of political shocks. They are selected in order to match six empirical moments, which are computed using data for the US over the sample period 1960-2003. The model implied moments are obtained by simulating the political equilibrium for 11,000 periods where the first 1,000 are discarded to eliminate the effects of initial conditions. Table 2 summarizes the values of the parameters obtained from the calibration along with the target moments.

Table 2: Calibrated parameters

U.S.		
parameter	parameter value	target
$\rho$	0.92	$\text{corr}(y_t, y_{t-1}) = 0.53$
$\text{vol}(\epsilon)$	1.86e-2	$\text{vol}(y) = 1.98\text{e-}2$
$\phi$	0.57	$\text{vol}(I) = 6.65\text{e-}2$
$p$	0.9	ave. pol. tenure = 10 yrs.
$\xi$	1.38e-2	$\text{vol}(g) = 2.47\text{e-}2$
$\bar{\lambda}$	0.37	$\text{mean}(g/y) = 0.24$

**Note:** Cyclical moments computed by HP-filtering ( $w = 100$ ) the natural logs variables over the sample 1960-2003.  $I$  and  $y$  are obtained from Kaminsky, Reinhart and Vegh (2004), and  $g$  is consolidated government expenditures net of transfers, from NIPA Table 3.1 Government Current Receipts and Expenditures.

Productivity, specified as  $z' = \rho z + \epsilon'$ , is discretized using a two-state Markov process with values chosen such that  $\rho$  delivers an output autocorrelation of 0.53 and the volatility of  $\epsilon$  implies an output volatility of 1.98%. Adjustment costs  $\phi$  are chosen so that model generated investment volatility is equal to the value observed in the US of 6.67%. The probability of re-election  $p$  generates



an average tenure in power of 10 years, in line with political turnover in the US. The mean value of  $\lambda_i$  is chosen to match the average ratio of public spending to output, while  $\xi$  is set so that the volatility of  $g$  obtained from the model is equal to the one observed in the US for the same time period, 2.47%.

Table 3 reports the fit of the model for a broader set of business cycle moments (those marked with asterisks are matched as part of our calibration strategy). The first thing to note is that the introduction of political frictions to an otherwise standard neoclassical framework does not undermine the fit of the model to primary economic variables. For example, the cyclical behavior of consumption and investment is remarkably close to its empirical counterpart, as seen by comparing our predicted measures of  $\rho(y, c)$  and  $\rho(y, I)$  to the US values. Moreover, the correlation between private consumption and investment is also close to the data. Even though it was not a target of our calibration, the relative volatility of consumption to output  $\sigma(c)/\sigma(y)$ , our main variable of interest, is in line with the observed value for the US over the sample. The model under-predicts the level of persistence in government expenditures, as well as its cyclicality. This is due to the fact that public spending is more responsive to political swings than to TFP shocks in our model.

Table 3: U.S. Data and model fit

Moment	Data	Model
$\sigma(y)$	1.98e-2	1.98e-2*
$\sigma(c)/\sigma(y)$	0.83	0.96
$\sigma(I)/\sigma(y)$	3.35	3.35*
$\sigma(g)/\sigma(y)$	1.25	1.25*
$\rho(y)$	0.53	0.53*
$\rho(g)$	0.65	0.48
$\rho(y, c)$	0.92	0.98
$\rho(y, I)$	0.88	0.85
$\rho(y, g)$	0.31	0.06
$\rho(c, I)$	0.71	0.88

\* calibrated moments.

Given the success of the model in matching business cycle moments for key economic as well as and political variables, we can now move toward computing the relative volatility of consumption and public spending for the cross-section of countries in our sample.

## 5.2 Political business cycles

In this section we analyze the effects of political polarization on the cyclical components of consumption  $c$ , investment  $I$ , output  $y$ , and public spending  $g$ . In the first exercise we abstract from other forms of heterogeneity across countries. We then allow different income processes for emerging and developed countries. Finally, we allow stability  $p$  to vary across countries, calibrating it to

a political stability data set.

### 5.2.1 Heterogeneity in polarization

In order to isolate political factors from productivity differences across countries, which have been studied at length in previous literature, we fix all parameters to the calibrated levels of our benchmark economy except for one: polarization. Therefore, our main experiment consists of allowing  $\xi_j$  to vary across countries. Recall that a type  $R$  agent living in country  $j$  has preferences that satisfy

$$(1 - \lambda_{Rj})u(c) + \lambda_{Rj}v(g), \quad \text{with } \lambda_{Rj} = \bar{\lambda} - \xi_j.$$

Changes in  $\xi_j$  across countries imply differences in their degree of polarization. The mapping between the empirical measure of polarization and  $\xi_j$  is inferred from two points:  $\xi_{US}$  and  $\xi_{Mex}$ , each chosen to match the implied relative volatility of public spending  $\sigma(g)/\sigma(y)$  with its data counterpart for the US and Mexico.<sup>7</sup>

These two countries were chosen as representatives for developed and emerging economies. We then impute  $\xi_j$  from the following linear relationship

$$\xi_j = \xi_{US} + \frac{P_j - P_{US}}{P_{Mex} - P_{US}}(\xi_{Mex} - \xi_{US}),$$

where  $P_j$  denotes country  $j$ 's value of polarization from the Lindqvist and Östling (2007) dataset. After inferring  $\xi_j$ , we re-compute and simulate the political equilibrium for each country in our sample (see Table 7 in Appendix 7.1 for the list of countries). The relative volatility of consumption to output for different polarization values implied by our model can be contrasted to the actual data in Figure 5.

