

# Rent-Seeking Distortions and Fiscal Procyclicality

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## Abstract

Recent research has demonstrated that while government expenditures are countercyclical in most industrialized countries, they tend to be procyclical in developing countries. We develop a dynamic political economy model to explain this phenomenon. In the model, public expenditures provide insurance to uninsured households, and optimal fiscal policy is countercyclical. The introduction of a political friction, in which successive governments disagree on the desired distribution of public spending, can lead to procyclical fiscal policies. Numerical simulations of the model allow us to compare quantitatively the relative role of common explanations for fiscal procyclicality. We conclude that political distortions in the fiscal process can explain fiscal procyclicality better than other common explanations, such as borrowing constraints and macroeconomic volatility. (JEL E62, D72, F41)

Keywords: Fiscal Procyclicality, Fiscal Policy in Developing Countries, Political Distortions.

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It has been observed that governments' fiscal policies differ greatly across income lines. Fiscal policies in almost all high-income countries are countercyclical, reflected in countercyclical government expenditures and deficits, and procyclical tax revenues.<sup>1</sup> Fiscal policies in developing countries are quite different. Whether in Latin America (Gavin and Perotti, 1997) or elsewhere in the developing world (Kaminsky, Reinhart and Végh, 2004), governments tend to spend and borrow more as economic conditions improve. That is, developing countries conduct procyclical fiscal policies.

The objective of this paper is to propose a theory that can account for the difference between fiscal policy in high-income and developing countries. In the process we explore quantitatively the potential of various theories to explain this difference. In the theoretical model, the government may use fiscal policy to provide social insurance to private households. Governments therefore choose expenditures and deficits that are countercyclical. Tax rates are smooth and tax revenues are procyclical as governments attempt to smooth distortionary taxes over time. This benchmark model matches the cyclical features of fiscal policy in high-income countries.

To explain why fiscal policy differs in developing countries, we consider several distortions. First, we add a political distortion, where alternating governments disagree on the desired distribution of public expenditures. Second, we explore financial market frictions in the form of borrowing constraints. Third, we look at the difference in macroeconomic volatility faced by policymakers in developing and high-income countries. These distortions correspond to commonly suggested explanations for the procyclicality of fiscal policy in developing countries.

Numerical simulations of the model show that as the political structure becomes more polarized, i.e. the disagreement between successive governments is more acute, fiscal policy becomes more procyclical and ultimately matches the cyclical features of fiscal policy in developing countries: procyclical expenditures and acyclical deficits, but revenues that are not much different in their cyclical patterns from those in high-income countries.

The intuition for these results is as follows. It has been shown elsewhere that alternating governments with divergent preferences introduce a political-economy friction that causes an over-accumulation of debt relative to a time-consistent policy maker (see, for example, Alesina and Tabellini, 1990)<sup>2</sup>. If the political environment is sufficiently polarized, the governing party's con-

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<sup>1</sup>Throughout this paper, countercyclicality or fiscal countercyclicality will refer to the combination of countercyclical government expenditures, procyclical or acyclical tax rates, and countercyclical deficits. Procyclicality or fiscal procyclicality will refer to a deviation of any one of these variables from the countercyclical definition. The assertions in the introduction and are based on data from the International Monetary Fund's World Economic Outlook database from 1970 to 2003.

<sup>2</sup>Amador (2003) uses a similar framework to explain the existence of lending to sovereigns, although debt is defaultable. Azzimonti (2009) studies the under-accumulation of capital in developing countries in a similar model.

stituency benefits from government spending, but does not fully internalize the cost of the (current or future) tax burden needed to finance these expenditures, because it is borne by the entire polity.

We take this logic a step further and study the cyclical policies arising from this political structure. In our model, a fiscal agent with time-consistent preferences would conduct countercyclical policies: all households prefer to obtain public expenditures at business cycle troughs to expenditures of the same magnitude at business cycle peaks, when publicly provided goods are substitutes for private consumption. When the political friction is introduced, the incumbent is uncertain as to whether his successor will value the same constituency as he does. Thus any savings a government passes on to its successor may be used to benefit a different political faction. The desire to capture rents for the benefit of its own constituency induces governments to save less and spend more when more tax revenues are available, making fiscal policy procyclical. Governments do so even though their preferred constituency would prefer to receive expenditures during downturns.

It is theoretically plausible for binding borrowing constraints to make government expenditures less countercyclical.<sup>3</sup> However, we find that borrowing constraints fail to explain fiscal procyclicality in practice. First, in simulations of the model, borrowing constraints do not contribute to fiscal procyclicality in isolation. A borrowing-constrained government will accumulate a buffer-stock of savings to avoid borrowing constraints from binding in the long run. This implies that in the long run, fiscal policy is no more procyclical than in an unconstrained economy, and in fact makes spending more countercyclical in the transition to the model's invariant distribution. Second, as suggested by Alesina, Campante and Tabellini (2008): in theory, borrowing constraints should bind, and thus affect the cyclicity of government expenditure, in business cycle downturns. Our model has a similar prediction. But this prediction is refuted in the data. In reality, the cyclicity of government expenditure appears to be symmetrical in peaks and troughs.

Several theories have suggested that procyclical fiscal policy could differ across income lines because developing countries face more volatile income shocks or a more volatile tax base (usually in interaction with other frictions).<sup>4</sup> In contrast, our model predicts that fiscal policy will be more

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Cuadra and Sapriza (2008) show that this setup can explain default rates observed in developing countries.

<sup>3</sup>Gavin and Perotti (1997) suggest that borrowing constraints in developing countries are the cause for fiscal procyclicality. When borrowing constraints are binding, governments may have no choice but to rely entirely on tax revenues to finance expenditures. This forces governments to either cut expenditures or increase taxation in bad times, yielding procyclical fiscal policies. Aizenman, Gavin, and Hausmann (2000) formalized this notion in a 2-period model, with endogenous credit risk. Riascos and Végh (2003) and Mendoza and Oviedo (2006) study the role of incomplete financial markets in generating procyclical fiscal policies. Aguiar, Amador and Gopinath (2006) find that capital taxation may optimally reinforce the business cycle when a sovereign cannot fully commit to repay foreign creditors. Cuadra, Sanchez and Sapriza (2009) study the role of credit risk in a quantitative model.

<sup>4</sup>Talvi and Végh's (2005) political-economy model, for example, requires an interaction between a political distortion and a volatile tax base to generate fiscal procyclicality. In Mendoza and Oviedo (2006), incomplete financial markets interact with volatile tax revenues to yield procyclical expenditure policies.

countercyclical in more volatile macroeconomic environments, all else equal. This is because the need for intertemporal insurance is greater where the business cycle is more volatile.

Several studies, cited above, have explored why financial market frictions may cause fiscal policies to differ in developing countries from those observed in the industrialized world. Another strand of the literature studies the role of political frictions in explaining procyclical fiscal policies. Talvi and Végh (2005) show that a model based on the "Voracity Effect" generates tax rates that reinforce the business cycle. The "Voracity Effect", first introduced by Lane and Tornell (1998), is based on a conflict of interest between divergent factions within a single government. Alesina, Campante and Tabellini (2008) demonstrate that a conflict of interest between a government and an electorate could lead to procyclical government expenditures and deficits. In Battaglini and Coate (2008), the conflict of interest is between districts within a legislature. The conflict of interest modeled here differs in that it is between successive fiscal decision-makers with different distributive objectives.

But the most novel contribution of this paper is in the quantitative analysis. We show that political conflicts of interest are not only theoretically appealing explanations for fiscal policies observed in developing countries, but can also quantitatively match the main features of the fiscal behavior of governments in the developing world. In this regard, this study also relates to a growing literature that uses numerical tools commonly employed in the macroeconomic literature, to provide quantitative predictions in political economy models.<sup>5</sup>

## 1 Stylized Facts

We begin by documenting the stylized facts on the cyclicity of fiscal policy in high-income and developing countries. Gavin and Perotti (1997) and Kaminsky, Reinhart and Végh (2004) have shown that government expenditures are countercyclical in high-income countries, but procyclical in Latin America and other developing countries. Alesina, Campante and Tabellini (2008) also show that expenditures and deficits differ greatly in their cyclical properties across countries. This section refines these observations. Figures 1-3 present the main differences in fiscal policies across countries. The most striking difference between fiscal policies in developing and high-income countries is in government expenditure, as shown in Figure 1. The graph plots the correlation between the cyclical component of real government expenditures and the cyclical component of real GDP between the years 1970 and 2003, against PPP GDP per capita in 1970. Cyclical components are measured as deviations from the trend, using a Hodrick-Prescott (HP) filter. The negative correlation between

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<sup>5</sup>Examples include Azzimonti (2009) and Azzimonti, Battaglini and Coate (2009).

the degree of procyclicality and income per capita is apparent and is statistically significant at the 99% confidence interval.

It is difficult to assess the cyclicity of tax policies, because time-series data on tax *rates*—the relevant policy variable—are unavailable for most developing countries. While there is anecdotal and indirect evidence that tax rates may be countercyclical in a number of developing countries (see for example Kaminsky, Reinhart and Végh, 2004), this does not translate into a difference in the cyclicity of tax revenues. As Figure 2 shows, the cyclicity of tax revenues is not correlated with GDP per capita. In fact, the correlation between the cyclical components of tax revenues and GDP is roughly the same in high income countries (.44) and developing countries (.43).<sup>6</sup>

In high-income countries, the combination of countercyclical government expenditures and procyclical tax revenues generates unambiguously procyclical surpluses, with an average correlation of .43 between their cyclical component and the cyclical component of GDP. Developing countries, whose expenditures and revenues are both procyclical, show great variance in the cyclicity of their surpluses, as shown in Figure 3. Surpluses in developing countries are acyclical on balance.

The differences in fiscal policies across income lines appear to be mainly due to variations in government spending patterns. So far, we have looked at total government expenditure, which includes government consumption, investment, transfers, and interest payments. It is interesting to consider the cyclicity of these components. Table 1 presents the basic stylized facts. Government investment and consumption are both procyclical in high-income countries, with correlation coefficients not much different than in developing countries.<sup>7</sup> Interest payments are acyclical, on average, in both income groups.<sup>8</sup> The main remaining component of total government expenditure is transfer payments. Transfer payments would appear to be the main driver of high-income countries' countercyclical spending patterns. While data on transfers are unavailable for most developing countries, the last line of Table 1 gives some anecdotal evidence. Comparing the cyclicity of social transfers in high-income countries to their cyclicity in a number of Latin American economies,

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<sup>6</sup>Income classifications by the World Bank began only in 1989, so that it is difficult to assess who would have qualified as a developing country in 1970 under its classification. In 2007, the World Bank classified countries with per-capita GDPs of over \$11,115 in PPP terms as high-income. Countries meeting this criterion in 2007 are considered high-income countries in this discussion. In interpreting figures I-III, note that countries with per-capita PPP GDPs of over \$3000 in 1970 are (with minor exceptions) high-income countries today.

<sup>7</sup>This contrasts with Talvi and Vegh's (2005) finding that high-income countries' government consumption is acyclical. In any case, their findings are consistent with the view that transfers are the main countercyclical component of government spending in high-income countries. Note also that the correlations reported here are simple bivariate relations. A more sophisticated empirical analysis shows that government consumption is more procyclical in developing countries than in high-income countries. See Ilzetzi and Végh (2008) for detailed evidence.

<sup>8</sup>Data on interest payments is available for only a subset of countries, and for only a subset of the time period, differing from country to country. The data is also from a different source, the International Monetary Fund's Government Finance Statistics.

we find that social transfers are countercyclical in high-income countries, but procyclical in Latin America. While social transfers may not be representative of other types of transfer payments, it is nevertheless interesting that unlike the other budgetary components listed in Table 1, the cyclicity of social transfers differs substantially across countries.

Lane (2003) shows that political factors are important in explaining the differences in the cyclicity of fiscal policy in OECD countries. Alesina, Campante, and Tabellini (2008) provide extensive empirical evidence that the cross-country heterogeneity in the cyclicity of fiscal policy is better explained by measures of institutional quality—particularly corruption—than by income per capita.

The theory that follows predicts that fiscal policy will be more procyclical in more polarized political environments. While political fractionalization and corruption may appear to be different explanations for the phenomenon of fiscal procyclicality, in practice, the two often appear in conjunction. As Alesina and Zhuravskaya (2008) show, political segregation (which combines political fractionalization and an ability to discriminate between diverse groups, due to regional separation, for example) is closely related to corruption, and may be an important variable in explaining corruption across countries.

To further support the claim that political polarization is an important factor in explaining procyclical fiscal policies, we use the index of ethnic fractionalization of Alesina et al (2003) to show, in Figure 4, that government expenditures are more procyclical in countries with more ethnically polarized societies. The correlation between the cyclicity of government expenditures and ethnic fractionalization is .36 and is statistically significant at the 99 percent confidence level. Similar results hold when using the linguistic fractionalization index, or Easterly and Levine’s (1997) measure of ethno-linguistic fragmentation. While there are many other dimensions along which a polity can be divided: e.g. regional, ideological, religious, or income, it is noteworthy that the cyclicity of fiscal policy is correlated with existing measures of political polarization.<sup>9</sup>

## 2 The Model

### 2.1 Economic Environment

Consider a small open economy consisting of a measure-one continuum of households. Households are indexed by  $i \in [0, 1]$ , and are identical in every respect, other than their political characteristics,

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<sup>9</sup>Fiscal policy does not appear to be related to religious fractionalization—an additional measure in the Alesina et al (2003) database. This is consistent with Alesina and Zhuravskaya’s (2008) finding that religious segregation does not affect the quality of government.

to be discussed shortly. Households value consumption,  $c_t^i$ , and dislike supplying hours worked,  $h_t^i$ . They also value publicly provided goods  $g_t^i$ . The  $i$  superscript in this latter variable indicates that this public expenditure can be targeted to the benefit of specific parts of the population. For each hour worked, households obtain wages  $w_t$ , which are identical across households. Wages follow a Markov process with support  $[\underline{w}, \bar{w}]$ . Households' labor income is taxed at a proportional tax rate  $\tau_t$ .<sup>10</sup>

Households' preferences over consumption, public goods, and hours worked are:

$$E_0 \sum_{t=0}^{\infty} \beta^t \tilde{u}(c_t^i, g_t^i, h_t^i).$$

Households choose their labor contribution and consumption in each period, but do not have access to financial markets. This is a simple way of motivating government insurance for the private sector. The government may use its ability borrow and save in international financial markets to provide intertemporal insurance for households. We assume that consumption and public goods are Edgeworth substitutes, so that  $\tilde{u}_{cg} < 0$ . This allows an insurance role for public consumption. Adding an additional public good that complements private consumption would not alter the model's qualitative results, but the assumption that a fraction of public expenditure serves as a substitute for private consumption is essential to allow an insurance role for public expenditure.<sup>11</sup>

Modeling government spending as a substitute to private consumption, with a potential to insure private households who have no access to private insurance has several advantages. First, we have seen that the main difference between the cyclical characteristics of fiscal policy in high-income and developing countries, and the driver of the countercyclicality of government spending in high-income countries, is government transfers. An important characteristic of government transfers—and potentially a central reason that they are countercyclical in high-income countries—is that they serve as substitutes, in some cases perfect substitutes, to private consumption. Second, fiscal policy used for this purpose will tend to be countercyclical. This biases the model against procyclical policies:

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<sup>10</sup>The assumption that public spending can be targeted to benefit specific constituencies, while taxes are uniform across households is standard in the political economy literature. This assumption allows for analytical tractability, but is without loss of generality as will be discussed below.

