

## ABSTRACT

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Several empirical studies have found that government expenditures are procyclical in developing countries, unlike the countercyclical expenditures observed in high-income countries. This dissertation attempts to explain this phenomenon and to refine this empirical observation. It contains two essays. The first provides a dynamic political economy theory of the phenomenon of procyclical fiscal policy. In the model, governments provide public insurance to uninsured households, and time-consistent redistributive policies are countercyclical. The introduction of a political friction, in which alternating governments disagree on the desired redistributive policy, can lead to procyclical

transfer policies. In numerical simulations, the model successfully captures the cyclicity of government expenditures, tax revenues, and deficits observed in the data for both high-income and developing countries. Simulations also allow a quantitative comparison with other common explanations for fiscal procyclicality. Without the political friction, borrowing constraints and differences in macroeconomic volatility cannot account for the differences in fiscal policy across countries in this setting.

The second chapter addresses potential endogeneity problems in the measurement of the fiscal stance. We build a novel quarterly dataset for 49 countries covering the period 1960-2006 and subject the data to a battery of econometric tests: instrumental variables, simultaneous equations, and time-series methods. We find that (i) fiscal policy is indeed procyclical in developing countries and (ii) fiscal policy is also expansionary, lending empirical support to the notion that "when it rains, it pours."

ESSAYS ON FISCAL POLICY IN DEVELOPING COUNTRIES

by

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## CHAPTER 1

### **Rent-Seeking Distortions and Fiscal Procyclicality**

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 chapter is to propose a theory that can account for the difference between fiscal policy in high-income and developing countries. The following chapter will go into more detail on the empirical underpinnings of these stylized facts.

I begin by refining the observations of the existing literature on the cyclicity of fiscal policy. I document that fiscal policy differs across countries mainly in the

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<sup>1</sup>Throughout this chapter, 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 Section 1.1 are based on data from the International Monetary Fund's World Economic Outlook database from 1970 to 2003.

cyclicality of government expenditures, not revenues. Specifically, there are some indications that government transfers are the main countercyclical component of spending in high-income countries.

I propose a model that captures these stylized facts. Because social-insurance programs make up a large share of government transfers in high-income countries, I model the cyclical component of government expenditure as redistributive policies that, *inter alia*, provide public insurance for uninsured households. This gives fiscal policy a countercyclical tendency and I prove that fiscal policy is indeed countercyclical in this model in this setting.

I then attempt to explain why fiscal policy differs in developing countries. A political distortion is studied, in which alternating governments disagree on the desired redistributive policy. I find that as the degree of political polarization increases, *i.e.* as the disagreement between successive governments increases, fiscal policy becomes more procyclical.

The intuition for these results is as follows. Alesina and Tabellini (1990) used a political-economy model of alternating governments with divergent preferences and shows that governments may over-accumulate debt due to this political friction. If the political environment is sufficiently polarized, the governing party's constituency benefits from government spending, but does not fully internalize the

cost of the (current or future) tax burden needed to finance these transfers, because it is borne by the entire polity. I take this logic a step further and study the cyclicity of policies arising from this political structure. In this model, a fiscal agent with time-consistent preferences would conduct countercyclical policies: all households prefer countercyclical transfers to procyclical transfers of the same magnitude, because transfers are valued more in economic downturns. When the political friction is introduced, however, the incumbent is uncertain as to whether his successor will value the same constituency that he does. Thus any savings a government passes on to its successor may be used to benefit a different political faction. This induces governments to save less and spend more when more tax revenues are available, making fiscal policy procyclical. Governments do so even though their own constituents would prefer to receive transfers during downturns.

Quantitative simulations of the model show that as the political structure becomes more polarized, government expenditures become more procyclical and deficits less countercyclical, while tax revenues remain highly procyclical. This captures some cross-sectional features of the data. In the data, government expenditures are countercyclical in high-income countries, but procyclical in developing countries. Deficits are countercyclical in high-income countries, but acyclical in the average developing country. Tax revenues are procyclical in both high-income and developing countries.

Other explanations have been suggested for the phenomenon of fiscal procyclicality in developing countries. The most common is that developing countries face tight borrowing constraints, which limits borrowing during recessions. I question the role of borrowing constraints on two counts. First, this model predicts that borrowing constraints will bind and will affect the cyclicity of government expenditure mainly in business cycle downturns. If borrowing constraints were the cause for fiscal procyclicality, we would expect this phenomenon to be particularly pronounced in economic downturns. In fact, the cyclicity of government expenditure observed in the data appears to be symmetric in peaks and troughs. Second, simulations of the model show that borrowing constraints have no effect on the cyclicity of fiscal policy, when the political friction is not present. This result holds although borrowing constraints are binding in half of the simulation periods.