Other than for Norway and Pakistan, our model resembles the bulk of the observations. We can quantify the fit as follows

$$F = 1 - \sum_{j=1}^{35} \frac{[\sigma(c_j)/\sigma(y_j) - \hat{\sigma}(c_j)/\hat{\sigma}(y_j)]^2}{\left[\sigma(c_j)/\sigma(y_j) - \overline{\sigma(c)/\sigma(y)}\right]^2}$$

where  $\hat{\sigma}$  denotes volatility predicted by the model and  $j$  the country observation. When all the countries in our sample are included,  $F = 0.13$ . If the two outliers (Norway and Pakistan) are excluded,  $F$  increases to 0.25. We take this as evidence that our theory complements existing ones in the literature, since the model is able to explain up to 25% of the variability in relative consumption volatilities across countries.

The dotted line in Figure 5 is the value of the relative volatility of consumption that would be obtained in an environment that abstracts from political shocks. Because we are assuming all parameters but  $\xi_j$  to be identical, the line is flat. Moreover,  $\sigma(c)/\sigma(y)$  is smaller than one, as

<sup>7</sup>Data on  $g$  for Mexico are obtained from the Mexican Central Bank, Table ‘Gastos Presupuestales del Sector Publico’. We construct  $g$  to be consistent with the US measure by subtracting Transfers from Total Expenditures for the consolidated government. The sample period is also 1960-2003. To compute the volatility, we take the logarithm of  $g$  and HP filter it with  $w = 100$ .

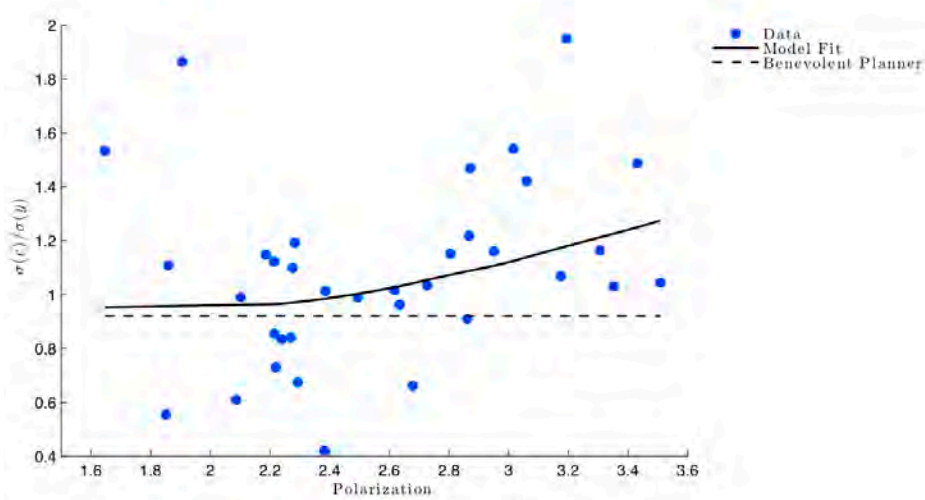


Figure 5: Relative volatility of consumption and polarization.

observed in developed economies, but is at odds with emerging economies' values. The intuition—closely linked to the one developed in Section 4.2—can be understood by comparing the responses of consumption and output to political versus TFP shocks, depicted in Figure 6. In both cases, the shocks last for 10 periods, the average tenure in power of a political party. Consumption responds slightly less than output to a TFP shock, as shown in the right panel. The volatilities for  $y$  and  $c$  are thus almost identical in the simulated model.

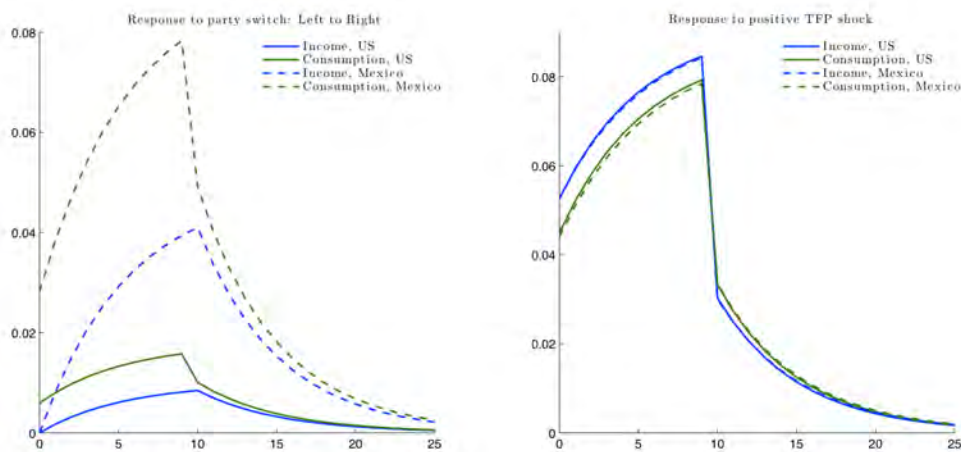


Figure 6: Response to 10-period political and TFP shocks.

The left panel of Figure 6 also makes it clear why  $\sigma(c)/\sigma(y)$  is bigger in emerging economies. The response of consumption is not only larger than that of output when there is a switch in political ideology, but the difference between them is wider in countries with bigger  $\xi_j$ . Because the degree of polarization is larger in emerging economies, policy swings resulting from changes in government type are more pronounced. This creates higher relative consumption volatility than the one observed in less polarized societies.