<sup>11</sup>The assumption that public expenditures and private consumption are Edgeworth substitutes is not crucial. If the two were complements, the government could provide intertemporal insurance through procyclical expenditures. Decreasing public expenditures in economic downturns would decrease the marginal utility of consumption, making households' consumption loss less painful during the downturn. This is not what normally comes to mind when considering public insurance policies, guiding our assumption of public expenditure as a substitute for private consumption. In this case as well, fiscal policy becomes more procyclical with the introduction of the political friction. But the Edgeworth-substitutes assumption gives a benchmark in which fiscal policy is countercyclical.

a bias the frictions we introduce will need to overcome. Finally, as documented in Claessens (2006), lack of access to financial markets is both prevalent and an important source of vulnerability in developing countries.<sup>12</sup>

A household,  $i$ , chooses consumption and hours worked in each period to maximize its expected lifetime utility subject to the budget constraint

$$c_t^i = (1 - \tau_t) w_t h_t^i. \quad (1)$$

In what follows, we will assume the following household preferences, which adapt the functional form proposed by Greenwood, Hercowitz and Huffman (1988) to include a public good:

$$\tilde{u}(c, g, h) = \frac{\left(c + \theta g - \frac{h^{1+1/\varepsilon}}{1+1/\varepsilon}\right)^{1-\gamma}}{1-\gamma}.$$

These preferences incorporate public spending in a form that is commonly used when public goods and private consumption are Edgeworth substitutes, as in Barro (1981) and Aschauer (1985). Experimentation with other functional forms shows that this assumption is without loss of generality.<sup>13</sup>

Given the limitations on households' access to credit markets, their optimization problem is static in each period, yielding the following labor-supply schedule:

$$h_t^i = h_t = [(1 - \tau_t) w_t]^\varepsilon \quad \forall i. \quad (2)$$

Substituting (1) and (2) into households' preferences, we obtain the following indirect period utility function:

$$u(g_t^i, \tau_t) = \frac{\left[\frac{[(1-\tau_t)w_t]^{\varepsilon+1}}{\varepsilon+1} + \theta g_t^i\right]^{1-\gamma}}{1-\gamma}.$$

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<sup>12</sup>Claessens (2006) reports that less than half of the population uses formal financial institutions to save in most developing countries. The proportion of the population with savings accounts is in some cases lower than 10%. Even in the United States, close to 10% of the population reported not holding any type of transaction account in 2001.

<sup>13</sup>The preferences used here imply that labor supply is not affected by the quantity of the provided public good. Allowing for distortionary government expenditure did not alter the model's qualitative results in computational simulation, but has the inconvenience of implying that the government may supply public goods to a select constituency until it has no incentive to work. The use of GHH preferences avoids having to account for the implicit non-negativity constraint on the supply of labor and the counterfactually high volatility of the labor supply that results. Similarly, numerical work shows that the specific functional form for government expenditure is without loss of generality. Further details available upon request.

## 2.2 Political Structure

There are two political factions:  $A$  and  $B$ . Each values the welfare of half the population.<sup>14</sup> The two groups alternate in power, with  $p$  denoting the probability that the incumbent remains in power in the following period. Each faction maximizes a welfare function that places an equal weight on the lifetime utility of each constituent. The constituencies of the two parties may be partially overlapping, with  $\alpha \in [0, 1]$  denoting the fraction of each constituency that is also valued by the other party. In other words, the constituency of a given party is of measure  $\frac{1}{2}$ , with measure  $\frac{\alpha}{2}$  also included in the constituency of the other party, while measure  $\frac{1-\alpha}{2}$  is uniquely in the constituency of the first party. A measure  $\frac{\alpha}{2}$  of the population is unrepresented.<sup>15</sup> There is disagreement between the two parties as to the desired target of government expenditures, with  $\alpha$  reflecting the degree of agreement or cohesion between the two political factions. Conversely, we can think of  $(1 - \alpha)$  as the degree of political polarization.<sup>16</sup> The top panel in Figure 5 illustrates the political structure, with the special cases of  $\alpha = 0$  and  $\alpha = 1$  displayed in the lower panels. The interests of each political faction are fully aligned with their constituencies, so the labels  $A$  and  $B$  refer to the two constituencies and the two political factions interchangeably.

At the beginning of each period, one of the two factions takes power. With probability  $p$  this is the same faction that governed in the previous period; with probability  $(1 - p)$  it is the opposing faction. A governing faction inherits a debt stock of  $b_{t-1}$  and observes a wage realization  $w_t$ . The government cannot discriminate between households in its tax policy. Tax revenues are accumulated through a non-discriminatory tax  $\tau_t$  on labor income.<sup>17</sup> The government can, however, target expenditures  $g_t^i$  to the exclusive benefit of specific groups. It is straightforward to show that the chosen expenditure policy involves zero expenditures  $g_t^i = 0$  to the benefit of households outside the government's constituency. The government can borrow and save freely in international capital

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<sup>14</sup>The constituency size is without loss of generality. As we discuss in Section 3, constituency size affects only the calibrated value of  $\theta$ , the relative value of private consumption and the public good. The constituency size of  $1/2$  is appealing a priori, as it could be interpreted as the size of a simple minimum winning coalition in a democratic context.

<sup>15</sup>Unrepresented households play no role in this model. The constituency size could be altered for each value of  $\alpha$  to ensure that the entire population is always represented, with all results carrying over.

<sup>16</sup>This is similar, but not identical to the definition of polarization in Alesina and Tabellini (1990). There, both parties place a positive weight on the welfare of all households, but disagree on the weights. In their formulation  $\alpha \in [\frac{1}{2}, 1]$  is the weight a party puts on its preferred constituency, with  $1 - \alpha$  giving the weight on the opposition's constituency. The closer  $\alpha$  is to 1, the more polarized is the polity. In our setting,  $\alpha \in [0, 1]$  is the percentage of the incumbent's constituency that is also in the opposition's constituency. Here, political polarization is decreasing in  $\alpha$ . The notation used here allows for derivation of analytical results, due to the fact that each faction only provides public goods to its own constituency when in power.

<sup>17</sup>Allowing the government to discriminate between households in tax rates as well as expenditures does not alter the model's results. The government would always tax the opposing constituency at the revenue-maximizing rate (at the peak of the Laffer curve) and set a zero tax on its own constituency, whenever possible. (It would only tax its own constituency at a higher rate if the burden of debt is sufficiently high.)

markets at an exogenous and constant interest rate  $r$ . Debt contracts are fully enforceable; we abstract from the question of sovereign default in this discussion.<sup>18</sup>

The welfare of the incumbent faction, normalized by the size of its constituency, is given by  $V(b_{t-1}, w_t)$ , representing the highest value that the governing faction can achieve when entering period  $t$  when the state of the economy is  $\{b_{t-1}, w_t\}$ :

$$V(b, w) = \max_{\tau, g, b'} u(g, \tau) + \beta [pEV(b', w') + (1-p)E\Omega(b', w')] \quad (3)$$

subject to

$$b' + w^{\varepsilon+1}\tau(1-\tau)^\varepsilon = \frac{g}{2} + (1+r)b, \quad (4)$$

$$g \geq 0, \quad (5)$$

where  $b \equiv b_{t-1}$ ,  $b' \equiv b_t$ , and  $w' \equiv w_{t+1}$ . Time  $t$  subscripts have been suppressed elsewhere. Using (2),  $\tau_t w_t h_t = w_t^{\varepsilon+1} \tau_t (1-\tau_t)^\varepsilon$  are government revenues.  $\Omega(b, w)$  gives the value of being out of power at time  $t$ .

The government also faces a borrowing constraint. This constraint may be an exogenous constraint on borrowing, or one that limits the government to borrow no more than it can repay almost surely—an adaptation of Aiyagari's (1994) natural debt limit. The natural debt limit constrains the government to hold no more debt than could be repaid if it faced the lowest possible wage realization in every subsequent period and taxed all households at the peak of the Laffer curve. The revenue-maximizing tax rate is the constant:

$$\tau_{Laffer} \equiv \frac{1}{\varepsilon + 1}.^{19}$$

It is never optimal for the government to choose a tax rate that exceeds this constant, as there is always a lower rate that generates the same of revenues at a lower utility cost to all households.

Using this result, the borrowing constraint can be written as:

$$b_t \leq \min \left\{ \bar{b}, \underline{w}^{\varepsilon+1} \frac{\varepsilon^\varepsilon}{r(\varepsilon+1)^{\varepsilon+1}} \right\}, \quad (6)$$

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<sup>18</sup>Introducing a time-varying interest rate may in itself affect the cyclicity of fiscal variables, depending on the cyclicity of the government's borrowing rate. However, allowing for an interest rate schedule that is increasing in the government's outstanding debt does not affect any of the paper's results.

<sup>19</sup>This is the solution to the unconstrained revenue maximization problem:

$$\max_{\tau} w^{\varepsilon+1} (1-\tau)^\varepsilon \tau.$$

where  $\bar{b}$  is an ad-hoc exogenous borrowing constraint and the second term is the natural debt limit.

The opposition values the welfare of its constituency, with equal weights on the utility of each one of its constituents. This leads to the following value of being in opposition, again normalized by constituency size:

$$\begin{aligned} \Omega(b, w) = & (1 - \alpha) u(g^*(b, w), \tau^*(b, w)) + \alpha u(0, \tau^*(b, w)) \\ & + \beta [(1 - p) EV(b^*(b, w), w') + pE\Omega(b^*(b, w), w')]. \end{aligned} \quad (7)$$

$g^*(b, w)$ ,  $\tau^*(b, w)$  and  $b^*(b, w)$  are the expenditure, tax, and debt policies, respectively, chosen by the incumbent.  $\Omega(b, w)$  reflects that a measure  $\frac{\alpha}{2}$  of the opposition's constituency also belongs to the incumbent's constituency and thus faces the same policies  $g^*(b, w)$ ,  $\tau^*(b, w)$  chosen by the incumbent for its own constituents. The remaining portion  $\frac{1-\alpha}{2}$  does not value the public goods that are currently provided, but is taxed at the same rate  $\tau^*(b, w)$ .

A key to understanding the model's dynamics is in the non-negativity constraint on public spending (5). When the burden of public debt is sufficiently high, this constraint is binding as the government sacrifices its redistributive objective in order to reduce the debt burden. Servicing the debt ultimately requires a tax rate sufficiently high (on its own constituency), that the government prefers reducing the debt burden to providing public expenditures valued by its constituents. We therefore refer to states of nature in which the non-negativity constraint on government spending is binding as a *fiscal crisis*. In all other periods, which we call the *redistributive regime*, the government is able to redistribute in favor of its constituency. In Section 3, we show quantitatively that fiscal crises are a rare occurrence in equilibrium.

The first order conditions of the government's maximization problem can be reduced to two equations. (For the moment, consider the case when (6) is non-binding.) The first reflects intratemporal optimization in the choice of the tax rate and government expenditure:

$$\frac{1}{2\theta} = \frac{1 - \tau - \varepsilon\tau}{1 - \tau} + \frac{\mu}{\lambda}, \quad (8)$$

where  $\lambda$  and  $\mu$  are the Lagrange multipliers on the government's budget constraint and the non-negativity constraint on public expenditure, respectively. This equation implies a baseline tax rate  $\tau^T$  in the *redistributive regime* (when  $\mu = 0$ ):

$$\tau^T \equiv \frac{2\theta - 1}{2\theta(1 + \varepsilon) - 1}. \quad (9)$$

The tax rate may exceed its baseline level during a Fiscal Crisis (when  $\mu > 0$ ).

An additional, intertemporal condition gives

$$\lambda + \beta [pEV_b(b', w') + (1 - p) E\Omega_b(b', w')] = 0, \quad (10)$$

where

$$\lambda = \frac{1 - \tau}{1 - \tau - \varepsilon\tau} \left[ \frac{[(1 - \tau)w]^{\varepsilon+1}}{\varepsilon + 1} + \theta g \right]^{-\gamma}. \quad (11)$$

Finally, the envelope condition is:

$$V_b(b, w) = -(1 + r)\lambda. \quad (12)$$

### 2.3 Dynamic Analysis

To understand the model's dynamics, first consider the benchmark case of  $p = 1$ , so that the incumbent expects to remain in power indefinitely. In this case, the government's problem is a standard time-consistent dynamic optimization problem, where (10) and (12) give:

$$\lambda = \beta(1 + r)E\lambda'. \quad (13)$$

This equation is a standard Euler equation as in a simple consumption-savings problem.

It is easy to see why fiscal policy is countercyclical in this case. Consider the case  $\beta(1 + r) = 1$ . In this case, the term  $\lambda_t = \frac{1 - \tau_t}{1 - \tau_t - \varepsilon\tau_t} \left[ \frac{w_t^{\varepsilon+1}(1 - \tau_t)^{\varepsilon+1}}{\varepsilon + 1} + \theta g_t \right]^{-\gamma}$  follows a Martingale process. Just as consumers smooth consumption in a consumption-savings problem, the government in this problem will attempt to smooth  $\lambda_t$ .

In the *redistributive regime*  $\tau_t = \tau^T$ , so that smoothing  $\lambda_t$  requires that increases in  $w_t$  be matched with decreases in  $g_t$ , giving countercyclical public expenditures. During a *fiscal crisis*,  $g_t = 0$ , so that  $\lambda_t = \frac{(1 - \tau_t)^{1 - \gamma(\varepsilon + 1)}}{1 - \tau_t - \varepsilon\tau_t} \left( \frac{w_t^{\varepsilon + 1}}{\varepsilon + 1} \right)^{-\gamma}$ . The term  $\frac{(1 - \tau_t)^{1 - \gamma(\varepsilon + 1)}}{1 - \tau_t - \varepsilon\tau_t}$  is unambiguously increasing in  $\tau_t$ , so that smoothing  $\lambda_t$  requires procyclical tax rates. Finally, Proposition 1, whose proof is provided in the appendix, states that government debt is countercyclical. Together, this points to countercyclical fiscal policy with countercyclical public expenditures and debt and procyclical tax rates, when  $p = 1$ .