Others have suggested that fiscal policy may differ across income lines because developing countries face more volatile income shocks or a more volatile tax base. In contrast, this model predicts that fiscal policy will be more 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.

Section 1.1 presents the basic stylized facts on the cyclicity of fiscal policy in high-income and developing countries. A review of the literature follows in Section

1.2. The model is presented in Section 1.3 and is simulated in Section 1.4, which presents this chapter's main results. Section 1.5 concludes.

### 1.1. Stylized Facts

I begin by documenting the stylized facts on the cyclicity of fiscal policy in high-income and developing countries. Kaminsky, Reinhart and Végh (2004) have shown that government expenditures are countercyclical in high-income countries, but procyclical in 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 stylized facts. Figures 1.1-1.3 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 1.1. 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 trend, using a Hodrick-Prescott (HP) filter. The negative correlation between the degree of procyclicality and income per capita is apparent and is statistically significant at the 99 percent confidence level.

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 counter-cyclical 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 1.2 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>2</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 1.3. Surpluses in developing countries are acyclical on average.

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<sup>2</sup>Income classifications by the World Bank began only in 1989, so it is impossible to determine which 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. Based on this classification, 20 percent of all countries in the sample are high-income countries today. In this discussion, the 20 percent of the top countries in terms of income per capita in 1970 are considered high-income countries. This happens to perfectly coincide with the countries that are high-income countries in 2007. In interpreting figures I-III, countries with per-capita PPP GDPs of over \$2400 in 1970 are high-income countries.

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 separately. Table 1.1 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>3</sup> Interest payments are acyclical, on average, in both income groups.<sup>4</sup> The main remaining component of total government expenditure is transfer payments. Transfer payments 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 1.1 gives some suggestive evidence. I find that social transfers are countercyclical in high-income countries, but procyclical in Latin America.<sup>5</sup> While social transfers may not be representative of other types

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<sup>3</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 relationships. A more sophisticated empirical analysis in the following chapter shows that government consumption may be more procyclical in developing countries than in high-income countries.

<sup>4</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.

<sup>5</sup>Social transfers are defined as transfers that fall into the "Social Protection" category according to the United Nation's Classification of the Functions of Government (COFOG). More details on this classification is available at <http://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=4>. The

of transfer payments, it is nevertheless interesting that unlike the other budgetary components listed in Table 1.1, the cyclicity of social transfers differs substantially between high-income and Latin American countries.

Focusing on developing countries, Table 1.2 compares the cyclicity of total government spending during periods in which GDP is above the HP filter trend to those that are below the trend. The difference between these two correlations is not statistically significant, indicating that government spending is no less correlated with the business cycle in good times than it is in bad times. When excluding crisis years, defined as those years when the cyclical component of output dropped by more than two standard deviations, the procyclicality of government expenditure drops by a statistically insignificant margin. In fact, during several recent output drops of this magnitude (e.g. Turkey in 2001 and Argentina in 2002) government spending was above-trend, reflecting these countries' ability to conduct countercyclical policies during some deep recessions. There is no evidence that the procyclicality of government expenditure is restricted to cyclical downturns, or particularly driven by these episodes.

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dataset was assembled by Michel Strawczynski of the Bank of Israel. The original data sources are the OECD for OECD countries and the Inter-American Development Bank for Latin American countries. All high-income OECD countries are included. The Latin American countries included are Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Panama, Paraguay and Uruguay.



So far, I have classified countries based on their per-capita income. The theory that follows predicts that fiscal policy will be more procyclical in more polarized political environments as well as in environments with higher political turnover. Using the index of ethnic fractionalization of Alesina et al (2003), Figure 1.4 shows that government expenditures are more procyclical in countries with more ethnically fragmented 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>6</sup> Table 1.3 presents this stylized fact differently: countries where fiscal policy is procyclical are more fragmented along ethnic lines than those conducting countercyclical policies. The difference is sizable and statistically significant at the 99 percent confidence level. Finally, Table 1.4 shows the results of a multivariate regression, where I regress the cyclicity of government expenditure on

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<sup>6</sup>Fiscal policy does not appear to be related to religious fractionalization—an additional measure in the Alesina et al (2003) database.