A summary of the average value of business cycle moments for developed and for emerging economies is contained in Table 4. The model does a good job of predicting the average moments in developed countries. The average relative volatility of consumption for these economies predicted by our model ( $\sigma(c)/\sigma(y) = 0.97$ ) is even closer to the empirical measure than the one reported in Table 3. Recall that we calibrated the model to the US economy and only varied polarization across countries.

Table 4: Business cycle models: data and model fit

Moment	<i>Developed Economies</i>		<i>Emerging Economies</i>	
	Data	Model1	Data	Model1
$\sigma(y)$	2.37e-2	2.00e-2	4.28e-2	2.08e-2
$\sigma(c)/\sigma(y)$	0.96	0.97	1.23	1.11
$\sigma(I)/\sigma(y)$	3.79	3.56	3.85	4.87
$\sigma(g_c)/\sigma(y)$	1.41	1.53	3.03	2.74
$\rho(y)$	0.61	0.54	0.56	0.56
$\rho(g_c)$	0.60	0.44	0.38	0.41
$\rho(y, c)$	0.80	0.97	0.71	0.86
$\rho(y, I)$	0.85	0.82	0.62	0.49
$\rho(y, g_c)$	0.24	0.06	0.22	0.07

Consistent with the data, our model predicts a significantly larger value for  $\sigma(c)/\sigma(y)$  in emerging economies (1.11 versus 0.97 in developed ones). This excess volatility is consistent with the optimal behavior of consumers that react to government policy. In contrast to previous work, we do not need to make additional assumptions regarding differences in the nature of the underlying income process to generate this fact.

### 5.2.2 Heterogeneity in the TFP process

Table 4 reveals that the model under-predicts the volatility of output for emerging economies and over-predicts their variability of investment. The reason is that the volatility of output is twice the value in developed countries and the process is less persistent. Here we re-calibrate the income process for Mexico, which we take as a representative emerging economy, and then re-compute moments for all other countries by only changing their degree of polarization. The fit for the Mexican economy can be found in the second column of Table 5, while the resulting average business cycle moments for emerging countries is shown in the last column.

Re-calibrating the TFP shocks and persistence to match Mexico’s income process improves the fit of the model regarding the volatility of output (see second column of Table 5) but hardly changes investment volatility (which is probably more related to adjustment costs being different in emerging versus developed economies).

Table 5: Re-calibrating the TFP process

Moment	Mexico		Emerging Economies	
	Data	Model2	Data	Model2
$\sigma(y)$	3.57e-2*	3.57e-2*	4.28e-2	3.52e-2
$\sigma(c)/\sigma(y)$	1.16	1.12	1.23	1.08
$\sigma(I)/\sigma(y)$	2.80	5.49	3.85	4.56
$\sigma(g_c)/\sigma(y)$	2.82	3.35	3.03	2.97
$\rho(y)$	0.62	0.55	0.56	0.55
$\rho(g_c)$	0.40	0.26	0.38	0.40
$\rho(y, c)$	0.81	0.81	0.71	0.83
$\rho(y, I)$	0.76	0.49	0.62	0.48
$\rho(y, g_c)$	0.27	0.09	0.22	0.09

\* calibrated moments.

The average relative volatility of consumption for emerging economies is 1.08, slightly lower than the value 1.11 obtained in our benchmark model, while the other moments remain basically unchanged.

### 5.2.3 Heterogeneity in political turnover

In this section we use data on government stability to construct a series of the probability of re-election for each country  $p_j$ , allowing for heterogeneity in political turnover in addition to polarization and productivity differences. The data for political stability come from values assigned by the Political Risk Services Group’s (PRS) International Country Risk Guide. The data set is described in Appendix 7.1, while the values for government stability are reported in the last column of Table 8 in the Appendix. The re-election probability  $p_j$  is constructed by fixing the U.S. probability at  $p_{US} = 0.9$  and adjusting the value for each country based on its stability relative to the U.S.,

$$p_j = \frac{\text{Stability}_j}{\text{Stability}_{US}} p_{US}.$$

In this model emerging countries are assumed to have a TFP process and polarization calibrated in the same manner as Model 2 with the addition of a different benchmark re-election probability. Developed countries have the TFP and polarization values of Model 1.

The results are summarized in Table 6, where Model 3 refers to the averages of values predicted by the model. In general the fit improves for most of the business cycle moments. In particular, the cyclicalities of public spending is much closer to the data for both emerging and developed

economies. This results from lower re-election probabilities: While developed countries tend to have more stable governments ( $\text{mean}(p_{Developed}) = 0.85$  and  $\text{mean}(p_{Emerging}) = 0.75$ ), both are less stable than the U.S. benchmark.

Table 6: Re-calibrating the political turnover

Moment	<i>Developed Economies</i>		<i>Emerging Economies</i>	
	Data	Model3	Data	Model3
$\sigma(y)$	2.37e-2	2.00e-2	4.28e-2	3.55e-2
$\sigma(c)/\sigma(y)$	0.96	0.97	1.23	1.06
$\sigma(I)/\sigma(y)$	3.79	3.71	3.85	4.66
$\sigma(g_c)/\sigma(y)$	1.41	1.67	3.03	2.48
$\rho(y)$	0.61	0.51	0.56	0.49
$\rho(g_c)$	0.60	0.36	0.38	0.22
$\rho(y, c)$	0.80	0.91	0.71	0.87
$\rho(y, I)$	0.85	0.78	0.62	0.62
$\rho(y, g_c)$	0.24	0.12	0.22	0.24

More frequent turnover increases the importance of political shocks in determining aggregate volatility, which in turn increases both the relative volatility of consumption and government expenditure. Countries with lower stability should exhibit higher relative consumption volatility. This effect is tempered, however, for emerging economies by the calibration strategy: Calibrating to a lower  $p$  increases the volatility of public expenditure; therefore, Model 3 has lower levels of  $\xi$  for emerging economies. The cyclicity of public spending increases to levels more in line with data observation in Model 3; however, this is due largely to the filtering methodology. As  $p$  decreases, the effects of political shocks come closer to standard annual business-cycle frequencies isolated by the filter.