**Proposition 1** Time Consistent Fiscal Policy. *Assume  $w_t$  follows an i.i.d process. When fiscal policy is time-consistent ( $p = 1$ ), debt is countercyclical, government expenditure  $g$  is countercyclical, and the tax rate  $\tau$  is procyclical.*

While the proof of Proposition 1 assumes that the wage process is i.i.d., we show through

numerical simulations in Section 3 that this is without loss of generality. In the appendix, we show that the analysis given here is identical for the case  $\alpha = 1$ . So we find that the benchmark cases of time consistent policy ( $p = 1$ ) and full policy consensus ( $\alpha = 1$ ) give countercyclical policies. In a technical appendix, available upon request, we prove a more general statement, that in this model any Pareto-efficient and time-consistent fiscal policy will be countercyclical, regardless of the government's specific distributive objective.

Why then does political turnover combined with political polarization cause procyclical policies? A complete analysis requires computational methods, to which we turn in the following section. But the intuition is as follows. A government in power faces a trade-off between its desire to smooth the consumption of its constituents and the fear that surpluses left to its successors will benefit a constituency other than its own. When  $p$  and  $\alpha$  are sufficiently high, the former effect overcomes the latter: the incumbent is either likely to remain in power in the following period, or likely to be followed by a like-minded successor. As the values of  $p$  and  $\alpha$  decline, the latter force becomes more pronounced. Expenditures become procyclical, as governments prefer to increase spending in good times and avoid leaving surpluses to their successors, who will use surpluses to benefit a different constituency.

We have described why the smoothing motivation would cause countercyclical fiscal policy. To see why the dynamic inconsistency due to low values of  $p$  or  $\alpha$  leads procyclical fiscal policies, it is useful to first say a few words about the model's invariant distribution. Proposition 2, whose proof is provided in the appendix, states that if an invariant distribution exists, this distribution always contains states in which  $g > 0$ . This means that there are no *fiscal crisis traps*: the government will not remain in a fiscal crisis indefinitely.

**Proposition 2 (No Fiscal Crisis Traps)** *Assume  $\beta(1+r) = 1$  and  $w_t$  is i.i.d. For any  $p \in [0, 1)$  and  $\alpha \in [0, 1)$ , if an invariant distribution exists, it contains states of nature for which the non-negativity constraint on government expenditure is non-binding. In other words, in any period  $t$ , the economy will return to the redistributive regime almost surely.*

The intuition of this result is as follows. In a fiscal crisis, the debt burden is sufficiently high that the incumbent prefers to increase taxes (including on its own constituency) than to provide targeted public expenditures to its constituency. The incumbent thus fully internalizes the trade-off between taxation and debt. While the assumption of non-discriminatory taxation is not essential for this result, it also implies that there is no longer a conflict of interest between the two factions during a fiscal crisis. In a fiscal crisis, the government thus faces a more standard problem, similar to a consumption-savings problem, where marginal utility of consumption follows a Martingale process,

and the debt burden will converge (almost surely) to a level where targeted public expenditures are provided once more.

If the political distortion is sufficiently acute ( $p$  and  $\alpha$  sufficiently low), fiscal policy fluctuates between the two regimes. A fiscal crisis is more likely at low wage realizations, giving one reason why fiscal policy is procyclical. But, as we show in the Section 3, fiscal policy is procyclical even at lower levels of debt, when a fiscal crisis is not imminent. The incumbent spends more at business cycle peaks for two reasons. First, the lower are  $p$  and  $\alpha$ , the more the incumbent discounts future expenditures relative to expenditures today. The incumbent may not be in power in the following period, and disagrees with his successor on the use of public funding. The incumbent thus increases targeted public expenditures when higher tax revenues are available, i.e. at business cycle peaks. Second, once in a fiscal crisis, there is no longer disagreement between the two political factions. Thus creating a future fiscal crisis is a means through which the incumbent can discipline his successor to behave in the incumbent's interests. Increasing expenditures rather than lowering the debt burden when income is high—giving procyclical expenditures—makes a fiscal crisis more probable in the following period.

Proposition 2 also implies that the political distortion studied here does more than simply create a more "impatient" fiscal agent. In the absence of the political distortion, a sufficiently impatient (low  $\beta$ ) government will accumulate sufficient debt to remain in a perpetual fiscal crisis. The invariant distribution will be comprised of fiscal crisis states only. Once in a fiscal crisis, the impatient government will never provide public expenditures again and government expenditures are acyclical, but not procyclical. Simple impatience generates a shut-down of government in the long run. The political friction studied here generates a more realistic brand of impatience that is present over finite horizons, but is reversed when the debt burden is sufficiently high.

We now turn to the numerical simulation of the model. A full definition of the model's equilibrium and further analytical details on the model's dynamics are provided in the appendix.

### 3 Computational Simulation

This section provides a quantitative analysis of the model's dynamics. The simulations indicate that neither borrowing constraints nor the volatility of the business cycle can account alone for fiscal procyclicality in this model. On the other hand, increases in the political distortion yield procyclical fiscal policies of the magnitudes observed in developing countries, and match a number of quantitative and qualitative features of the data.

The model is simulated in three environments. In each environment, we study the effect of

political polarization (changes in the value of  $\alpha$ ) on fiscal variables. We then look separately at the role of political turnover (changes in the value of  $p$ ).

First, the model is simulated with the business cycle volatility of the United States. This is a benchmark simulation, with borrowing constraints set at the natural debt limit and with the macroeconomic volatility of an industrialized country. This round of simulations shows countercyclical fiscal policy in the absence of the political distortion, with countercyclical government expenditures and procyclical government revenues, giving countercyclical deficits. However, procyclical government fiscal policies are observed when the polity is sufficiently polarized, with procyclical expenditures and government revenues, and acyclical deficits, as is commonly observed in the developing world.

Second, simulations with a more volatile business cycle, with parameters set to match the business cycle features of Argentina, demonstrates that the higher volatility observed in emerging markets causes government spending and deficits that are more *countercyclical*. This is because, with higher business-cycle volatility, there is an even stronger demand for intertemporal social insurance. But with a sufficiently polarized polity, government spending again becomes procyclical, and deficits become acyclical.

Third, the model is simulated with borrowing constraints. We simulate the model with different levels of  $\bar{b}$ , i.e. different debt limits. While tighter borrowing constraints do contribute to the procyclicality of fiscal policy, they only do so when interacting with the political distortion. In other words, borrowing constraints are neither a necessary nor a sufficient condition for fiscal procyclicality in this model, but can further contribute to procyclical fiscal policies in politically polarized environments.

### 3.1 Parametrization

It is easy to show that the introduction of a constant-returns-to-scale firm using labor as its only input would give wages that are perfectly correlated with an exogenous productivity shock. We assume that the productivity shock follows a lognormal process, so that  $w_t = e^{z_t}$ , where  $z_t$  is an AR(1) random variable:

$$z_t - \bar{z} = \rho(z_{t-1} - \bar{z}) + \epsilon_t. \tag{14}$$

Here  $\bar{z}$  is the trend level of productivity, which is normalized to 0;  $\rho$  is the autocorrelation coefficient; and  $\epsilon_t$  is an i.i.d shock normally distributed with mean 0 and variance  $\sigma^2$ . The analysis in Section 2, and in much of the existing literature, such as Alesina, Campante and Tabellini (2008), shocks

are assumed to be i.i.d.<sup>20</sup> Here we relax this assumption; the computational analysis that follows shows that the results described above generalize to more realistic shock processes.

Several parameters govern the phenomena we have hypothesized as potential causes for fiscal procyclicality. These include political parameters ( $\alpha$  and  $p$ ), the tightness of borrowing constraints ( $\bar{b}$ ), and business cycle volatility ( $\rho$  and  $\sigma$ ). The benchmark is a set of simulations in a frictionless environment, so that  $\alpha = p = 1$ ,  $\bar{b}$  set at the natural debt limit, and  $\rho$  and  $\sigma$  set to match features of the U.S. economy. Simulation over a wide range of the other parameters indicated that with the exception of business cycle autocorrelation and volatility ( $\rho$  and  $\sigma$ ), the cyclical properties of the model remained unchanged whether parameter values were chosen to match the business cycle features of the United States, those of Argentina, or those of other emerging markets and developing countries. We therefore chose the values of the remaining parameters to match features of the U.S. data, without loss of generality. This also has the advantage of creating an environment for "pure" experiments. It allows us to ask whether the introduction of any single modelled friction could bring the cyclical features of fiscal policy in the United States to resemble those of Argentina.

Parameter values are summarized in Table 2. For the U.S., we choose the values of  $\{\rho, \sigma^2\}$  typically used in the RBC literature, in order to isolate the effects of political phenomena. Given that the model is simulated at annual frequency, this yields  $\rho = 0.81$  and  $\sigma = 0.0144$ . As in Arellano (2008), we use the realized real GDP process of Argentina to obtain parameters for simulations with Argentina's business cycle features. Using annual data from the International Monetary Fund's (IMF) International Financial Statistics (IFS), Argentina's shock process can be thus be represented as  $\rho = 0.67$  and  $\sigma = 0.046$ . This implies a business cycle that is significantly more volatile than in the U.S. As mentioned above, these are the only parameters that differ between our simulations of the U.S. and Argentina, so that the main role of the "Argentina" simulations is to assess the role of differences in business cycle volatility.

We set risk aversion to  $\gamma = 2$ , as is common in the literature. The elasticity of labor supply is set to  $\varepsilon = 1.7$ . This is the value used in Greenwood, Hercowitz and Huffman (1988). For our benchmark simulation, we set the real interest rate to  $r = 2.4\%$ , the average ex-post real return on 10-year Treasury bonds from 1970 to 2003 (nominal returns and inflation taken from the International Monetary Fund's International Financial Statistics). We intentionally use the same interest rate in the simulations for Argentina to assure the reader that the differences between simulation results for the United States and for Argentina are not driven by differences in borrowing rates (which may result from an endogenous limit on borrowing). The results are virtually unchanged when simulating the model for a wide range of interest rates; none of the results presented here are

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<sup>20</sup>An exception is Battaglini and Coate (2008).

sensitive to the specific borrowing rate chosen, or to the introduction of a debt-elastic interest rate schedule.

$\beta$  is chosen to ensure that when simulated with the business cycle features of the United States, the government's debt-to-GDP ratio is on average 42%, matching the U.S. government's average indebtedness since 1980, based on the IMF's World Economic Outlook (WEO). This gives  $\beta = 0.976$ . Note that  $\beta(1+r) < 1$ , which ensures that the model has a non-explosive level of assets for all parameter values. The parameter  $\theta$ , which determines the marginal value of the public good relative to private consumption mainly governs the size of government in the simulations. When set at  $\theta = 0.84$ , simulations deliver a ratio of total government expenditure (including debt service) of 18%, the average size of the U.S. federal government between 1960 and 2003, using WEO data.<sup>21</sup>

Turning to political parameters, we leave political cohesion  $\alpha$  as a free parameter. For ease of presentation, we choose benchmark values for  $p$  and look at the effects of changes in  $\alpha$  for a given level of  $p$ . We later revisit the interaction between the two political parameters. The benchmark values of  $p$  are chosen to match the turnover rate in the two countries. In the United States, the observed likelihood that the incumbent party retained the presidency in an election year was 0.64 in the 20th century. Adjusting this to reflect the annual frequency of the model gives  $p = 0.91$ . In Argentina, government turnover is more irregular and Argentina was a non-democracy for parts of the 20th century. Also, the volatile party structure in Argentina makes it difficult at times to determine whether a given party represents the same economic interests as its successors. Using the World Bank's Database of Political Institutions (Beck et al, 2001) the hazard rate of the party controlling the executive branch was  $p = 0.87$  between 1975 and 2004. With only a minor difference in turnover probability at annual frequency, we set  $p = 0.9$ . We then report simulations for various rates  $p$  to isolate the effects of political turnover.

## 3.2 Results

Figures 6-8 present the main simulation results. The solid curves represent the correlation between a given fiscal variable and GDP in three sets of simulations, each across a range of values of  $\alpha$  (political cohesion). The correlations are computed using the deviations of the simulated time series from their HP filter trend. A complete description of the computational algorithm used to simulate the model is provided in the appendix.

The graphs are on an inverted scale ranging from  $\alpha = 1$  on the left to  $\alpha = 0$  on the right.

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<sup>21</sup>The value of  $\theta$  that yields this result depends on the constituency size, which we have set at 1/2. Any other constituency size can be accommodated by altering the value of  $\theta$ , so that our assumption on the constituency size is without loss of generality.

The intersections with the  $y$  axis are then results when no political distortion is present, as  $\alpha = 1$  implies no disagreement between the political factions. Political polarization increases (political cohesion decreases) moving rightward along the  $x$  axis. To facilitate comparison with the data, the actual correlation between (the cyclical components of) GDP and each fiscal variable in the U.S. and Argentina are shown in horizontal dotted lines. Figure 6 gives results for the correlation between government expenditures and GDP. Figure 7 shows correlations between tax revenues and GDP. Figure 8 shows correlations between the deficit and GDP.

The results of a benchmark simulation, with the business cycle features of the United States and no frictions, can be seen in the intersection of the "U.S." curves with the  $y$  axis in each of these three figures. The model predicts highly countercyclical government expenditures (Figure 6) and deficits (Figure 8), and highly procyclical tax revenues (Figure 7) when no distortions are present. The model requires only a small degree of political polarization (0.95 for expenditures and 0.85 for deficits) to match actual values observed in the U.S.

Moving along the  $x$  axis, as political polarization increases, government spending becomes less countercyclical, and eventually procyclical. Deficits become less countercyclical, and eventually acyclical. Altering only political parameters, the model can move from countercyclical deficits and expenditures—with values similar to those observed in high-income countries—to procyclical and acyclical, respectively, in more polarized political environments.

Consistent with the data, the model shows procyclical revenues with little differences across countries. Having said this, the correlation of government revenues with GDP in the model is almost always very close to 1. This is a feature of many models with linear income taxes. In this model, simulated tax rates are generally smooth, so that their correlation with GDP is close to zero. Tax rates do become more countercyclical as  $\alpha$  decreases, but this does not have a sizeable effect on the cyclicity of revenues. The excessive correlation between tax revenues and GDP relative to the data is a feature of many modern models of optimal linear labor taxation. The tax-smoothing motivation, combined with a perfect correlation between the tax base and GDP, lead to an almost perfect correlation between tax revenues and GDP. The gap between theory and reality may be explained by the fact that the tax base is not perfectly correlated with GDP in reality, unlike in this class of models.

A second curve in Figures 6-8 shows results of simulations when the model is parametrized with the business cycle features of Argentina. The results are qualitatively similar. Without the political distortion, government expenditures are strongly countercyclical, as in the "U.S." simulations. In fact, the model predicts policies that are more *countercyclical* in the volatile Argentine environment, for almost any value of  $\alpha$ . This is because the need for intertemporal insurance for households

increases with higher business-cycle volatility.