GDP per capita, the index of ethnic fractionalization, and the International Country Risk Guide's (ICRG) measure of government stability. The latter is intended to capture the degree of government turnover, which will play an important role alongside political polarization in predicting procyclical fiscal policies in the theory that follows. While the political and social factors do not capture the entire heterogeneity in fiscal procyclicality across countries of different income levels, ethnic fractionalization (significant at the 5 percent confidence level) and to a lesser extent government instability (significant only at 10 percent confidence level) remain important in explaining procyclical fiscal policies, after controlling for income per capita.<sup>7</sup>

## 1.2. Literature Review

Gavin and Perotti (1997) and Kaminsky, Reinhart and Végh (2004) provide evidence of the procyclicality of fiscal policies in developing countries. Additional

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<sup>7</sup>This regression is merely indicative, and may perhaps understate the role of political polarization in explaining fiscal procyclicality. As I mentioned, there are other dimensions along which a polity may be polarized, for which indices are not readily available. Alesina, Campante and Tabellini (2008) and an earlier version of this paper (Ilzetzki, 2006) show that corruption is an important factor in explaining fiscal procyclicality. Alesina and Zhuravskaya (2008), however, show that political segregation (a parameter that is closely related to political polarization) is an important determinant of corruption. Controlling for democracy does not alter these results. Unlike Alesina, Campante and Tabellini (2008), I find that democracy is negatively correlated with procyclical fiscal policies, although this relation is only significant at the 90 percent confidence level. An attempt to control for corruption in addition to ethnic fractionalization and government stability leaves all variables statistically insignificant, presumably due to the multicollinearity between corruption and the political variables studied here.

empirical work by Lane (2003) and Alesina, Campante and Tabellini (2008) shows that political distortions play a role in explaining fiscal procyclicality. Studying OECD countries, the former shows that fiscal policy is more procyclical in more fragmented political systems. The latter show that after controlling for a measure of corruption, fiscal policy's cyclicity is no longer correlated with income per capita. They also show that financial market frictions have little explanatory power for the cyclicity of fiscal policies.

A number of explanations have been proposed for the phenomenon of fiscal procyclicality. Three factors are prominent in discussions on this topic. First, 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 either to cut expenditures or to 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. Cuadra, Sanchez and Sapriza (2009) study the role of credit risk in a quantitative model. 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.

Second, it has been suggested that the procyclicality of fiscal policy in developing countries may be an optimal reaction to the different stochastic environments confronting developing countries. 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.

Third, a number of theories suggest that political distortions may cause fiscal procyclicality. The theory in this paper falls into this category. Talvi and Végh (2005) show that political distortions based on Tornell and Lane's (1999) "voracity effect" may cause procyclical policies. In their taxation model, governments that are unable to run fiscal surpluses due to political factors may diverge from the common tax-smoothing prescription. In contrast to their model, which focuses on the cyclicity of tax policy, this model predicts differences in government expenditure policies, consistent with the stylized facts presented in Section 1.1.

Alesina, Campante and Tabellini (2008) develop a voting model, in which fiscal procyclicality is a side effect of voters' attempts to discipline rent-seeking officials. In their model, households demand higher transfers at business cycle peaks, knowing that the government will extract rents if resources are left idle. The political mechanism underlying the Alesina, Campante and Tabellini (2008) result is

a de-facto dynamic contract between the polity and rent-seeking politicians. The political structure in this model is different. There is no conflict of interest between the government and its constituency. Instead, it is successive governments that disagree on how to target expenditures. This paper also differs from Alesina, Campante, and Tabellini (2008) in that I provide a quantitative assessment of my theory.

Battaglini and Coate (2008a, 2008b) study the cyclical properties of fiscal policy in a dynamic version of Baron and Ferejohn's (1989) legislative bargaining model. Azzimonti, Battaglini and Coate (2008) analyze this framework quantitatively. In their real business cycle (RBC) framework, Battaglini and Coate (2008b) predict procyclical fiscal policies. While the political structure I study is different from theirs, the underlying political mechanism is similar. In both cases, the political inefficiency is a dynamic common pool problem. In this paper, successive governments do not fully internalize the costs of transfers to their constituency, while in Battaglini and Coate (2008a, 2008b) it is legislative coalitions that do not take in account the social costs of pork barrel spending. My theory differs from theirs in two ways. First, Battaglini and Coate's (2008a, 2008b) theory is primarily geared to explaining fiscal policies in the United States and countries with similar political structures. Here, I am interested in comparisons of fiscal policy across countries. Also, in Battaglini and Coate (2008a, 2008b), households are risk neutral, so that

their framework gives no reason why fiscal policies may ever be countercyclical. In fact, in Battaglini and Coate (2008b), government expenditures are procyclical even when the political distortion is absent, so that optimal fiscal policy is procyclical. In this model, the ruling party faces a trade-off between its constituents' desire for countercyclical policies with its desire to discipline its successors.