Quantitatively, the effect of including stability in the analysis is small. Graphically, this can be seen in Figure 7. Developed countries do not exhibit high enough levels of heterogeneity in government stability to make much of a difference. For emerging economies however there is a positive correlation between government stability and observed relative consumption volatility, which is also suggested by the model. This offers only a small improvement in fit however. The values for model fit remain essentially unchanged at  $F = 0.14$  for all countries and  $F = 0.27$  when removing the two outliers.

### 5.3 Inefficiencies

In this section, we analyze the welfare costs associated with the political process. To do this, we compute the fraction of private consumption agents would collectively forego to replace the political system with a benevolent planner who puts equal weight on each type. Its objective is given by

$$0.5[(1 - \lambda_L)u(c) + \lambda_L v(g)] + 0.5[(1 - \lambda_R)u(c) + \lambda_R v(g)] \equiv (1 - \bar{\lambda})u(c) + \bar{\lambda}v(g).$$

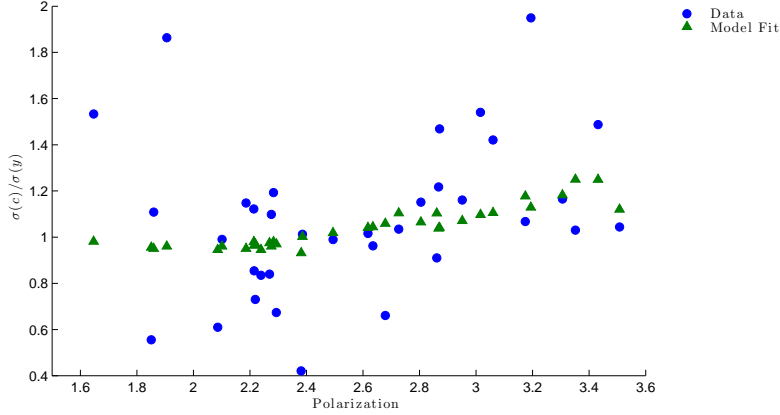


Figure 7: Relative volatility of consumption, polarization, and political turnover.

We assume that the planner is subject to the same frictions as any incumbent party: (i) lack of commitment, (ii) distortionary taxation, and (iii) incomplete markets to face productivity shocks. The main difference is that the planner does not suffer from political instability. The objective is thus to isolate the effects of political shocks on welfare from those implied by the other three frictions.

Define the functions  $\mathcal{C}^{\text{Pol}}$ ,  $\mathcal{G}^{\text{Pol}}$  as equilibrium consumption and government expenditure with politics for a fixed level of polarization and  $\mathcal{C}^{\text{BP}}$ ,  $\mathcal{G}^{\text{BP}}$  as the equilibrium policies for a benevolent planner. The cost  $\eta$  is implicitly defined by

$$\mathbb{E}_{s_t} \sum_{t=0}^{\infty} \beta^t [(1 - \bar{\lambda})u((1 + \eta)\mathcal{C}(s_t)^{\text{Pol}}) + \bar{\lambda}v(\mathcal{G}(s_t)^{\text{Pol}})] = \mathbb{E}_{s_t} \sum_{t=0}^{\infty} \beta^t [(1 - \bar{\lambda})u(\mathcal{C}(s_t)^{\text{BP}}) + \bar{\lambda}v(\mathcal{G}(s_t)^{\text{BP}})].$$

where  $s_t$  is the state triplet  $(i, z, k)$  that evolves according to equilibrium policy  $\mathcal{H}$  and the transition processes for parties and productivity. The distribution of  $s_0$  is the invariant distribution of capital, party in power and productivity given equilibrium policy.<sup>8</sup>

The first line in Figure 8 represents the baseline scenario of fixing all parameters to the U.S. benchmark and adjusting polarization. Welfare costs are increasing in polarization because consumption volatility induced by political turnover is larger as polarization rises. For the second line the model is calibrated to the emerging economies' income and political process, which have more

<sup>8</sup>We run 1,000 simulations of the political equilibrium for 6,000 periods each. Then, we compute the discounted utility of each agent after dropping the first 5,000 periods in order to eliminate the effect of initial conditions. This approximates the expected value function of agent type  $i$  in country  $j$ . We then add the expected values for  $L$  and  $R$  in order to obtain aggregate welfare in the political equilibrium. We perform the same exercise, assuming that policy is determined by a benevolent planner, then add an increasing fraction of private consumption to the model with politics until the agent is indifferent between the two. The figure shows the welfare cost in consumption for different values of polarization.