As discussed in the Section 2, there are two competing forces driving the cyclicity of fiscal policy in the model. The first is the desire of an optimizing government to insure households against negative income shocks through government spending that is complementary to private consumption. This motivates even a rent-seeking government to spend countercyclically, in an attempt to insure its own constituency. The second is the uncertainty as to the identity or preferences of the successive government. The concern that the incumbent may be replaced in power by representatives of a different political faction, motivates the government to spend procyclically. The government would prefer to insure its constituents, but is uncertain whether it will be in power when the economy is hit by an adverse shock. In this model, therefore, business cycle volatility causes fiscal policy to be more countercyclical, all else equal. The higher business cycle volatility increases the value of countercyclical insurance, so that a greater political distortion is required to overcome the insurance motivation of fiscal policy.

The model matches the observed correlation between government expenditure and GDP in the Argentine data for  $\alpha = 0.6$ , and between government deficits and GDP for  $\alpha = 0.3$ . The conclusion emerging from this set of simulations is that we would expect more countercyclical fiscal policies in more volatile business cycle environments, all else equal.

In the third round of simulations, we tightened the borrowing constraint, so that the debt limit is at the extreme value of  $\bar{b} = 0$ . The business cycle features of the United States were used in these simulations, but simulations with the business cycle features of Argentina yielded qualitatively similar results. Virtually identical results obtained with different values of the debt limit.<sup>22</sup> Figures 6-8 show that borrowing constraints do not contribute to the procyclicality of fiscal policy unless the political friction is also present. In fact, in the absence of the political friction, government expenditure is slightly more *countercyclical* when an exogenous constraint on borrowing is present. The intuition is the familiar precautionary savings motive: in business cycle peaks, the government decreases expenditures to a greater extent in order to avoid binding borrowing constraints in the future.<sup>23</sup> This gives fiscal policies that are more procyclical when the borrowing constraints are slack, but also decreases the probability that borrowing constraints are binding along the equilibrium path.

It is interesting, however, that borrowing constraints do appear to reinforce procyclical expen-

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<sup>22</sup>The simulations were repeated for a broad range of exogenous borrowing constraints, ranging from  $\bar{b}/GDP = 0\%$  to  $\bar{b}/GDP = 100\%$ . The results remained identical due to the precautionary savings motivation. The average debt/GDP ratio became smaller in equilibrium as borrowing constraints were tightened.

<sup>23</sup>This phenomenon is even more pronounced in the transition to the invariant distribution, where the government saves more in business cycle peaks in order to accumulate a buffer-stock of savings.

ditures and deficits when the political friction is present. This indicates that political and financial market frictions might reinforce each other, but we do not find support for the idea that borrowing constraints alone play an important role in explaining fiscal procyclicality.

Figure 9 shows the interaction between the two political parameters. It shows simulation results for "Argentina" for a variety of  $p$  values (the probability of the incumbent remaining in power in the following period), with  $\alpha$  (political cohesion) changing along the  $x$  axis as before. According to the World Bank's Database of Political Institutions (Beck et al, 2001) annual turnover rates range from 3% to 30% in annual frequency, implying values of  $p \in [0.7, 0.93]$ . We look at values of  $p$  ranging from 0.5 to 0.95, keeping in mind that the lower end of this range implies unrealistically high turnover relative to the rates observed in the data. Not surprisingly, higher turnover (lower  $p$ ) causes fiscal policy to become more procyclical.

But Figure 9 also demonstrates the utility of quantitative analysis in the understanding of political economy models. It was to be expected that the cyclicity of fiscal policy would be affected by both turnover ( $1 - p$ ) and political polarization ( $1 - \alpha$ ). Figures 6 to 9 show that both are necessary for distorted policies to appear in model simulations. However, model simulations highlight that while political polarization uniformly affects the cyclicity of government expenditures for any value of  $p \in (0, 1)$ , political turnover has little effect on the cyclicity of fiscal policy in cohesive political environments (high levels of  $\alpha$ ). Even with turnover rates that are significantly more frequent than observed in reality, the cyclicity of government expenditures remains virtually unchanged for values of  $\alpha > 0.9$  (see the circled area in the figure.) Thus a cohesive polity can expect to benefit from countercyclical fiscal policies even when turnover is frequent. At the same time, a dictator ruling over a polarized society might conduct distorted fiscal policies, as long as there is some positive probability that an opposing faction will seize power in the future. These are perhaps good news for proponents of democratic forms of government. The research of Alesina, Campante and Tabellini (2008) indicates that the interaction between democracy and corruption explains procyclical fiscal policies in a cross-section of countries. The results presented in Figure 9 certainly reinforce the conclusion that interactions between political turnover and rent-seeking lead to procyclical fiscal policies. But they add to the discussion in that they indicate the degree to which political turnover and political polarization contribute independently to fiscal procyclicality.<sup>24</sup>

The model's predictions arising from simulations can be summarized as follows. Without the political distortion, fiscal policy is countercyclical, reflected in procyclical tax revenues, and coun-

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<sup>24</sup>The analogy with Alesina, Campante and Tabellini (2008) is admittedly imperfect. Political turnover occurs in both democratic and autocratic polities, while the measure of democracy in Alesina, Campante and Tabellini (2008) captures more than merely democratic transitions of government. And while corruption is correlated with political polarization, the correlation is imperfect.

tercyclical expenditures and deficits. This is true even in volatile macroeconomic environments, and even when borrowing constraints are tight. The introduction of the political distortion can match the procyclical policies observed in developing countries, when political polarization is sufficiently high ( $\alpha$  is sufficiently low). Turnover ( $1 - p$ ) contributes to the procyclicity of fiscal policy, but only in conjunction with political polarization.

### 3.3 Exposition of the Model's Dynamics

Simulations also allow a further exploration of the model's dynamics. Proposition 2 states that the model's invariant distribution includes a positive probability of being in the redistributive regime. The same cannot be said in general of the fiscal crisis regime. In fact, simulations of the model indicate that fiscal crises are very rare events. For sufficiently low values of  $\alpha$ , the model moves between the redistributive and fiscal crisis regimes. But as Figure 10 shows, the procyclicity of government expenditures is not driven by fiscal crises alone. The figure presents an example of a typical simulation sequence. The top panel gives a 100-year sample of the random process for  $w_t$ , simulated to match the business cycle features of Argentina.<sup>25</sup> The lower panel shows the government's choice of expenditures  $g_t$  as a percent of GDP when  $\alpha = 0.8$  and  $\alpha = 0.4$ . The former value of  $\alpha$  is sufficiently high to give countercyclical policies, while the latter gives procyclical policies.

In both cases fiscal crises are rare occurrences. There are only two such events (episodes C and F in the figure) in the 100 year sample. These are triggered by recessions that are long and deep. Once in a fiscal crisis, fiscal policy is procyclical for both values of  $\alpha$ , as governments use any new fiscal room created by positive wage shocks to resume public expenditure policies.

The two governments differ, rather, in their conduct in the redistributive regime. Governments in the more cohesive polity ( $\alpha = 0.8$ ) decrease expenditures during business cycle booms (episodes A, D, and G), leaving them room to increase expenditures during the recessions that follow (episodes B, E, and H). Governments in the more polarized polity increase expenditures in business cycle booms, forcing them to decrease spending even in mild recessions. They are forced to do so to avoid a full-blown fiscal crisis due to a relatively moderate recession.

Figure 10 also shows that despite the greater motivation of the government in the polarized political system to myopically seek rents for the benefit of its constituency, government spending is not a higher proportion of GDP than in the less polarized environment. This is because greater political polarization implies a higher debt burden in equilibrium, and therefore a lower capacity to

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<sup>25</sup> Here, a 5-state Markov chain was used to simulate wages as opposed to the 11-state one used in calculating the correlations in Figures 6-9. This makes it easier to visually identify business cycle peaks and troughs.

use fiscal policy for redistributive purposes. This is consistent with the smaller size of government observed in developing countries relative to high-income countries.

## 4 Conclusions

A growing theoretical literature provides explanations for the cyclicity of fiscal policy in developing countries. A number of empirical studies give cross sectional evidence of the factors contributing to procyclical fiscal policies. This paper demonstrates the utility of a different approach—commonly used in modern macroeconomics, but only recently employed in the study of political economy phenomena. We develop a dynamic model of fiscal policy and simulate it to explore whether various explanations that are theoretically plausible in principle have the ability to explain quantitatively the phenomenon in practice.

Imperfections in capital markets are frequently assumed to be the main culprit for the procyclicality of fiscal policy in developing countries. The volatile business cycle environment in developing countries is also often cited as a contributing factor. The model presented in this paper raises questions regarding the power of these explanations. It provides an alternative political explanation, and demonstrates using numerical simulations that polarized political environments may yield procyclical fiscal policies. Quantitative simulations of the model show that political frictions are able to capture a number of the salient differences in the cyclicity of fiscal policy across countries.

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## A Proof of Proposition 1

*Proposition 1: Time Consistent Fiscal Policy.* Assume  $w_t$  follows an i.i.d process. When fiscal policy is time-consistent ( $p = 1$ ), debt is countercyclical, government expenditure  $g$  is countercyclical, and the tax rate  $\tau$  is procyclical.

**Proof.** The maximization problem facing the time-consistent government is as follows:

$$V(b, w) = \max_{\tau, g, b'} u(g, \tau) + \beta EV(b', w')$$

subject to

$$b' + w^{\varepsilon+1} \tau (1 - \tau)^\varepsilon = \frac{g}{2} + (1 + r)b + g,$$

$$g \geq 0$$

If the value function  $V(b, w)$  is to have the standard properties as in Stokey, Lucas and Prescott (1989) (pp. 84, theorem 4.11), the period return function  $\hat{u}(b', b, w)$  implied by this problem must be continuously differentiable. There is a set on  $\{b, w\}$  where potential non-differentiabilities might be present. This is at the transition between the redistributive and the fiscal crisis regimes. We can think of the function  $V(b, w)$  as being a sum of two separate value functions, one for each of the fiscal regimes, each non-zero only in the relevant subset of the state space. The function  $V(b, w)$  is continuously differentiable if the limits of the differentials of these three functions are equal at all intersection points. The envelope theorem can be applied to both value functions in the relevant region of the state space. In both cases, we obtain:

$$V_b(b, w) = -(1 + r)\lambda, \tag{15}$$

We have seen that

$$\lambda = \frac{1 - \tau}{1 - \tau - \varepsilon\tau} \left[ \frac{[(1 - \tau_t)w_t]^{\varepsilon+1}}{\varepsilon + 1} + \theta g_t \right]^{-\gamma}$$

$V_b(b, w)$  is thus a continuous function at  $g = 0$ , and therefore over the entire state space. There is no guarantee that  $V(b, w)$  is twice differentiable. This is not a specific feature of this model. It is in general difficult to establish that the value function is twice differentiable in a large class of recursive models. The objective function is strictly concave and the set defined by the government's budget constraint is compact, so that the value function is (decreasing in and) concave in  $b$ . In the analysis that follows, we will casually use second derivatives of the value function. In doing so, we follow Sargent (1979), who argues that even if a concave value function is not differentiable, one

can view such casual differentiation as a the limit of finite differences.

We can now conduct comparative statics on the following equations:

$$b' + w^{\varepsilon+1}\tau(1-\tau)^\varepsilon \geq \frac{g}{2} + (1+r)b \quad (16)$$

and

$$\frac{1-\tau}{1-\tau-\varepsilon\tau} \left[ \frac{[(1-\tau)w]^{\varepsilon+1}}{\varepsilon+1} + \theta g \right]^{-\gamma} + \beta EV_b(b', w') = 0. \quad (17)$$

Consider the *redistributive regime*. Here  $\tau = \tau^T$ , so that the tax rate is unaffected by small perturbations in  $w$ . Differentiating both equations by  $w$  gives

$$\frac{\partial b'}{\partial w} + (\varepsilon+1)w^\varepsilon\tau(1-\tau)^\varepsilon = \frac{1}{2} \frac{\partial g}{\partial w}$$

and

$$\begin{aligned} & \gamma \frac{1-\tau}{1-\tau-\varepsilon\tau} \left[ \frac{[(1-\tau)w]^{\varepsilon+1}}{\varepsilon+1} + \theta g \right]^{-\gamma-1} \left[ (1-\tau)^{\varepsilon+1}w^\varepsilon + \theta \frac{\partial g}{\partial w} \right] \\ &= \beta EV_{bb}(b', w') \frac{\partial b'}{\partial w}, \end{aligned}$$

respectively. Solving these two equations for  $\frac{\partial b'}{\partial w}$ , and recalling that the concavity of  $EV(b', w')$  implies that  $EV_{bb}(b', w') \leq 0$ , gives  $\frac{\partial b'}{\partial w} < 0$ . (16) then implies  $\frac{\partial g}{\partial w} < 0$ .

Next consider a *fiscal crisis*. Here  $g = 0$ , so that differentiating (16) and (17) gives:

$$\frac{\partial b'}{\partial w} + (\varepsilon+1)w^\varepsilon\tau(1-\tau)^\varepsilon + w^{\varepsilon+1}(1-\tau)^\varepsilon \frac{1-\tau-\varepsilon\tau}{1-\tau} \frac{\partial \tau}{\partial w} = 0$$

and

$$\begin{aligned} & \frac{\varepsilon}{(1-\tau-\varepsilon\tau)^2} \left[ \frac{[(1-\tau)w]^{\varepsilon+1}}{\varepsilon+1} + \theta g \right]^{-\gamma} \frac{\partial \tau}{\partial w} \\ & + \gamma \left[ \frac{[(1-\tau)w]^{\varepsilon+1}}{\varepsilon+1} + \theta g \right]^{-\gamma-1} (1-\tau)^\varepsilon w^{\varepsilon+1} \frac{\partial \tau}{\partial w} \\ &= -\beta EV_{bb}(b', w'). \end{aligned}$$

These two equations also give  $\frac{\partial b'}{\partial w} < 0$ . This implies  $\frac{\partial \tau}{\partial w} > 0$ . So that in both regimes, debt is countercyclical; government expenditure is countercyclical and the tax rate is procyclical. ■

## B Analysis of Policy Consensus ( $\alpha = 1$ )

When  $\alpha = 1$ , the two factions fully concur on the way to target government expenditure. This is seemingly identical to the previous assumption, where the same party remains in power forever. However, there is a subtle difference.

The incumbent's maximization problem is still as defined in (3). Here, however, the opposition's value function is:

$$\begin{aligned} \Omega(b, w) = & u(g^*(b, w), \tau^*(b, w)) \\ & + \beta [(1 - p) EV(b^*(b, w), w') + pE\Omega(b^*(b, w), w')]. \end{aligned} \quad (18)$$

Deriving an Euler equation from the first order condition (10) requires differentiating both  $V(b, w)$  and  $\Omega(b, w)$ . In differentiating  $V(b, w)$ , we can apply the envelope theorem to (3) and obtain (12). However, (18) is not a maximization problem and the envelope theorem cannot be applied. Differentiating this function is the main challenge in obtaining a general term for the Euler Equation, as seen in Appendix D. However, when there is no disagreement between successive governments ( $\alpha = 1$ ), a shortcut is available. Given that the government and opposition receive identical payoffs in every period, it is apparent that  $\Omega(b, w) = V(b, w)$ . The problem is now identical to the case  $p = 1$ . Thus the analysis of the  $p = 1$  case, including Proposition 1, holds in this case as well, and fiscal policy is countercyclical when  $\alpha = 1$ .