This paper provides a new political economy explanation for fiscal procyclicality, but also makes a unique contribution to the literature by presenting a macroeconomic model that allows for all three proposed explanations for fiscal procyclicality and that lends itself to a comparative quantitative analysis of the three theories.

### **1.3. The Model**

This section describes the model and includes some basic analytical results, showing that time-consistent fiscal policy is countercyclical. The following section shows through numerical simulations that fiscal policy becomes more procyclical as the degree of political polarization increases. I begin by describing the model's economic environment and then describe the political structure.

### 1.3.1. 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 except for their political characteristics, and thus potentially differ only in the public policies they face. Households value consumption,  $c_t^i$ , and dislike supplying hours worked,  $h_t^i$ . In each period, they obtain a wage  $w_t$  (identical across households) per hour worked. Wages follow a Markov process with support  $[\underline{w}, \bar{w}]$ .

Households choose their labor contribution and consumption in each period. They do not have access to financial markets. This is a simple way to motivate government insurance for the private sector. The government uses its ability to borrow and save in international financial markets to provide intertemporal insurance for households.

Modeling fiscal policy in such a way has several advantages. First, we have seen that the main source of countercyclicality in the spending behavior of governments in high-income countries is government transfers, of which social insurance programs are a large component. Second, fiscal policy used for this purpose will tend to be countercyclical. This biases the model against procyclical policies, a bias that the political distortion introduced here 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>8</sup>

Household labor income is taxed at a uniform, proportional tax rate  $\tau_t$ . As we will discuss in the following subsection, the government cannot discriminate between households in its tax policy. It can, however, discriminate between households in its targeted transfers  $T_t^i \geq 0$ .

A household  $i$  chooses consumption and hours worked in each period to maximize its expected lifetime utility. Its preferences over consumption and hours worked are:

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

where period utility takes the form proposed by Greenwood, Hercowitz and Huffman (1988):

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

These preferences are useful for the purposes of the current study. Labor supply decisions are not dependent on households' wealth, which increases analytical

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<sup>8</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.



tractability. This also implies that transfers  $T_t^i$  are not distortionary, while taxes  $\tau_t$  affect the labor supply decisions of households in both groups<sup>9</sup>.

Household  $i$  chooses  $c_t^i$  and  $h_t^i$  in each period to maximize its lifetime utility subject to its budget constraint:

$$c_t^i = (1 - \tau_t) w_t h_t^i + T_t^i \quad (1.1)$$

Given that households have no access to credit markets, their optimization problem is static in each period, yielding the following labor-supply schedule:

$$h_t = h_t^i = [(1 - \tau_t) w_t]^\varepsilon \quad \forall i. \quad (1.2)$$

The first equality reflects that labor contributions are uniform across household types.

Substituting (1.1) and (1.2) into households' preferences, the following indirect period utility function is obtained:

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

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<sup>9</sup>This is important in forcing the government to internalize the distortionary cost of taxation: sufficiently high transfer payments could decrease the labor contributions of transfer recipients to the extent that they no longer share the burden of distortionary taxes.

The marginal utility of the transfer payment is equal to the marginal utility of consumption, which I denote

$$\lambda_t^i \equiv \tilde{u}_c^i = u_T^i = \left[ \frac{[(1 - \tau_t) w_t]^{\varepsilon+1}}{\varepsilon + 1} + T_t^i \right]^{-\gamma}. \quad (1.3)$$

The marginal (dis-) utility of taxes is

$$u_\tau^i = -w_t^{\varepsilon+1} (1 - \tau_t)^\varepsilon \lambda_t^i. \quad (1.4)$$

### 1.3.2. Political Structure

There are two political factions  $A$  and  $B$ . Each values the welfare of half the population<sup>10</sup>. The two parties alternate in power, with  $p$  denoting the probability that the incumbent remains in power in the following period. Each faction maximizes a social welfare function that places an equal weight on the welfare of each member of its constituency. The constituencies of the two parties may be partially overlapping, with  $\alpha \in [0, 1]$  denoting the fraction of each constituency that also belongs to the constituency of 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

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<sup>10</sup>The constituency size is without significant loss of generality. As I discuss below, an appropriate calibration of the constituency size would lead to a value of approximately one half. Moreover, this constituency size is appealing a priori, as it could be interpreted as the size of a minimum winning coalition in a democratic context. When the political distortion is present, a smaller constituency size makes fiscal policy more procyclical, all else equal.

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. There is disagreement between the two parties as to the desired redistributive policy, 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>11</sup> The top panel in Figure 1.5 illustrates the political structure. The bottom two panels of the same figure present the special cases of  $\alpha = 0$  and  $\alpha = 1$ . The interests of each political faction are fully aligned with their constituencies, so that I also use the labels  $A$  and  $B$  to refer to the two constituencies as well.