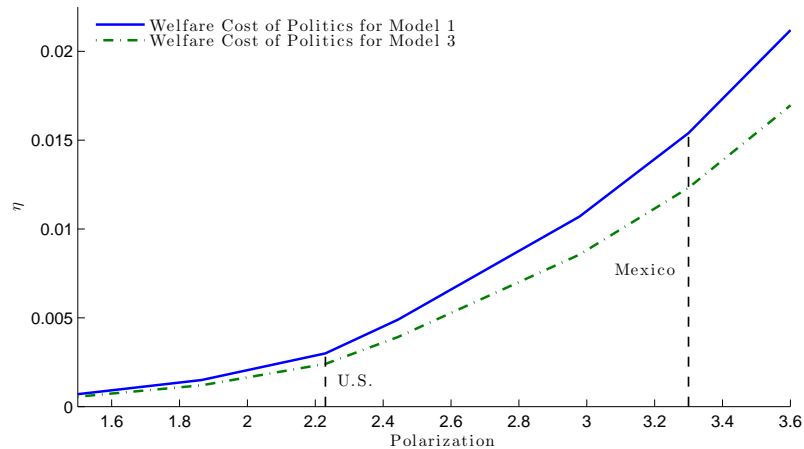


Figure 8: Welfare gains as a function of polarization.

volatile productivity and a lower re-election probability. Costs are lower because reducing polarization has less of an effect in reducing consumption volatility. For the U.S. case, the representative individual would be willing to sacrifice no more than 0.3% of consumption to remove politics, while for the Mexico case the fraction is much higher at 1.23% at the emerging economy benchmark.

## 6 Conclusion and Extensions

We presented a model where political parties that disagree on the size of the government alternate in power. This introduces an additional source of volatility for economic variables, triggered by changes in government policy that can be interpreted as political shocks. We showed that a standard RBC model where only transitory productivity shocks are present cannot explain the consumption volatility puzzle. However, when political shocks in the form of ideological switches are incorporated (in addition to TFP shocks), the relative volatility of consumption gets closer to what is observed in the data. We simulated the model and found that political polarization explains up to 27% of the variation in the relative volatility of consumption across countries. This theory thus complements existing explanations for the puzzle found in the literature.

There are three interesting extensions to the model that are beyond the scope of this paper but will complement the analysis. The first one is introducing a distinction between different types of public expenditures. By adding transfers in addition to government consumption, it would be possible to generate the mild counter cyclicalities of expenditures observed in many developed countries. The second extension would consider the effect of political shocks in small open economies. On the one hand, the access to international capital markets may dampen the effects of political shocks. On the other hand, however, this could result in government policy that responds even more to ideology switches. The final effect on the relative volatility of consumption is thus unclear.



The final extension would analyze the political equilibrium where the government is not subject to a balanced budget. This would allow parties to smooth productivity shocks, which could reduce swings in taxes relative to our benchmark model. But it would also introduce a new channel for manipulation, which can affect the cyclicity of deficits in non trivial ways.

## 7 Appendix

### 7.1 Data

The data are obtained from Kaminsky, Reinhart, and Végh (2004), who compiled a comprehensive cross-country panel for our main variables of interest from the IMF World Economic outlook (WEO) and IMF Government Financial Statistics (GFS) data sets. Output  $y$  is ‘gross domestic product’. Consumption  $c$  is ‘private consumption’, which combines household consumption and non profit institutions. Investment  $I$  is ‘national gross fixed capital formation’. Public consumption  $g_c$  is ‘consolidated general government consumption’. The series are deflated using the GDP deflator. We compute business cycle moments (volatilities, autocorrelations and correlations) on HP filtered (with parameter 100) natural logs of each GDP deflated variable, on the available time series for each country.

‘Political Polarization’ is based on interviews with respondents in 81 countries, compiled at the World Values Survey (Lindqvist and Östling, 2010). We use answers to the following question: ‘How would you place your views on this scale?’ where 1 means agree completely with the left (people should take more responsibility to provide for themselves) and 10 means agree completely with the right (the government should take more responsibility). Our measure of polarization is the standard deviation of responses per country.

‘Political Stability’ is obtained from Political Risk Services’ (PRS) International Country Risk Guide data set, and the variable name is ‘Government Stability’. We use the 1980-1990s average for this variable. Countries are assigned ‘government stability’ points based on an assessment of the government’s ability to carry out its declared programs as well as its ability to stay in office using PRS’ proprietary methodology.

Since data availability is not consistent across the four economic variables for individual countries, the period studied in each case reflects the longest time span for which we have complete data for that country. Sample lengths for each country are reported in Table 7. We also dropped from the sample countries for which we had no Polarization data.

### 7.2 Proof of Proposition 4.1

With logarithmic utility, agent optimization implies

$$\frac{1}{c} = \beta \mathbb{E} \left[ \frac{r'(1 - \tau')}{c'} \right]$$

where the expectation is over both realization of TFP and party in power. Competitive firm behavior gives

$$r = \frac{\alpha y}{k}, \quad y = rk + w.$$

Table 7: Sample lengths

<b>Developed Economies</b>		<b>Emerging Economies</b>	
<i>Country</i>	<i>Period</i>	<i>Country</i>	<i>Period</i>
Australia	1960-2003	Algeria	1969-2003
Austria	1965-2003	Bangladesh	1969-2003
Canada	1960-2003	Brazil	1977-2003
Finland	1965-2003	Chile	1966-2003
France	1970-2003	China	1981-2003
Germany	1979-2003	Dominican Republic	1969-2003
Ireland	1960-2003	Egypt	1969-2003
Italy	1965-2003	Indonesia	1969-2003
Japan	1960-2003	Iran	1969-2003
Netherlands	1960-2003	Jordan	1963-2003
New Zealand	1969-2003	Korea	1960-2003
Norway	1969-2003	Mexico	1969-2003
Portugal	1969-2003	Morocco	1969-2003
Spain	1969-2003	Pakistan	1963-2003
Switzerland	1969-2003	Peru	1969-2003
United Kingdom	1960-2003	Philippines	1969-2003
United States	1960-2003	South Africa	1966-2003
		Uganda	1982-2003
		Zimbabwe	1969-2003