## C Proof of Proposition 2

*Proposition 2: No Fiscal Crisis Traps.* Assume  $\beta(1 + r) = 1$  and  $w_t$  is i.i.d. For any  $p \in [0, 1)$  and  $\alpha \in [0, 1)$ , if an invariant distribution exists, it contains states of nature for which the non-negativity constraint on government expenditure is non-binding. In other words, in any period  $t$ , the economy will return to the redistributive regime almost surely.

**Proof.** Assume via contradiction that the economy converges to an invariant distribution for which  $\mu_t > 0 \forall t > \bar{t}$ , in other words the economy is always in a *fiscal crisis* from  $\bar{t}$  onwards. Given that  $g_t = 0 \forall t > \bar{t}$ , it must be the case that  $\Omega(b_t, w_t) = V(b_t, w_t) \forall t > \bar{t}$ . (10) and (12) then imply that (13) holds in this case. Looking at (13),  $\lambda_t$  is a positive Martingale process. The Martingale convergence theorem (see, for example, Shiryaev, 1989 pp. 509, Corollary 3) then states that  $\lambda_t$  converges to a finite value,  $\tilde{\lambda}$ . Thus the invariant distribution is degenerate at  $\lambda_t = \tilde{\lambda}$ .

Turning now to (10):

$$\tilde{\lambda} + \beta EV_b(b', w') = 0,$$

this equation is only a function of  $b'$ , because  $w_t$  is i.i.d.  $EV_b(b', w')$  is decreasing in  $b'$  (see Appendix A). This means that as soon as  $b_{t+1} = \tilde{b}$  in the invariant distribution.

Let  $\tilde{\tau}(w_t)$  denote the tax rate that gives  $\lambda_t = \tilde{\lambda}$ , given the current value of  $w_t$ :

$$\tilde{\lambda} = \frac{1 - \tilde{\tau}}{1 - \tilde{\tau} - \varepsilon \tilde{\tau}} \left( \frac{[(1 - \tilde{\tau}) w_t]^{\varepsilon+1}}{\varepsilon + 1} \right)^{-\gamma}.$$

This equation implies that  $\tilde{\tau}(w_t)$  is strictly increasing in  $w_t$  in the invariant distribution. Tax revenues are therefore increasing in the realized value of  $w_t$ :

$$w_t^{\varepsilon+1} \tilde{\tau}(w_t) (1 - \tilde{\tau}(w_t))^{\varepsilon} = (\varepsilon + 1) \left[ \tilde{\lambda} \frac{1 - \tilde{\tau}(w_t) - \varepsilon \tilde{\tau}(w_t)}{1 - \tilde{\tau}(w_t)} \right]^{-1/\gamma} \frac{\tilde{\tau}(w_t)}{1 - \tilde{\tau}(w_t)},$$

as the right-hand-side of this equation is unambiguously increasing in  $w_t$ .

With tax revenues increasing in wages, and a constant debt stock, the budget constraint

$$w_t^{\varepsilon+1} \tilde{\tau}(w_t) (1 - \tilde{\tau}(w_t))^{\varepsilon} = r\tilde{b},$$

must be violated for some value of  $w_t$ . This contradicts the existence of an invariant distribution that consists entirely of fiscal crisis states. ■

## D Definition of the Equilibrium

This appendix defines the model's equilibrium for the general case, where  $\alpha < 1$  and  $p < 1$ . The model presented here has multiple equilibria, and an equilibrium refinement is necessary to make further progress in analyzing the dynamics of the model. First, we restrict attention to symmetric Markov-perfect equilibria. While other, cooperative equilibrium paths also exist, a non-cooperative game appears the more appropriate characterization of the interaction between polarized factions in a developing country.<sup>26</sup>

Unfortunately, this refinement is insufficient. The game studied here may have multiple Markov Perfect equilibria, as shown in a slightly different context in Krusell and Smith (2003). To address this problem, we follow Krusell, Kuruscu and Smith (2002) in a further equilibrium refinement. we restrict attention to differentiable policy functions. In this context this implies a differentiable function  $b' = f(b, w)$ , giving a government's choice of debt.<sup>27</sup> we can now define the Differentiable

<sup>26</sup>See however, Alesina (1987) and Acemoglu, Golosov and Tsyvinsky (2008) examples of the interesting dynamics that arise in political economy models with reputational mechanisms.

<sup>27</sup>There is a subtle difference between our problem and that of Krusell, Kuruscu and Smith (2002). It is unclear

Equilibrium.

**Definition** (Differentiable Equilibrium) *A Differentiable Equilibrium is defined as two value functions:  $V(b, w)$  and  $\Omega(b, w)$  and three policy functions:  $g(b, w)$ ,  $\tau(b, w)$  and  $f(b, w)$ , such that given a stochastic process for  $\{w_t\}_{t=0}^{\infty}$ :*

(1) *Given  $V(b, w)$  and  $\Omega(b, w)$ ;  $g(b, w)$ ,  $\tau(b, w)$  and  $f(b, w)$  solve the maximization problem in equations (3) to (6) for the variables  $g$ ,  $\tau$ , and  $b'$ , respectively.*

(2) *Given  $g(b, w)$ ,  $\tau(b, w)$  and  $f(b, w)$ ;  $V(b, w)$  and  $W(b, w)$  satisfy the functional equations (3) and (7), respectively.*

(3)  *$f(b, w)$  is differentiable in its first argument for  $\forall \{b, w\}$  for which  $g(b, w) = 0$  and  $\tau(b, w) = \tau^T$  do not both hold.*

The Differentiable Equilibrium yields the following Generalized Euler Equation (GEE):

$$\lambda = \beta(1+r) \left[ \int_{w'|g'=0} \lambda' dw' + (p + \alpha(1-p)) \int_{w'|g'>0} \lambda' dw' \right] \quad (19a)$$

$$+ \beta(1-p) \left[ \begin{array}{l} (1-p)\beta(1+r) E[f_b(b', w') \lambda''] - \\ \left( \begin{array}{l} \alpha \int_{w'|g'>0} f_b(b', w') \lambda' dw' \\ + \int_{w'|g'=0} f_b(b', w') \lambda' dw' \end{array} \right) \end{array} \right] \quad (19b)$$

$$- \beta p \{ p\beta(1+r) E[\lambda'' f_b(b', w')] - E[\lambda' f_b(b', w')] \}, \quad (19c)$$

where the integrals are over values of  $w'$ , for which  $g' = 0$  (fiscal crisis) or  $g' > 0$  (redistributive regime).

To obtain the GEE we begin by rewriting the two value functions, assuming a differentiable policy function  $b' = f(b, w)$ :

$$V(b, w) = \max_{\tau, g, b'} u(g, \tau) + \beta [pEV(b', w') + (1-p)E\Omega(b', w')]$$

s.t.

$$b' + w^{\varepsilon+1} \tau (1-\tau)^{\varepsilon} = \frac{g}{2} + (1+r)b,$$

---

whether a policy function  $f(b, w)$  that is differentiable over the entire state space exists. It is apparent, for example, that the policy functions  $g(b, w)$  and  $\tau(b, w)$  are non-differentiable at the transition from the redistributive regime to the fiscal crisis regime. It is sufficient for our purposes to assume a policy function  $f(b, w)$  that is differentiable everywhere except in the set on  $\{b, w\}$  that results in  $g = 0$  and  $\tau = \tau^T$ .

$$g \geq 0.$$

The function  $\Omega(b, w)$  is given by:

$$\begin{aligned} \Omega(b, w) &= \alpha u(g^*, \tau^*) + (1 - \alpha) u(0, \tau^*) \\ &\quad + \beta [(1 - p) EV(f(b, w), w') + pE\Omega(f(b, w), w')], \end{aligned}$$

where  $g^*$ ,  $\tau^*$  and  $f(b, w)$  are the solutions to the maximization problem above.

We now differentiate the two functions.  $V(b, w)$  and  $\Omega(b, w)$ . In the case of  $V(b, w)$ , the envelope condition holds, and therefore

$$V_b(b, w) = -(1 + r)\lambda.$$

In the case of  $\Omega(b, w)$ , the envelope theorem does not apply, as  $g^*$ ,  $\tau^*$  and  $f(b, w)$  are chosen optimally from the perspective of the incumbent, not from the perspective of the opposition. We must therefore differentiate the function  $\Omega(b, w)$  explicitly:

$$\begin{aligned} \Omega_b(b, w) &= \alpha u_g(g, \tau) \frac{\partial g}{\partial b} + \alpha u_\tau(g, \tau) \frac{\partial \tau}{\partial b} + (1 - \alpha) u_\tau(0, \tau) \frac{\partial \tau}{\partial b} \\ &\quad + \beta [(1 - p) EV_b(f(b, w), w') + pEW_b(f(b, w), w')] f_b(b, w). \end{aligned} \quad (20)$$

Next, differentiate the government's budget constraint with respect to  $b$ :

$$f_b(b, w) + w^{\varepsilon+1} (1 - \tau)^\varepsilon \frac{1 - \tau - \varepsilon\tau}{1 - \tau} \frac{\partial \tau}{\partial b} = \frac{1}{2} \frac{\partial g}{\partial b} + (1 + r).$$

There are two possibilities. First, whenever (5) is binding,  $\frac{\partial g}{\partial b} = 0$ . Second, whenever  $g > 0$ ,  $\frac{\partial \tau}{\partial b} = 0$ , with  $\frac{1 - \tau - \varepsilon\tau}{1 - \tau} = \frac{1}{2\theta}$ , as (8) confirms. In both cases, we can rewrite the previous equation as:

$$f_b(b, w) = \frac{1 - \tau - \varepsilon\tau}{1 - \tau} \left[ \theta \frac{\partial g}{\partial b} - w^{\varepsilon+1} (1 - \tau)^\varepsilon \frac{\partial \tau}{\partial b} \right] + (1 + r), \quad (21)$$

giving a term for  $f_b(b, w)$  that can be used throughout the state space. Using this result in (20), gives

$$\begin{aligned} \Omega_b(b, w) &= \alpha [f_b(b, w) - (1 + r)] \lambda + (1 - \alpha) u_\tau(0, \tau) \frac{\partial \tau}{\partial b} \\ &\quad + \beta [(1 - p) EV_b(f(b, w), w') + pEW_b(f(b, w), w')] f_b(b, w), \end{aligned}$$

noting that  $u_\tau(g, \tau) = -w^{\varepsilon+1} (1 - \tau)^\varepsilon \frac{1 - \tau - \varepsilon\tau}{1 - \tau} \lambda$  and  $u_g(g, \tau) = \theta \frac{1 - \tau - \varepsilon\tau}{1 - \tau} \lambda$ .

Now note that when  $g > 0$ ,  $\frac{\partial \tau}{\partial b} = 0$ , so that the second term in the first row of this last equation is equal to zero. On the other hand, when  $g = 0$ ,  $u_\tau(0, \tau) = u_\tau(g, \tau) = -w^{\varepsilon+1} (1 - \tau)^\varepsilon \frac{1 - \tau - \varepsilon \tau}{1 - \tau} \lambda$ , while (21) reads:

$$f_b(b, w) = -\frac{1 - \tau - \varepsilon \tau}{1 - \tau} w^{\varepsilon+1} (1 - \tau)^\varepsilon \frac{\partial \tau}{\partial b} + (1 + r),$$

giving:

$$\begin{aligned} \Omega_b(b, w) &= \beta [(1 - p) EV_b(f(b, w), w') + pEW_b(f(b, w), w')] f_b(b, w) \\ &\quad + \begin{cases} [f_b(b, w) - (1 + r)] \lambda & \text{for } g = 0 \\ \alpha [f_b(b, w) - (1 + r)] \lambda & \text{for } g > 0 \end{cases} \end{aligned}$$

Analyzing the first line of this equation gives:

$$\begin{aligned} &\beta [(1 - p) EV_b(f(b, w), w') + pE\Omega_b(f(b, w), w')] f_b(b, w) \\ &= \beta \frac{p}{1 - p} \left[ \frac{(1 - p)^2}{p} EV_b(f(b, w), w') + (1 - p) E\Omega_b(f(b, w), w') \right] f_b(b, w) \\ &= -\frac{p}{1 - p} \left[ \lambda + \beta (1 + r) \frac{1 - 2p}{p} E\lambda' \right] f_b(b, w), \end{aligned}$$

using (12) and (10) in the last step. This gives

$$\begin{aligned} \Omega_b(b, w) &= -\frac{p}{1 - p} \left[ \lambda + \beta (1 + r) \frac{1 - 2p}{p} E\lambda' \right] f_b(b, w) \\ &\quad + \begin{cases} [f_b(b, w) - (1 + r)] \lambda & \text{for } g = 0 \\ \alpha [f_b(b, w) - (1 + r)] \lambda & \text{for } g > 0 \end{cases} \end{aligned} \tag{22}$$

We now use (12) and (22) in (10) to obtain the GEE in (19a) to (19c).

The intuition for the GEE is as follows.  $\lambda$  is the marginal cost of reducing government debt by one unit, as valued by the incumbent. The benefit of this extra unit of savings is given by the long term on the right hand side of the equation. The extra unit of savings will be available to next period's incumbent. In all states of nature for which  $g' = 0$  there is no disagreement between the two factions. Given that the successor will be in a fiscal crisis, the marginal dollar saved will be used to reduce the burden of taxation on all households, and either faction would behave identically if in power. On the other hand, in all states of nature for which  $g' > 0$ , taxes will be set at  $\tau' = \tau^T$  and all savings will go in to public expenditures or future savings. With probability  $p$  the incumbent will be in office in the following period. With probability  $1 - p$  the incumbent is out of office in the following period, and only a fraction  $\alpha$  of the incumbent's constituency (those who also belong to the opposition's constituency) will benefit from the marginal dollar saved. This explains

(19a).

However, the incumbent and his successor may also disagree on the optimal choice of debt two periods ahead:  $f(b', w')$ . If case the incumbent loses office, he would like to influence his successor's borrowing choice. The only means through which he can do so is the debt burden he leaves to his successor. This effect is captured in (19b). With probability  $1 - p$  the incumbent loses power.  $f_b(b', w')$  is the extent to which a additional dollar saved by the period  $t$  incumbent influences his successor in period  $t + 1$  to save an additional dollar for period  $t + 2$ . With probability  $(1 - p)^2$  the incumbent will regain power two periods from now. And to the extent that an additional dollar of savings today induces the successor to roll over some of the savings to the following period—giving a return to savings of  $f_b(b', w')$ —this gives the period  $t + 2$  government a marginal benefit of  $\lambda''$ . At the same time, these induced savings come at the expense of lower public expenditure (or higher taxes) in period  $t + 1$ . Thus, the incumbent takes into account the cost of inducing his successor to increase savings at time  $t + 1$ . This is reflected in losses in public expenditure to a fraction  $\alpha$  of his constituency in the redistributive regime, or to higher taxes for his entire constituency in a fiscal crisis.