Similar alternating-government structures have been used in a number of political economy studies. Alesina and Tabellini (1990) study how political distortions affect steady-state deficits. They find that both the frequency of political turnover and the degree of political polarization increase the steady state level of debt. Amador (2003) uses a similar framework to show that political distortions may help sustain agreement between a sovereign debtor and international

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<sup>11</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.  $\alpha \in [\frac{1}{2}, 1]$  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  $\alpha$ . Both structures yield qualitatively similar results. However the notation used here simplifies analysis, given that each faction only transfers to its own constituency when in power.

creditors. Cuadra and Sapriza (2008) show that this structure can explain the frequency of default and the magnitude of sovereign spreads in politically polarized and politically volatile environments. Azzimonti (2005) uses this framework to explain the under-accumulation of capital in developing countries. Her study also contributes to this literature by showing that this simple alternating-government framework follows from a model with political microfoundations based on Lindbeck and Weibull's (1993) probabilistic voting model. She shows that as long as neither party has a structural electoral advantage, the probability of re-election  $p$  will be constant across time, even if voters take the state of the economy into consideration in their electoral decisions.

While the terminology used here implies a democratic transition of government, transitions of power between conflicting ethnic, ideological, or interest groups occur in non-democracies as well, so that the theory presented here need not restrict discussion to democracies alone.

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 and 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 incumbent provides a required

(constant) level of government consumption  $g$ .<sup>12</sup> Tax revenues are accumulated through a tax  $\tau_t^i = \tau_t$  on labor income that is equal across households. The government can, however, discriminate between households in its choice of transfer payment  $T_t^i \geq 0$ . It is straightforward to show that the optimal transfer policy involves an equal transfer payment  $T_t^i = T_t$  to each household in the government's constituency, and a transfer of zero to all other households. The government can borrow and save freely in international capital markets at an exogenous and constant interest rate  $r$ . Debt contracts are fully enforceable; I abstract from the question of sovereign default in this discussion<sup>13</sup>. Government consumption is acyclical by assumption, so that total government expenditure, given by  $g + \frac{T}{2}$ , is perfectly correlated with transfers in the model.

The incumbent maximizes a social welfare function that puts equal weight on each constituent household. The welfare function is here normalized by the size of the constituency.  $V(b_{t-1}, w_t)$  represents the highest value that the governing party

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<sup>12</sup>Government consumption plays no role in this model and setting  $g = 0$  does not affect any of the results herein. It is useful to include  $g$  for quantitative simulations of the model, where  $g$  is chosen to match the average level of government consumption observed in the data.

<sup>13</sup>Introducing a time-varying interest rate may in itself affect the cyclicity of fiscal variables, depending on the cyclicity of government's borrowing rate. Allowing for an interest rate schedule that is increasing in the government's outstanding debt does not affect any of the paper's results. However, the analysis of Cuadra, Sanchez and Saprizza (2009) implies that a borrowing rate that is determined by the government's default probability could in and of itself cause fiscal policy to become procyclical.

can achieve when entering period  $t$  with the state of nature given by  $\{b_{t-1}, w_t\}$ :

$$V(b, w) = \max_{\tau, T, b'} u(T, \tau) + \beta [pEV(b', w') + (1-p)E\Omega(b', w')] \quad (1.5)$$

subject to

$$b' + w^{\varepsilon+1}\tau(1-\tau)^\varepsilon = \frac{T}{2} + (1+r)b + g, \quad (1.6)$$

$$T \geq 0, \quad (1.7)$$

where  $b \equiv b_{t-1}$ ,  $b' \equiv b_t$ , and  $w' \equiv w_{t+1}$ . Time  $t$  subscripts have been suppressed.  $\tau_t w_t h_t = w_t^{\varepsilon+1} \tau_t (1 - \tau_t)^\varepsilon$  are government revenues, using (1.2).  $\Omega(b, w)$  gives the value of being out of power.