Table 8: Relative volatility of consumption, investment and public spending

<i>Country</i>	$\sigma(c)/\sigma(y)$	$\sigma(I)/\sigma(y)$	$\sigma(g_c)/\sigma(y)$	Polarization	Stability
<b>Developed Economies:</b>					
Australia	0.68	3.78	1.35	2.29	8.27
Austria	0.85	3.60	1.32	2.10	8.43
Canada	0.85	4.03	1.47	2.21	8.12
Finland	0.68	3.83	0.76	2.09	8.90
France	0.73	4.51	0.91	2.22	8.06
Germany	1.19	2.33	1.33	2.28	8.03
Ireland	1.11	4.10	1.58	2.28	8.88
Italy	0.96	3.58	1.96	2.21	7.15
Japan	0.56	2.69	2.01	1.85	8.06
Netherlands	1.23	3.64	1.58	1.86	8.62
New Zealand	1.20	3.75	1.73	2.27	7.88
Norway	1.81	4.8	1.58	1.91	8.04
Portugal	0.95	4.60	1.68	2.73	8.03
Spain	1.02	3.35	1.03	2.49	8.27
Switzerland	0.55	4.13	1.06	2.38	9.75
United Kingdom	1.15	4.39	1.37	2.19	8.26
United States	0.83	3.35	1.21	2.24	8.83
<i>Mean</i>	<i>0.96</i>	<i>3.79</i>	<i>1.41</i>	<i>2.21</i>	<i>8.33</i>
<b>Emerging Economies</b>					
Algeria	1.95	3.14	1.46	3.19	8.07
Bangladesh	1.03	1.53	3.60	3.35	5.88
Brazil	1.12	3.32	2.49	3.20	
Chile	1.20	5.85	1.99	2.80	7.30
China	1.22	2.29	1.19	2.87	8.38
Dominican Republic	1.31	3.39	7.51	3.17	6.76
Egypt	1.28	4.50	2.71	2.87	8.25
Indonesia	0.96	3.99	6.0	2.64	7.39
Iran	1.02	2.74	1.71	2.62	7.22
Jordan	1.16	2.60	4.19	2.95	8.16
Korea	1.00	4.18	2.28	2.39	7.70
Mexico	1.16	2.80	2.82	3.31	7.44
Morocco	1.04	3.98	2.40	3.51	8.77
Pakistan	1.53	4.08	2.64	1.65	7.20
Peru	0.91	3.11	2.74	2.86	6.06
Philippines	0.66	4.14	2.80	2.68	6.44
South Africa	1.93	5.03	3.99	3.06	7.73
Uganda	1.52	4.09	2.95	3.02	7.50
Zimbabwe	1.31	8.30	2.14	3.43	6.13
<i>Mean</i>	<i>1.23</i>	<i>3.85</i>	<i>3.03</i>	<i>2.92</i>	<i>7.39</i>

**Note:** Cyclical moments (autocorrelations and volatilities) are computed by HP-filtering ( $w = 100$ ) the natural logarithms of variables over the sample period 1960-2003 of data obtained from Kaminsky, Reinhart, and Végh (2004). Polarization is computed in Lindqvist and Östling (2010). Political Stability comes from Political Risk Services (PRS) government stability indicator.

Using the guess  $c = s(1 - \tau)y$  (which from agent budget constraint implies  $k' = (1 - s)(1 - \tau)y$ ) we have

$$\frac{1}{s(1 - \tau)y} = \beta \mathbb{E} \left[ \frac{\frac{\alpha y'}{k'}(1 - \tau')}{s(1 - \tau')y'} \right].$$

Simple inspection reveals  $s = 1 - \alpha\beta$ . Since  $g = \tau y$ , substitution of  $s$  and  $\tau$  give

$$c = (1 - \alpha\beta)(y - g), \quad (6)$$

$$k' = \alpha\beta(y - g). \quad (7)$$

Given agent optimization, the current government's problem is

$$\max_{g_i} (1 - \lambda_i) \ln(c) + \lambda_i \ln(g) + \beta \mathbb{E}_z [pV_i(z', k') + (1 - p)W_i(z', k')]$$

subject to (9), (10). Here the expectation is taken only over the realization of the TFP shock  $z$ .  $V_i$  and  $W_i$  are defined as in the text, they are the equilibrium continuation values of remaining in power and losing power, respectively, for a given party of type  $i$ . The government's first order condition can be written as

$$-\frac{(1 - \lambda_i)}{y - g_i} + \frac{\lambda_i}{g_i} = \alpha\beta^2 \mathbb{E}_z [pV'_{k,i} + (1 - p)W'_{k,i}]. \quad (8)$$

The equilibrium continuation values use equilibrium policy for  $g_i$ . Assume (as is later confirmed) that the equilibrium policy for  $g_i$  is  $g_i = \lambda_i \eta y$ . The derivative of the  $V_i(z, k)$  is then

$$V_{k,i} = \frac{(1 - \lambda_i)}{c} (1 - \alpha\beta) \frac{\alpha y}{k} (1 - \lambda_i \eta) + \frac{\lambda_i}{g} \frac{\alpha y}{k} \lambda_i \eta + \beta \mathbb{E}_z [pV_{k,i} + (1 - p)W_{k,i}] \alpha\beta \frac{\alpha y}{k} (1 - \lambda_i \eta).$$