There are also higher order effects. The incumbent's attempt to influence his successor distorts his own decisions in the following period, if he retains power. (19c) gives the costs of self-induced over-saving if incumbent remains in power, caused by his attempts to influence his successor's behavior.

## E Computational Algorithm

The time inconsistency inherent in the political structure of the model poses some computational challenges. In the Section 2, we followed Krusell, Kuruscu and Smith (2002) in restricting attention to equilibrium paths with differentiable policy functions. In these types of problems, standard computational methods do not perform well, presumably due to the models' multiple equilibria. The government's optimization problem is not a contraction, and iterations on the value function do not necessarily converge. On the other hand, the perturbation method suggested by Krusell, Kuruscu and Smith (2002) cannot be applied in our context, because the non-negativity constraint on government expenditures creates kinks in the policy functions. The computational algorithm therefore uses finite-horizon backward induction. We solve a finite-horizon variant of the model with  $\bar{t} = 10,000$  periods (years). Increasing the time horizon up to one million periods did not affect simulation results. There is no guarantee that this finite-horizon analysis is identical to the Differentiable Equilibrium that was analyzed in Appendix C. However, Krusell, Kuruscu and

Smith (2002) show that in their context the Differentiable Equilibrium is the limit of a finite horizon problem. We can therefore expect that the numerical solution presented in this section would yield an accurate approximation of Differentiable Equilibrium at the infinite horizon limit.

We solve a finite horizon variant of the model using backward induction. Let  $\bar{t}$  be the foresight horizon of the model—the number of periods from time  $t = 0$  the end of history. We simulate the model over  $t_{sim}$  periods, where  $t_{sim} < \bar{t}$ . The model is solved computationally as follows.

1. Create a grid on  $w$  and  $b$ .
2. History ends at time  $\bar{t}$ . All outstanding debt  $b_{\bar{t}-1}$  must be repaid:  $b_{\bar{t}} = 0$ . The government's time  $\bar{t}$  maximization problem is:

$$V^{\bar{t}}(b_{\bar{t}-1}, w_{\bar{t}}) = \max_{\tau_{\bar{t}}, g_{\bar{t}}} u(g_{\bar{t}}, \tau_{\bar{t}}).$$

s.t.

$$\tau_{\bar{t}}(1 - \tau_{\bar{t}})^{\varepsilon} w_{\bar{t}}^{\varepsilon+1} = (1 + r) b_{\bar{t}-1} + \frac{g_{\bar{t}}}{2},$$

giving the solutions  $\tau_{\bar{t}}^*(b_{\bar{t}-1}, w_{\bar{t}})$  and  $g_{\bar{t}}^*(b_{\bar{t}-1}, w_{\bar{t}})$ . This problem is solved for each grid point on  $\{b, w\}$ . The opposition party's value can then be calculated via

$$W^{\bar{t}}(b_{\bar{t}-1}, w_t) = \alpha u(g_{\bar{t}}^*, \tau_{\bar{t}}^*) + (1 - \alpha) u(0, \tau).$$

3. Iterate back from  $\bar{t} - 1$  to zero. For each  $t \in [0, \bar{t} - 1]$  the incumbent takes the resulting value functions from the pervious step,  $V^{t+1}(b_t, w_{t+1})$  and  $W^{t+1}(b_t, w_{t+1})$ , as given. The incumbent solves

$$V^t(b_{t-1}, w_t) = \max_{\tau_t, g_t, b_{t+1}} u(g_t, \tau_t) + \beta [pEV^{t+1}(b_t, w_{t+1}) + (1 - p)EW^{t+1}(b_t, w_{t+1})]$$

s.t.

$$b_{t+1} + \tau_t(1 - \tau_t)^{\varepsilon} w_t^{\varepsilon+1} = (1 + r) b_t + \frac{g_t}{2},$$

giving  $\tau_t^*(b_{t-1}, w_t)$ ,  $g_t^*(b_{t-1}, w_t)$  and  $b_t^*(b_{t-1}, w_t)$ . The opposition's value function is given by:

$$W^t(b_{t-1}, w_t) = \alpha u(g_t^*, \tau_t^*) + (1 - \alpha) u(0, \tau_t^*) + \beta [(1 - p)EV(b_t^*, w_{t+1}) + pEW(b_t^*, w_{t+1})].$$

4. Repeat step 3 until  $t = 0$ , or until  $V^t = V^{t+1}$  and  $W^t = W^{t+1}$ , in which case the value functions have converged.

We simulate the model with 1000 grid points for  $b$ , between  $[-2, b_{\max}]$ , where  $b_{\max}$  is the highest level that can be repaid almost surely or the ad hoc debt limit, whichever is smaller. The lower bound on debt (upper bound on assets) is never binding. Eleven grid points are used for  $z$ , giving eleven grid points for  $w = e^z$ . The grid points are chosen using the method of Hussey and Tauchen (1991), whose method we also use to convert the AR(1) process into a discrete Markov chain. The reported simulations have  $\bar{t} = 10,000$  and  $t_{sim} = 1000$ . Moments are calculated using the last 100 periods.

For some parametrizations, the iteration did not converge to stationary value functions. However, the value functions did converge in a neighborhood around the model's stationary distribution. In other words, the lack of convergence had little bearing on the long-run dynamics of the model.

**Table 1**  
**Components of Government Expenditure**  
Average correlation of cyclical component with the cyclical component of GDP

	High-Income Countries	Developing Countries
Total Government Expenditure	-.12	.37
Government Consumption	.21	.23
Government Capital Formation	.29	.30
Government Interest Expenditure	-.07	-.04
	High-Income Countries	Latin America
Social Transfers	-.26	.11

Annual data. Cyclical component estimated using Hodrick-Prescott filter.

Source: IMF WEO, except for interest expenditure from the International Monetary Fund's Government Finance Statistics. Correlations are between 1970 and 2003.

n=81 for developing countries and n=21 for high-income countries, except capital expenditures where the number of observations is for high-income countries drops to 20.

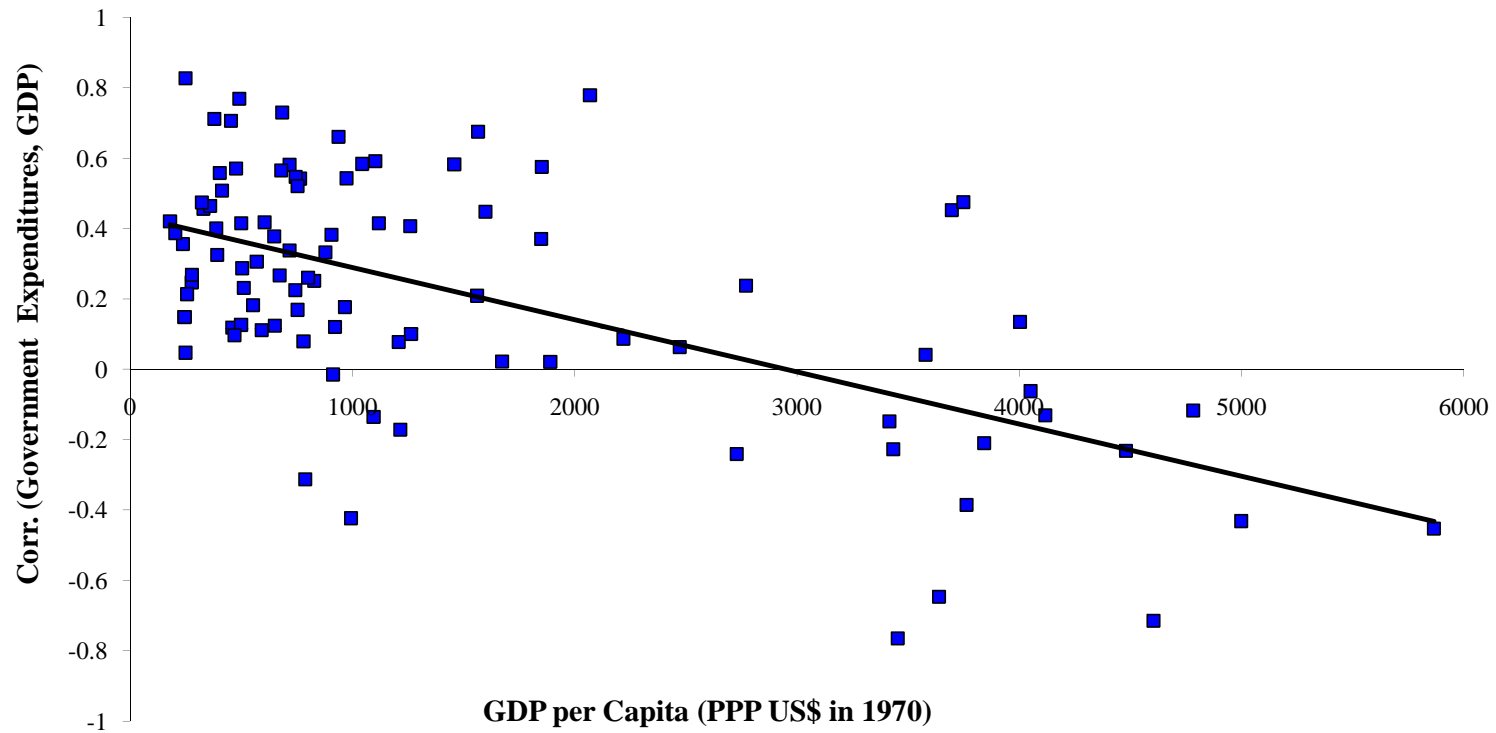
For interest expenditures n=20 for high-income countries and n=66 for developing countries.

For interest expenditures, the time period of the correlation varies from country to country, and in the case of several developing countries only short time periods are available. The cyclicity of interest expenditure is therefore only indicative that the cyclicity of government expenditure is not driven by interest payments, rather than a precise measurement of its cyclicity.

**Table 2**  
**Parameter Values**

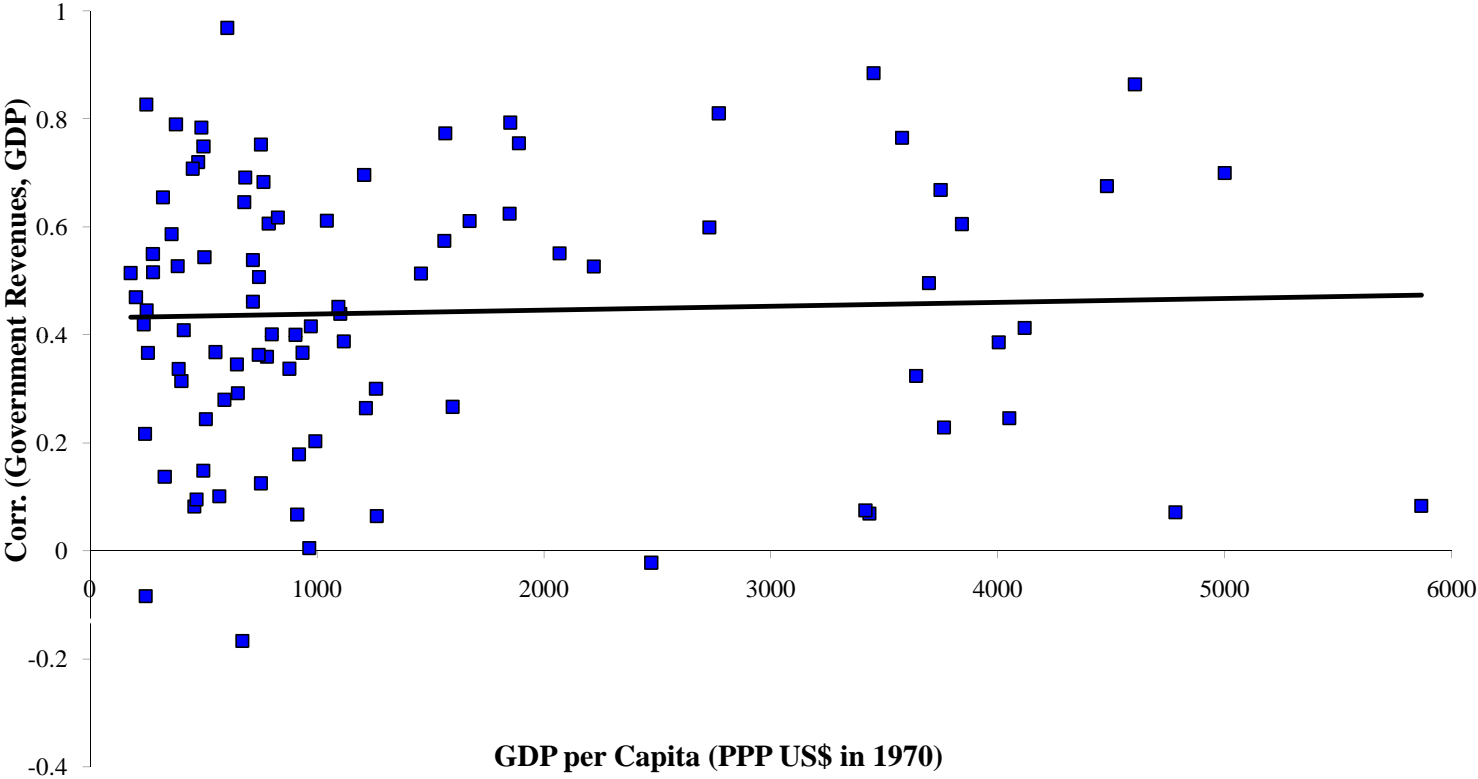
Parameter	Value (U.S./Argentina)	Source
$\sigma$	.0144 / .046	Cooley and Precott (1995), adapted to annual data / Estimate from IMF IFS data
$\rho$	0.81 / 0.69	Cooley and Precott (1995), adapted to annual data / Estimate from IMF IFS data
$\gamma$	2	
$\varepsilon$	1.7	Greenwood, Hercowitz, and Huffman (1998)
$r$	2.40%	Average annual real yield on 10-year U.S. Treasury Bonds (source: IMF)
$\beta$	0.976	Set to match the average debt-to-GDP ratios between 1970 and 2003 of 42% in the U.S. (source: Congressional Budget Office)
$\theta$	0.84	Set to match the averages size of the U.S. Federal government of 18% between 1960 and 2003. (Source: IMF WEO)
$p$	0.9	Probability that the party in power of the presidency in the United States remain in power in a given year in the 20th century (0.91). Similar to the same measure in Argentina (0.87) from 1975 to 2004 (Beck et al, 20000)