The government also faces a borrowing constraint. This constraint may be exogenous and ad hoc, or it may be a natural debt limit as in Aiyagari's (1994). 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, while taxing at the peak of the Laffer curve. The revenue-maximizing tax rate is a constant and is given by:

$$\tau_{Laffer} \equiv \frac{1}{\varepsilon + 1}.^{14}$$

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<sup>14</sup>This is the solution to the unconstrained revenue maximization problem:

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

It is never optimal for the government to choose a tax rate that exceeds this rate, as there is always a lower tax rate that generates the same amount of revenues at a lower utility cost to all households. Using this result, the borrowing constraint can be written as:

$$b_t \leq \min \left\{ \bar{b}, \underline{w}^{\varepsilon+1} \frac{\varepsilon^\varepsilon}{r(\varepsilon+1)^{\varepsilon+1}} \right\}, \quad (1.8)$$

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 member. This leads to the following value of being in opposition:

$$\begin{aligned} \Omega(b, w) = & \alpha u(T^*(b, w), \tau^*(b, w)) + (1 - \alpha) u(0, \tau^*(b, w)) \quad (1.9) \\ & + \beta [(1 - p) EV(b^*(b, w), w') + pE\Omega(b^*(b, w), w')], \end{aligned}$$

where  $T^*(b, w)$ ,  $\tau^*(b, w)$  and  $b^*(b, w)$  are respectively the transfer, tax and debt policies chosen by the incumbent. This equation 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  $T^*(b, w)$  and  $\tau^*(b, w)$  chosen by the incumbent for its own constituents. The remaining portion  $\frac{1-\alpha}{2}$  receives no transfer, but is taxed at the same (non-discriminatory) rate  $\tau^*(b, w)$ .

A key to understanding the model's dynamics is the non-negativity constraint on transfers (1.7). When the public debt burden is sufficiently high, this constraint is binding, as the government sacrifices its redistributive objective in order to reduce the debt burden. Given that the government must impose the same tax rate on its constituents as on the population at large, servicing the debt ultimately requires a tax rate so high that the government prefers reducing the debt burden to redistributing income in favor of its constituents. I therefore refer to states of nature in which the non-negativity constraint on transfers is binding as a *fiscal crisis*. In all other periods, which I refer to as the *redistributive regime*, the government redistributes in favor of its constituency.

The first order conditions of the government's maximization problem can be reduced to two equations. (For the moment, consider the case where the borrowing limit (1.8) is non-binding.) The first reflects intratemporal optimization in the choice of the tax rate and transfer payment:

$$\frac{1}{2} = \frac{1 - \tau - \varepsilon\tau}{1 - \tau} + \frac{\mu}{\Lambda}, \quad (1.10)$$

where  $\Lambda$  and  $\mu$  are the Lagrange multipliers on the government's budget constraint and the non-negativity constraint on transfers, respectively. This equation implies a baseline tax rate  $\tau^T$  in the redistributive regime (when the transfer payment is



provided and  $\mu = 0$ ):

$$\tau^T \equiv \frac{1}{1 + 2\varepsilon}. \quad (1.11)$$

The tax rate may exceed its baseline level during a fiscal crisis (when  $\mu > 0$ ). Note that these last two equations do not contain the political parameters  $\alpha$  or  $p$ . Thus intratemporal optimization is not affected by the political distortion in the static sense. However, an additional condition relates  $\Lambda$ , the Lagrange multiplier on the government's budget constraint, to the marginal utility of consumption of households in the incumbent's constituency:

$$\Lambda = \frac{1 - \tau}{1 - \tau - \varepsilon\tau} \lambda^A, \quad (1.12)$$

where without loss of generality, faction  $A$  is assumed to be the incumbent, so that  $\lambda^A$  gives the marginal utility of consumption of households in group  $A$ , given by (1.3).

Finally, the first order condition with respect to  $b'$  gives the following intertemporal optimality condition:

$$\Lambda + \beta [pEV_b(b', w') + (1 - p)E\Omega_b(b', w')] = 0, \quad (1.13)$$

With these equations in mind, I now turn to an analysis of the model's dynamics.

### 1.3.3. Dynamic Analysis

In analyzing the model's dynamics, I start from the benchmark cases  $p = 1$  and  $\alpha = 1$ , in which the political distortion is not present. I then define an equilibrium for the model and analyze the model's dynamics more generally. Further analysis of the model's dynamics require computational methods, to which I turn in Section 1.4.

**1.3.3.1. Time Consistent Policy (p=1).** First, consider the case of a time-consistent policy maker, one that remains in power indefinitely. In this case fiscal policy will be countercyclical. Proposition 1 proves that the debt burden will be countercyclical, and the discussion that follows explains why one might expect transfers to be countercyclical and tax rates to be procyclical.

Without loss of generality, let the current decision maker's constituency be group  $A$ . The government's problem becomes a standard time-consistent dynamic optimization problem. In this case (1.13) becomes a standard Euler equation:

$$\Lambda = \beta (1 + r) E\Lambda', \quad (1.14)$$

where I have used the envelope condition:

$$V_b(b, w) = -(1 + r) \Lambda. \quad (1.15)$$

(1.14) gives an Euler equation as in a standard consumption-savings problem.