We use the government's FOC (government optimality must hold in equilibrium) to eliminate the  $\mathbb{E}_z [pV'_{k,i} + (1 - p)W'_{k,i}]$  term. After canceling terms and then updating one period we have

$$V_{k,i} = \frac{\alpha}{k} \frac{1}{\eta} \Rightarrow \mathbb{E}_z [V'_{k,i}] = \frac{\alpha}{k'} \frac{1}{\eta}.$$

The derivative of  $W$  is slightly more complex because the government's FOC cannot be used to directly cancel the value function derivatives next period. It is

$$W_{k,i} = \frac{(1 - \lambda_i)}{c} (1 - \alpha\beta) \frac{\alpha y}{k} (1 - \lambda_j \eta) + \frac{\lambda_i}{g} \frac{\alpha y}{k} \lambda_j \eta + \beta \mathbb{E}_z [(1 - p)V_{k,i} + pW_{k,i}] \alpha\beta \frac{\alpha y}{k} (1 - \lambda_j \eta)$$

where  $g_j = \lambda_j \eta$  is the policy of the opposing party  $j$ . We know the value of  $\mathbb{E}_z [V_{k,i}]'$  and we can solve for  $\mathbb{E}_z [W_{k,i}]'$  from (8). It is

$$\mathbb{E}_z [W'_{k,i}] = \left[ \frac{1}{\alpha\beta^2} \left[ -\frac{(1 - \lambda_i)}{y'(1 - \lambda_i \eta)} + \frac{1}{\eta y'} \right] - p \mathbb{E}_z [V_{k,i}] \right] \frac{1}{1 - p}.$$

After some algebra this becomes

$$\mathbb{E}_z[W'_{k,i}] = \frac{1}{k'} \frac{1}{1-p} \left[ \frac{1-\eta-p\alpha\beta}{\beta} \right].$$

Returning to  $W_{k,i}$  and simplifying the first two terms we can write

$$W_{k,i} = \frac{\alpha}{k} + \beta \left[ \frac{1}{k'} \frac{p}{(1-p)} \left[ \frac{1-\eta-p\alpha\beta}{\beta} \right] + \frac{1}{k'} (1-p) \frac{\alpha}{\eta} \right] \alpha\beta \frac{\alpha y}{k} (1-\lambda_j\eta).$$

We have a closed form expression for  $k'$  when party  $j$  is in power,  $k' = \alpha\beta(1-\lambda_j\eta)y$ . Inserting this into the above equation allows us to simplify  $W_{k,i}$  to

$$W_{k,i} = \frac{\alpha}{k} \left[ 1 + \frac{\alpha\beta(1-2p)}{(1-p)\eta} + \frac{p}{1-p} \frac{1-\eta}{\eta} \right].$$

Just like  $V_{k,i}$  this can be updated by simply replacing  $k$  with  $k'$ ; no expectation operator is necessary. The government's first order condition (8) using the equilibrium policy rule can then be written as

$$-\frac{(1-\lambda_i)}{(1-\lambda_i\eta)y} + \frac{\lambda_i}{\lambda_i\eta y} = \alpha\beta^2 \left[ p \frac{\alpha}{\alpha\beta(1-\lambda_i\eta)\eta y} + (1-p) \frac{\alpha}{\alpha\beta(1-\lambda_i\eta)y} \left[ 1 + \frac{\alpha\beta(1-2p)}{(1-p)\eta} + \frac{p}{1-p} \frac{(1-\eta)}{\eta} \right] \right].$$

Notice here everything cancels except the primitives  $\alpha$ ,  $\beta$ , and  $p$ . After some more brief algebra we arrive at

$$\eta = \frac{1-2\alpha\beta p - \alpha^2\beta^2(1-2p)}{1-\alpha\beta(1-2p)}.$$

### 7.3 Proof of Proposition 4.2

Defining  $\hat{c}_t = \ln(c_t)$  and  $\hat{y}_t = \ln(y_t)$  we want to show that in this environment  $Var(\hat{c}_t) > Var(\hat{y}_t)$ . We know from above that

$$c_t = (1-\alpha\beta)(1-\lambda_t\eta)y_t, \tag{9}$$

$$k_{t+1} = \alpha\beta(1-\lambda_t\eta)y_t \tag{10}$$

where  $\lambda_t$  is the realization of the political shock in period  $t$ . Taking logs of equation (9) gives

$$\begin{aligned} \ln(c_t) &= \ln(1-\alpha\beta) + \ln(1-\lambda_t\eta) + \ln(y_t), \\ \hat{c}_t &= \ln(1-\alpha\beta) + \hat{x}_t + \hat{y}_t. \end{aligned}$$

with  $\hat{x}_t = \ln(1-\lambda_t\eta)$ . Then

$$Var(\hat{c}_t) = Var(\hat{y}_t) + Var(\hat{x}_t) + 2Cov(\hat{x}_t, \hat{y}_t). \tag{11}$$

Using (10) and initial production  $y_0$ ,  $\hat{y}_t$  can be written as

$$\hat{y}_t = \ln(z_t) + \alpha^t \hat{y}_0 + \sum_{k=1}^t \alpha^k \ln(z_{t-k}) + \alpha^k \ln(\alpha\beta) + \alpha^k \hat{x}_{t-k}.$$

Using this expression it is apparent that

$$Cov(\hat{x}_t, \hat{y}_t) = \sum_{k=1}^t \alpha^k Cov(\hat{x}_t, \hat{x}_{t-k}).$$