**Figure 1: Cyclicity of Government Expenditures and GDP per Capita**



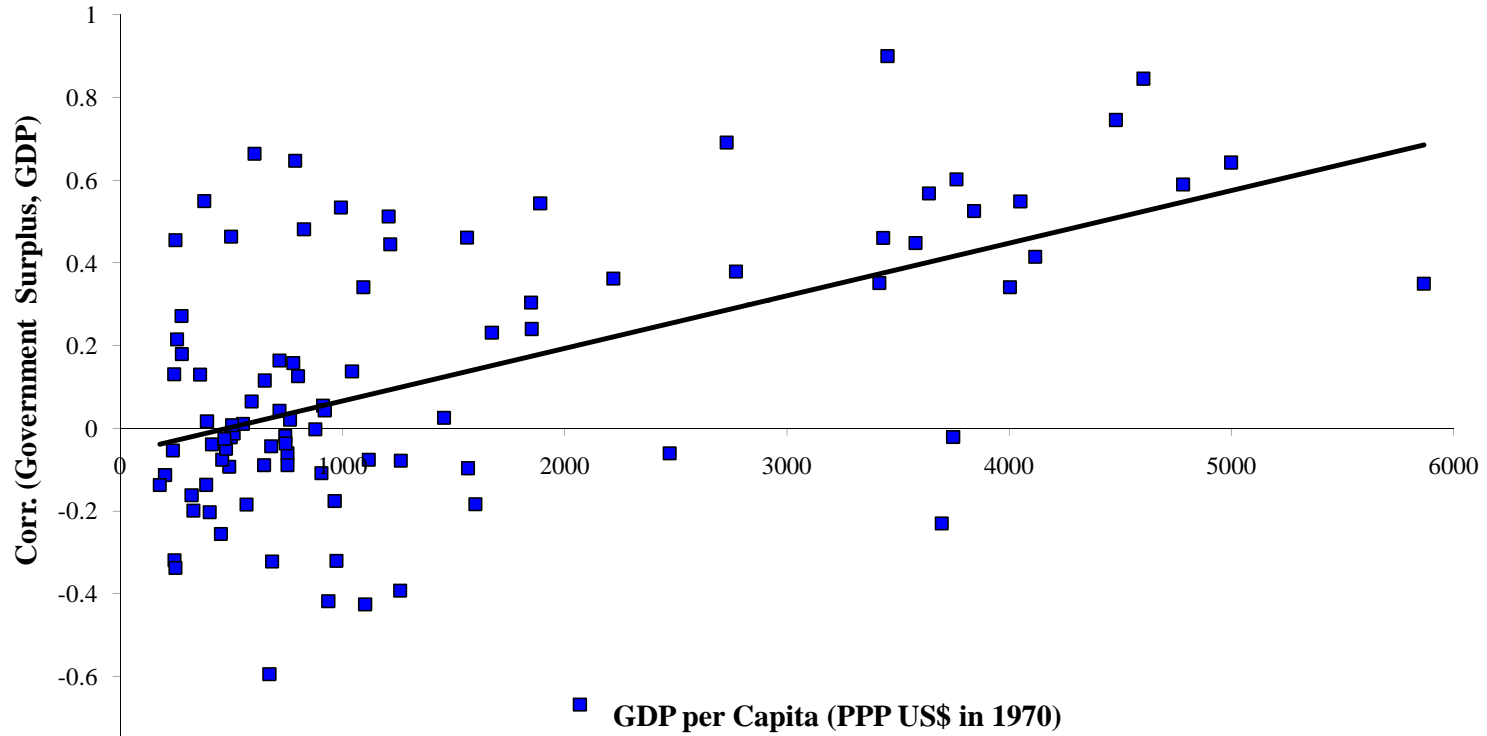
HP-filtered cyclical components of total real central government expenditures and real GDP from 1970 to 2003, using IMF WEO data. PPP GDP per capita in US\$ in 1970 is from the Heston, Summers, and Aten (2002) database.

**Figure 2: Cyclicity of Government Revenues vs. GDP per Capita**



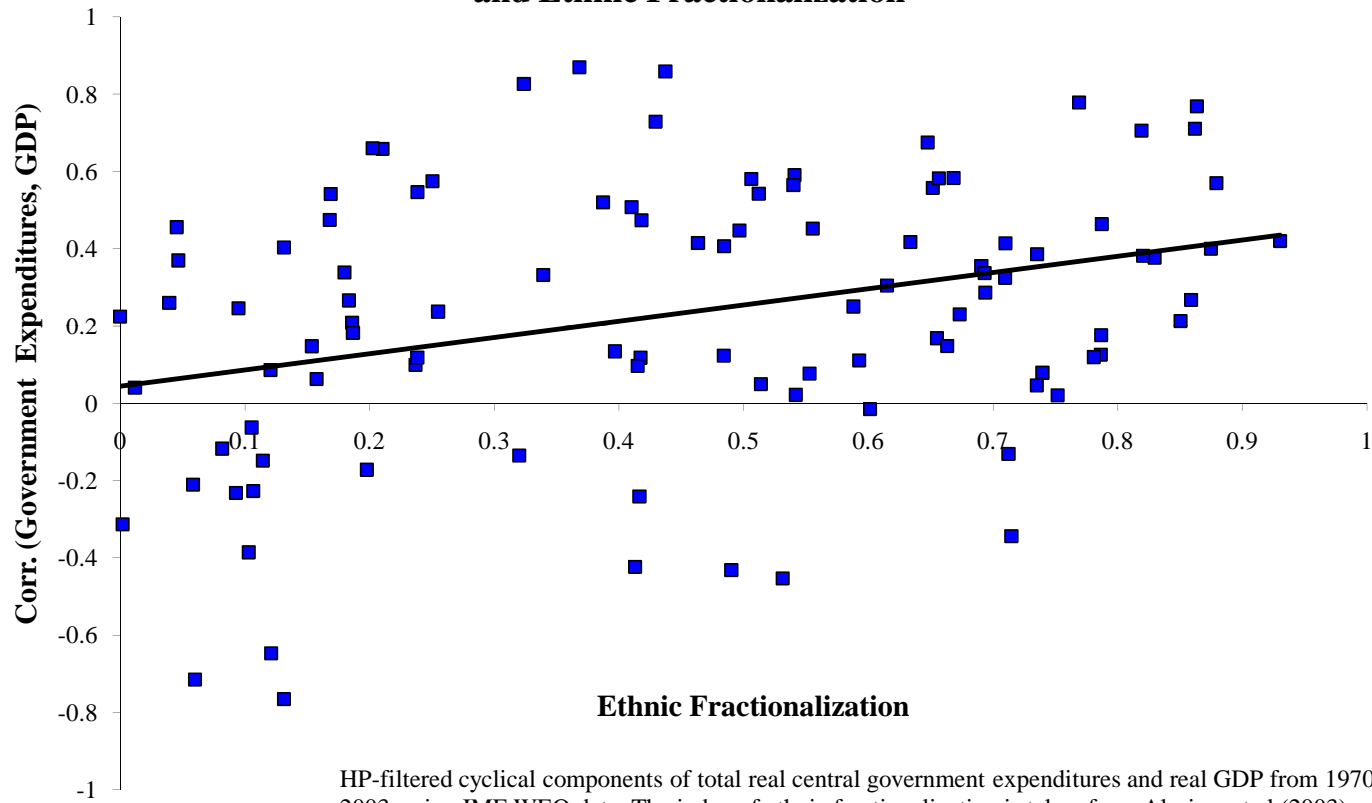
HP-filtered cyclical components of total real central government revenues and real GDP from 1970 to 2003, using IMF WEO data. PPP GDP per capita in US\$ in 1970 is from the Heston, Summers, and Aten (2002) database.

**Figure 3: Cyclicity of Government Surplus vs. GDP per Capita**



HP-filtered cyclical components of total real central government surplus and real GDP from 1970 to 2003, using IMF WEO data. PPP GDP per capita in US\$ in 1970 is from the Heston, Summers, and Aten (2002) database.

**Figure 4: Cyclical components of Government Expenditures and Ethnic Fractionalization**



**Figure 5: Political Structure: Overlapping Constituencies**

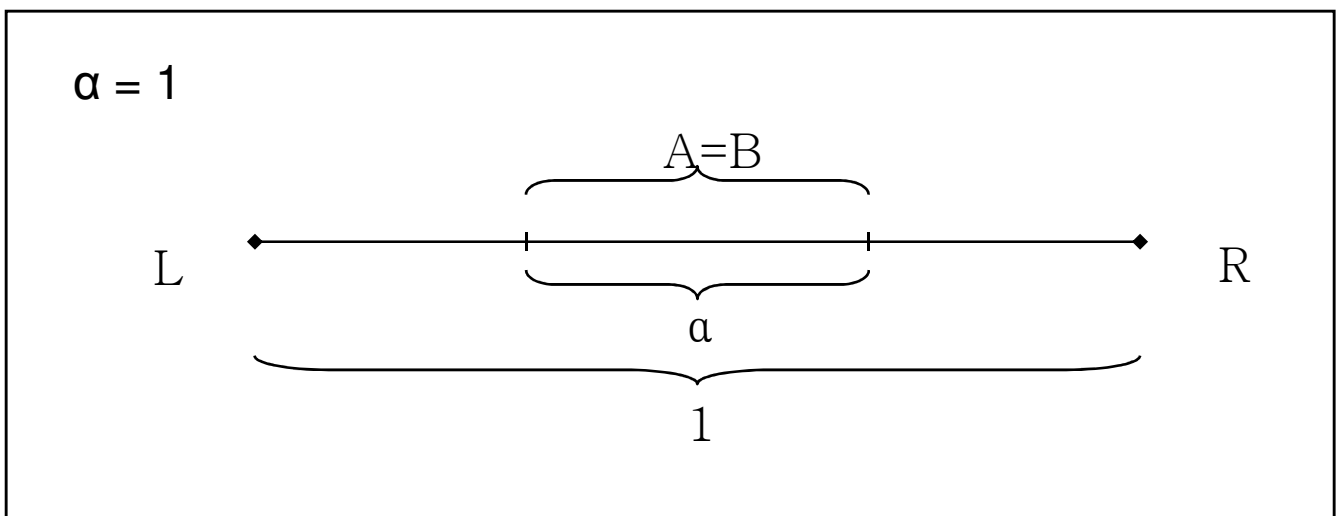
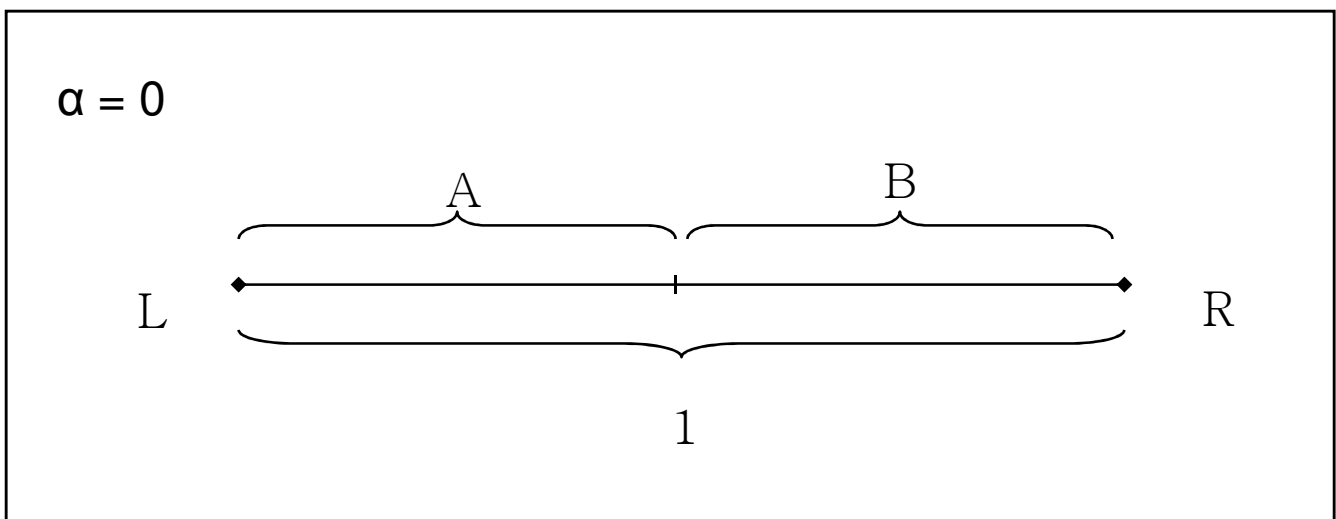
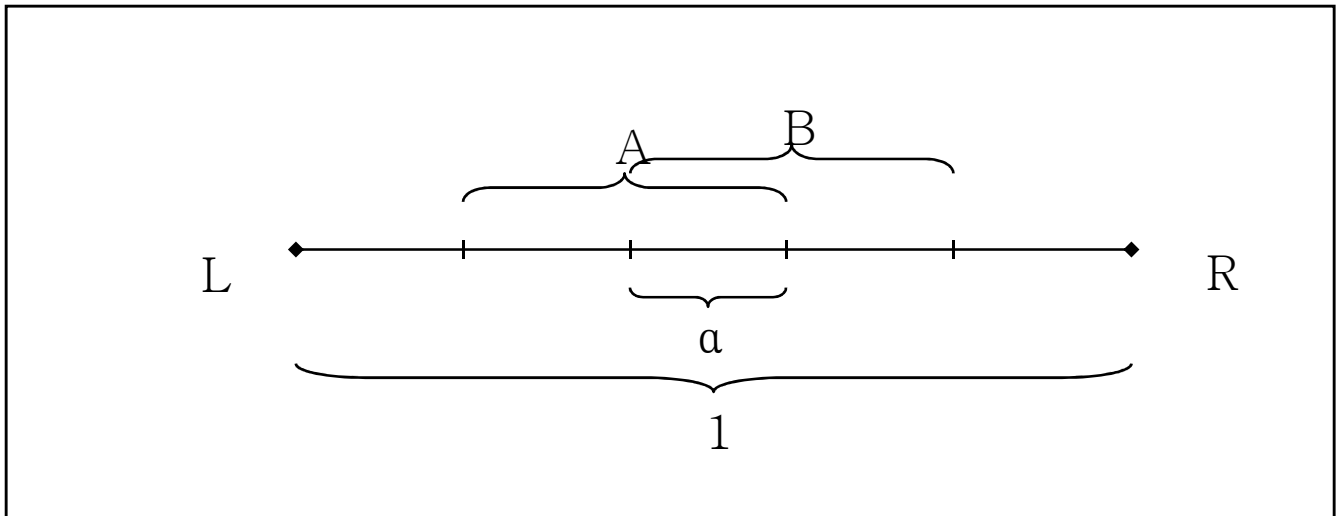