Writing the equation explicitly using (1.12) gives:

$$\begin{aligned} & \frac{1 - \tau_t}{1 - \tau_t - \varepsilon\tau_t} \left[ \frac{w_t^{\varepsilon+1} (1 - \tau_t)^{\varepsilon+1}}{\varepsilon + 1} + T_t \right]^{-\gamma} \\ = & \beta (1 + r) E_t \left\{ \frac{1 - \tau_{t+1}}{1 - \tau_{t+1} - \varepsilon\tau_{t+1}} \left[ \frac{w_{t+1}^{\varepsilon+1} (1 - \tau_{t+1})^{\varepsilon+1}}{\varepsilon + 1} + T_{t+1} \right]^{-\gamma} \right\}. \end{aligned} \quad (1.16)$$

It is easy now to see why the benchmark fiscal policy is countercyclical. Just as consumers smooth consumption in a consumption-savings problem, the government in this problem will attempt to smooth  $\Lambda_t = \frac{1 - \tau_t}{1 - \tau_t - \varepsilon\tau_t} \left[ \frac{w_t^{\varepsilon+1} (1 - \tau_t)^{\varepsilon+1}}{\varepsilon + 1} + T_t \right]^{-\gamma}$ .

In the redistributive regime  $\tau_t = \tau^T$  and taxes are acyclical. Increases in  $w_t$  must be matched with decreases in  $T_t$  to smooth  $\Lambda_t$ . During a fiscal crisis,  $T_t = 0$ , 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 of  $\Lambda_t$  requires procyclical tax rates in the fiscal crisis regime. Finally, Proposition 1, whose proof is provided in Appendix A, states that government debt is countercyclical. Together, this points to countercyclical fiscal policy with a time-consistent policy maker (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.*

In a previous version of this paper (Ilzetzki, 2008), I proved a more general statement, that redistributive policies that are Pareto-efficient and time consistent will tend to be countercyclical, regardless of the government's objective function.

**1.3.3.2. Policy Consensus ( $\alpha = 1$ ).** When  $\alpha = 1$ , the two factions fully concur on the identity of transfer receipts. The incumbent's maximization problem is still as defined in (1.5). Here, however, the opposition's value function is:

$$\begin{aligned} \Omega(b, w) = & u(T^*(b, w), \tau^*(b, w)) & (1.17) \\ & + \beta [(1 - p) EV(b^*(b, w), w') + pE\Omega(b^*(b, w), w')]. \end{aligned}$$

Deriving an Euler equation from the first order condition (1.13) requires differentiating both  $V(b, w)$  and  $\Omega(b, w)$ . Given the maximization problem (1.5), one can apply the envelope theorem once again to obtain (1.15). However, (1.17) is not a maximization problem, so that the envelope theorem cannot be applied to  $\Omega(b, w)$ . Differentiating this function is the main challenge in obtaining a general term for the Euler equation, to which I will turn shortly.

In this case, however, a shortcut is available. Given that the government and opposition receive identical payoffs in every period, it is apparent that  $\Omega(b, w) =$

$V(b, w)$  is an equilibrium of the game between successive governments. The problem is now identical to the case  $p = 1$ . Thus Proposition 1 holds in this case as well and fiscal policy is countercyclical when  $\alpha = 1$ .

**1.3.3.3. Borrowing Constraints.** So far, I have ignored the borrowing constraint in (1.8). Before turning to an analysis of the political distortion, it is interesting to explore whether the combination of a borrowing constraint and the absence of a complete market for contingent claims could in themselves cause fiscal policy to become procyclical.

The following proposition, whose proof is in Appendix A, states that borrowing constraints will be binding for low realizations of the wage shock.

**Proposition 2** (Borrowing Constraints). *Assume that shocks are i.i.d and either  $p = 1$  or  $\alpha = 1$ . For a given level of inherited debt  $b_{t-1}$ , if borrowing constraints are binding for some wage realizations and slack for other wage realizations, there exists a cutoff wage  $\tilde{w}(b_{t-1})$  below which borrowing constraints are binding and above which borrowing constraints are slack.*

Thus, if borrowing constraints are the main cause of fiscal procyclicality, we would expect fiscal procyclicality to be observed mainly during economic downturns. The stylized facts of Section 1.1 show that the procyclicality of government expenditure is not restricted to economic downturns. It is hard to explain the

procyclicality of fiscal policy during economic booms with borrowing constraints alone.

Simulations of the model in Section 1.4 show that in a dynamic context, the presence of borrowing constraints does not affect the cyclicity of fiscal policy, unless the political distortion is also present. Even when borrowing constraints are frequently binding, procyclical government expenditures are not observed. In this model, borrowing constraints are at best a partial explanation for the procyclical fiscal policies observed in developing countries.