Now using

$$Cov(\hat{x}_t, \hat{x}_{t-k}) = \mathbb{E}[\hat{x}_t \hat{x}_{t-k}] - \mathbb{E}[\hat{x}_t] \mathbb{E}[\hat{x}_{t-k}]$$

and a symmetric two-state process for  $\lambda$  (which implies  $\hat{x}_t \in \{\hat{x}_H, \hat{x}_L\}$ ) we know the unconditional expectation for  $\hat{x}_t$  is

$$\mathbb{E}[\hat{x}_t] = \mathbb{E}[\hat{x}_{t-k}] = 0.5\hat{x}_L + 0.5\hat{x}_H.$$

The joint expectation depends on the path from  $t - k$  to  $t$ .

$$\mathbb{E}[\hat{x}_t \hat{x}_{t-k}] = \sum_i \sum_j Prob(\hat{x}_{t-k} = \hat{x}_j) Prob(\hat{x}_t = \hat{x}_i | \hat{x}_{t-k} = \hat{x}_j) \hat{x}_j \hat{x}_i.$$

Defining  $P$  as the transition matrix for  $\hat{x}$ , this expression becomes

$$\mathbb{E}[\hat{x}_t \hat{x}_{t-k}] = \sum_i \sum_j 0.5 P_{i,j}^k \hat{x}_j \hat{x}_i.$$

Where  $P_{i,j}^k$  is the  $\{i, j\}$  element of the transition matrix to the  $k$ th power. With re-election probability  $p$  the transition matrix<sup>9</sup>

$$P = \begin{pmatrix} p & 1-p \\ 1-p & p \end{pmatrix}, \quad P^k = \frac{1}{2} \begin{pmatrix} 1 + (2p-1)^k & 1 - (2p-1)^k \\ 1 - (2p-1)^k & 1 + (2p-1)^k \end{pmatrix}.$$

Thus

$$\mathbb{E}[\hat{x}_t \hat{x}_{t-k}] = 0.5(\hat{x}_H^2 + \hat{x}_L^2)0.5[1 + (2p-1)^k] - \hat{x}_H \hat{x}_L [(1 - (2p-1)^k)0.5]$$

Rearranging terms

$$Cov(\hat{x}_t, \hat{x}_{t-k}) = 0.5^2(2p-1)^k (\hat{x}_H - \hat{x}_L)^2$$

So we can rewrite (11) as

$$Var(\hat{c}_t) = Var(\hat{y}_t) + Var(\hat{x}_t) + 2 \sum_{k=1}^t \alpha^k 0.5^2 (2p-1)^k (\hat{x}_H - \hat{x}_L)^2.$$

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<sup>9</sup>From Hamilton, J.D., 1994, *Time Series Analysis*, Princeton University Press.

## 7.4 Algorithm

The numerical implementation consists of finding a fixed-point in the two equilibrium policy rules:  $\mathcal{G}_i(z, k)$  and  $\mathcal{H}_i(z, k)$ . Because of asymmetric preferences, stochastic productivity, and the importance of the transitional dynamics in determining the simulated moments of the model, it is not enough to solve at steady states as in Klein, Krusell and Rios-Rull (2008). We require a global solution for the equilibrium rules. To accomplish this we make guesses at these rules and iterate on them using the agents' and government's first order conditions until convergence. The algorithm proceeds as follows:

1. Start with a sufficiently large grid for  $k$  and  $g$ .
2. Make "good" guesses for the functions  $\mathcal{G}_i^N(z, k)$  and  $\mathcal{H}_i^N(z, k)$  for each of the points on the grid of  $k$ , the realization of the shock  $z$ , and the party in power  $i$ . We use cubic spline interpolation to determine policy for off-grid values of  $k$  and also the derivatives of the policy functions that appear in the government's optimality condition.
3. Using these guesses and the current state solve the agent's Euler equation for  $k'$  at each state,  $\{k, z, i\}$  as well as the level of  $g$ . This gives the function  $H_i(z, k, g) = k'$ .
4. The government takes agent optimization  $H_i$  in the current period as given. The next step is to solve the government's first order condition for  $g$  given future policy  $\mathcal{G}^N$  and  $\mathcal{H}^N$  and current agent optimization  $H_i$ . The solution to this problem gives the updated guess for  $g$  policy,  $\mathcal{G}_i^{N+1}(z, k) = g$ .
5. Update the guess at equilibrium savings policy:  $\mathcal{H}_i^{N+1}(z, k) = H_i(z, k, \mathcal{G}_i^{N+1}(z, k))$ .
6. Repeat this process until  $\max\{|\mathcal{G}_i^{N+1}(z, k) - \mathcal{G}_i^N(z, k)|, |\mathcal{H}_i^{N+1}(z, k) - \mathcal{H}_i^N(z, k)|\}$  is small enough.

Time-consistency introduces particular challenges to computation of the equilibrium. The government's problem is not in general a contraction and has significant non convexities. To overcome the lack of contraction in a similar framework, Ilzetzki (2010) solves the finite horizon problem for a long horizon. We do not need to resort to this; in practice our program converges relatively quickly given our "good" initial guesses.

The advantage we have in solving the problem is the "good" initial guess of having a closed form solution given Assumption 1. Starting with an exact solution for the policy functions, the parameters can be slowly adjusted to the desired calibration. This adjustment is done at times extremely slowly to maintain a contraction in the government's problem. For a grid of 60 points for  $k$  and 30 points for  $g$  we consistently achieve convergence of 1e-7.

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