Figure 6: Government Expenditures and Political Cohesion

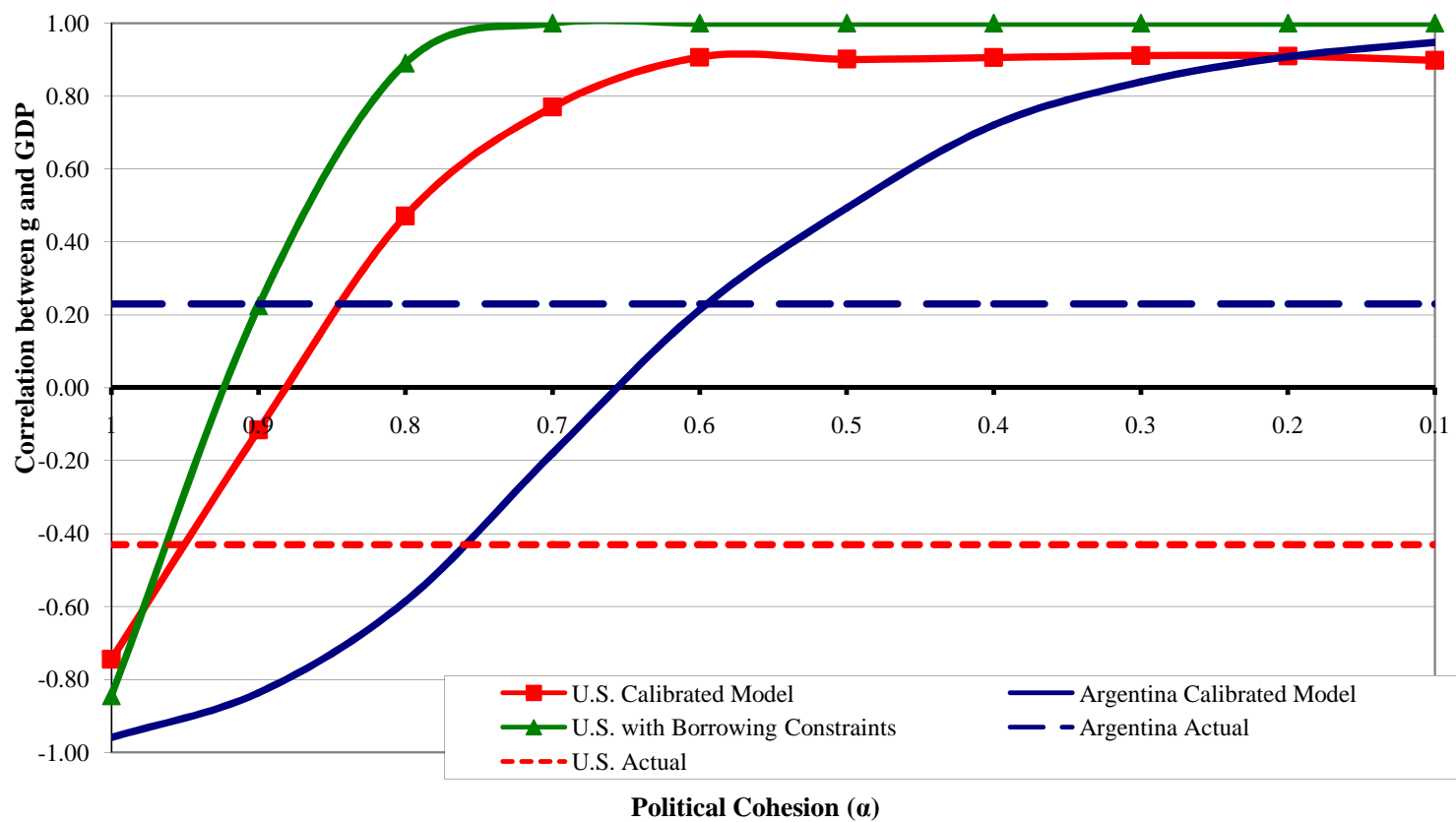
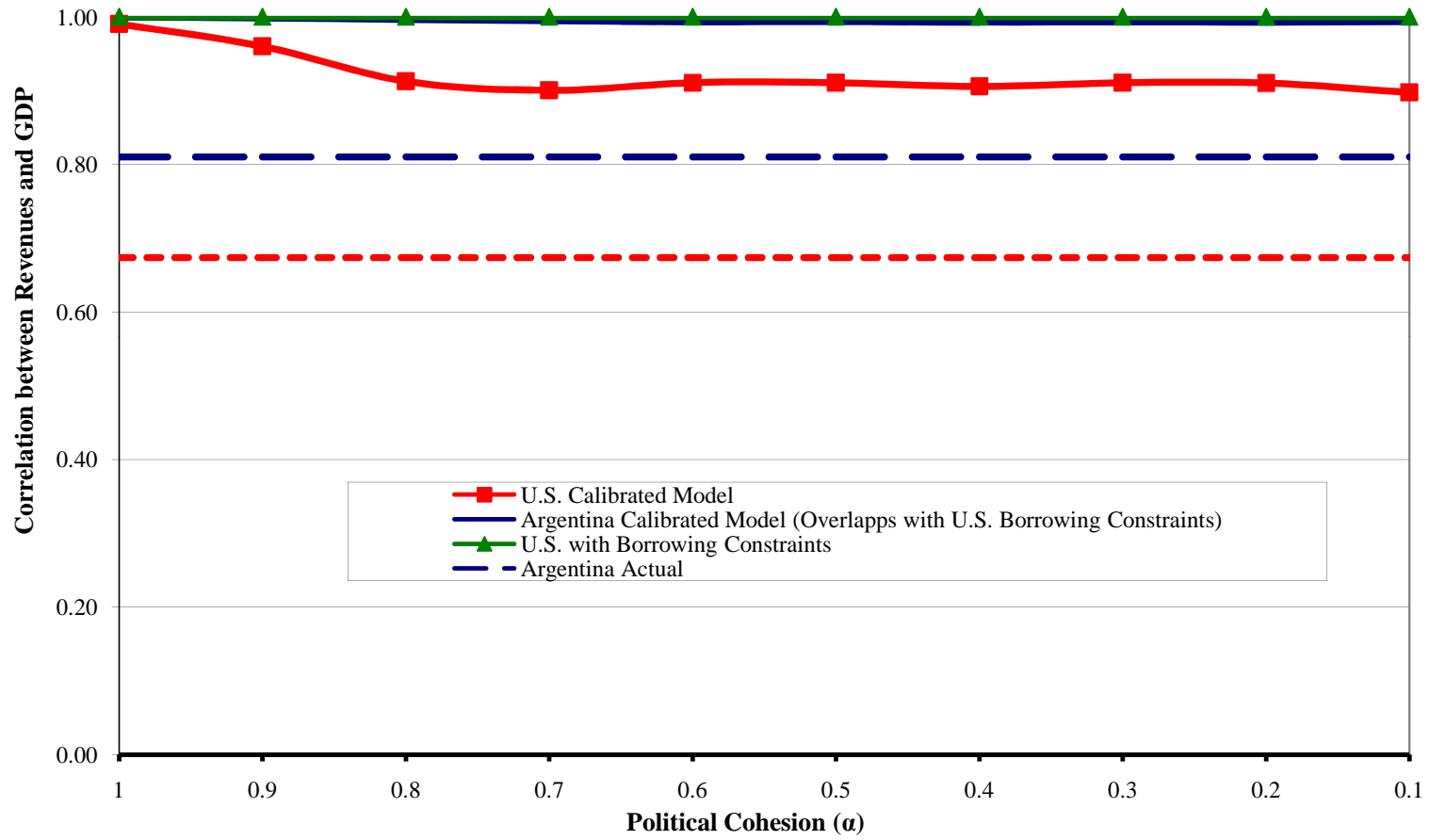
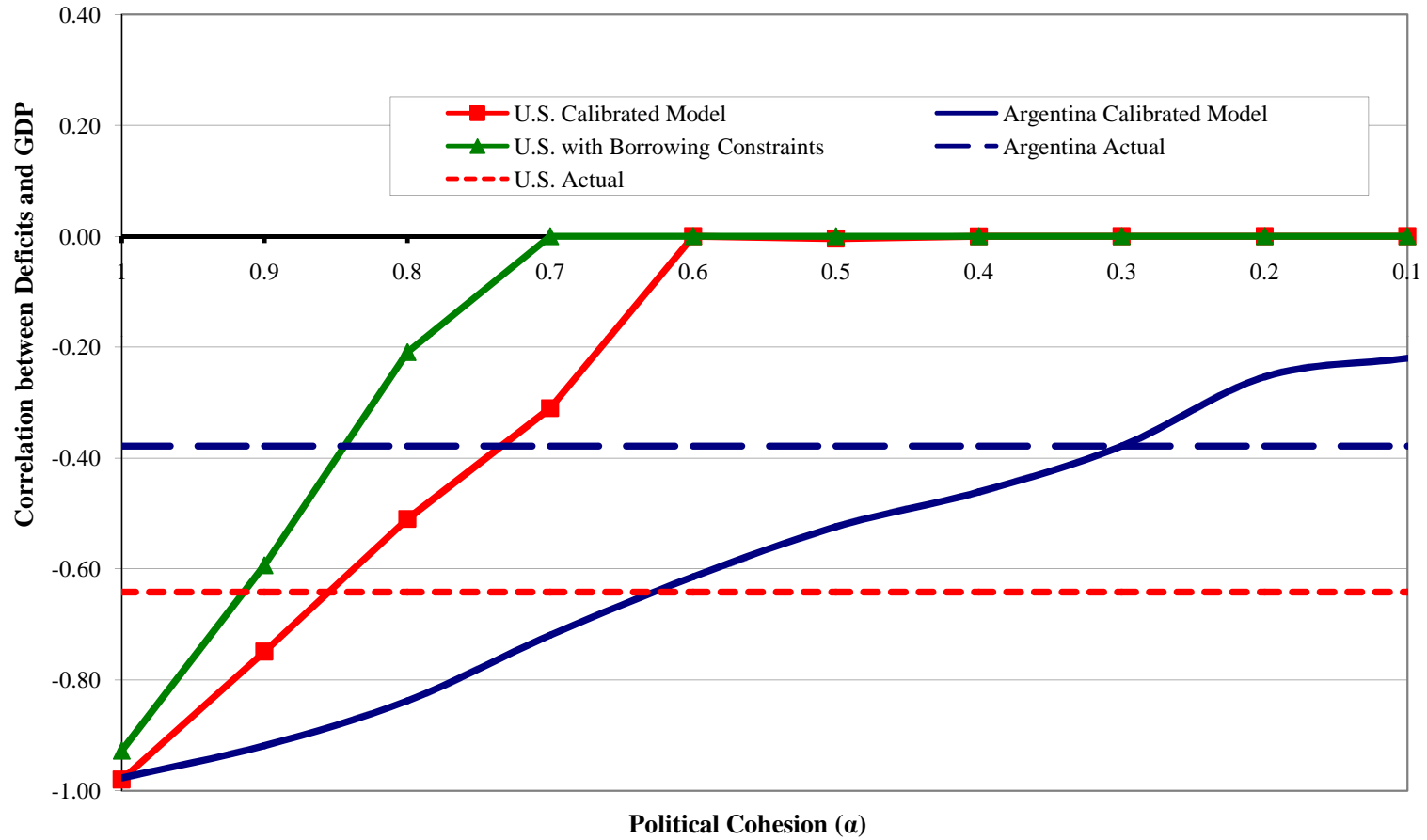


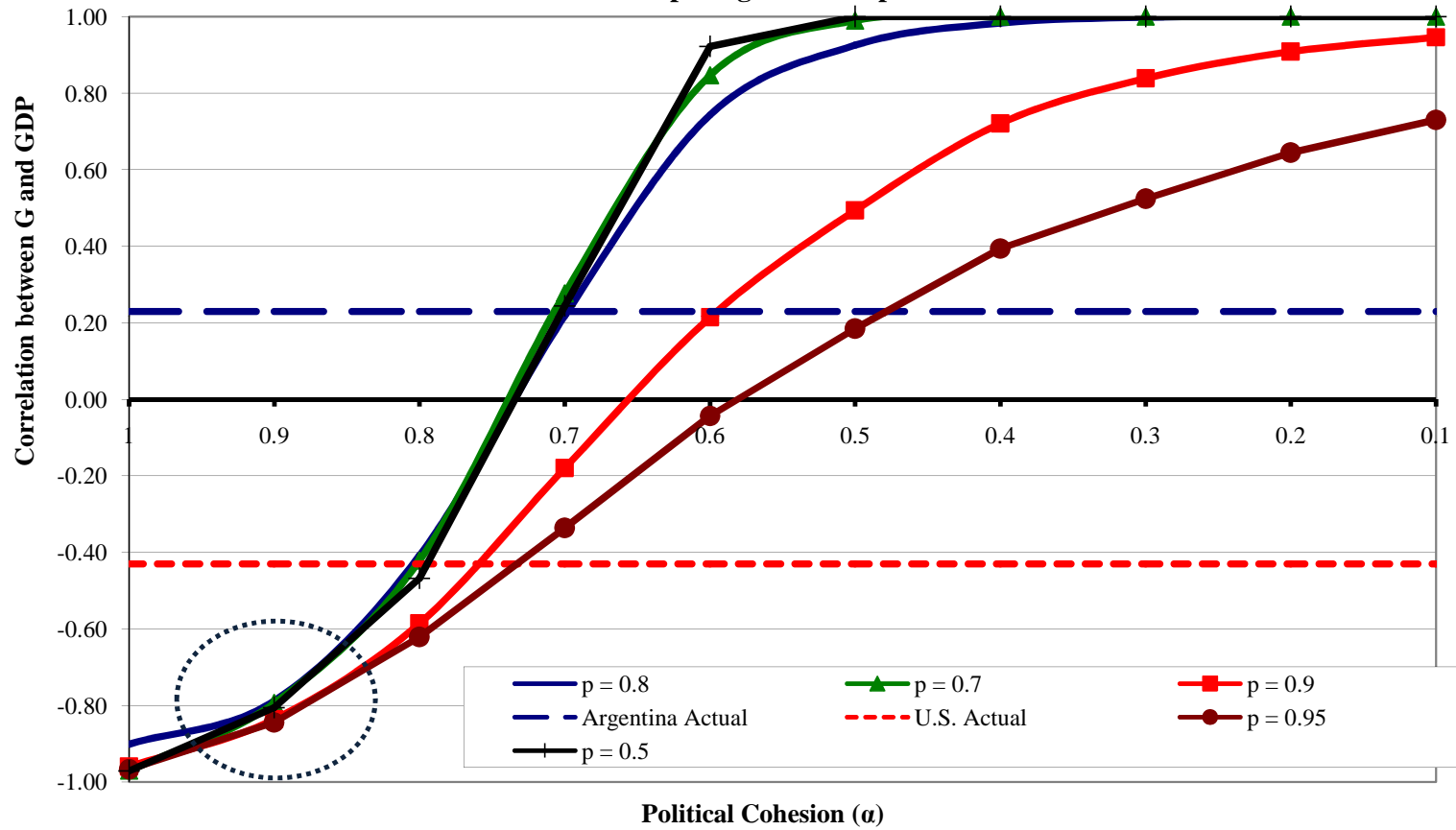
Figure 7: Government Revenues and Political Cohesion



**Figure 8: Government Deficit and Political Cohesion**



**Figure 9: Government Expenditures and Political Cohesion**  
**Comparing Values of p**



**Figure 10: Response of Government Expenditures to Wage Shocks**  
 $\alpha=0.8$  and  $\alpha=0.4$