**1.3.3.4. Political Distortions.** Let us now revisit the general case, where  $\alpha < 1$  and  $p < 1$ . As discussed earlier, the main challenge is differentiating the function  $\Omega(b', w')$  in (1.13).

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, I 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>15</sup>

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<sup>15</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.

Unfortunately, this refinement is insufficient. The game studied here may have multiple Markov Perfect equilibria. In a slightly different context, Krusell and Smith (2003) show that the savings-consumption problem of a hyperbolic consumer may have multiple equilibria, or even a continuum of equilibria. To address this problem, I follow Krusell, Kuruscu and Smith (2002) in a further equilibrium refinement. I 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>16</sup> I can now define the Differentiable Equilibrium.

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

(1) *Given  $V(b, w)$  and  $\Omega(b, w)$ ;  $T(b, w)$ ,  $\tau(b, w)$  and  $f(b, w)$  solve the maximization problem in equations (1.5) to (1.8) for the variables  $T$ ,  $\tau$ , and  $b'$ , respectively.*

(2) *Given  $T(b, w)$ ,  $\tau(b, w)$  and  $f(b, w)$ ;  $V(b, w)$  and  $W(b, w)$  satisfy the functional equations (1.5) and (1.9), respectively.*

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<sup>16</sup>There is a subtle difference between our problem and that of Krusell, Kuruscu and Smith (2002). It is unclear 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  $T(b, w)$  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  $T = 0$  and  $\tau = \tau^T$ .

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

I now characterize the Differentiable Equilibrium. The analysis proceeds as follows. Differentiate the value functions  $V(b, w)$  and  $\Omega(b, w)$  with respect to  $b$ . Rather than using the envelope theorem in this differentiation, have each party take as given the policy function  $f(b, w)$  of next period's incumbent when evaluating the marginal (dis-)utility of debt accumulation. This gives the following Generalized Euler Equation (GEE), whose derivation is given in Appendix A:

$$\Lambda = \beta(1+r) \left[ \int_{w'|T'=0} \Lambda' dw' + (p + \alpha(1-p)) \int_{w'|T'>0} \Lambda' dw' \right] \quad (1.18a)$$

$$+\beta(1-p) \left[ \begin{array}{c} (1-p)\beta(1+r) E[\Lambda'' f_b(b', w')] - \\ \left( \begin{array}{c} \alpha \int_{w'|T'>0} f_b(b', w') \Lambda' dw' \\ + \int_{w'|T'=0} f_b(b', w') \Lambda' dw' \end{array} \right) \end{array} \right] \quad (1.18b)$$

$$-\beta p \{p\beta(1+r) E[\Lambda'' f_b(b', w')] - E[\Lambda' f_b(b', w')]\}, \quad (1.18c)$$

where the integrals are over values of  $w'$ , for which  $T' = 0$  (fiscal crisis) or  $T' > 0$  (redistributive regime). The intuition for this intertemporal condition is as follows. Recalling that  $\Lambda$  is the Lagrange multiplier on the government's budget constraint,



$\Lambda$  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 right hand side of (1.18a). This extra unit of savings will be available to next period's incumbent. In all states of nature for which  $T' = 0$  there is no disagreement between the two parties and the marginal dollar saved will be used optimally from the perspective of the current government, regardless of who his successor is. On the other hand, in all states of nature for which  $T' > 0$  these savings will have no marginal benefit for households who do not receive transfers. 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 (1.18a).

However, the incumbent and his successor disagree on the optimal choice of debt two periods ahead:  $f(b', w')$ . In case the incumbent loses office, he would like to influence his successor's borrowing choice. This effect is captured by (1.18b). With probability  $1 - p$  the incumbent loses power.  $f_b(b', w')$  is the extent to which an 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 transfer recipients (or of the entire population in a fiscal crisis) in period  $t + 1$ . Thus, the incumbent takes into the account the cost of inducing his successor to increase savings at time  $t + 1$ , in terms of transfer losses to a fraction  $\alpha$  of his constituency in the redistributive regime, or 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. (1.18c) gives the costs of self-induced over-saving if incumbent remains in power, caused by his attempts to influence his successor's behavior.

**1.3.3.5. Procyclical Polices.** Why does political polarization cause procyclical policies? 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 would benefit a constituency other than their 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.

Section 1.3.3.1 described why the smoothing motivation would cause counter-cyclical fiscal policy. This section analyzes why the dynamic inconsistency due

to low values of  $p$  or  $\alpha$  leads not only to a higher steady-state level of debt, but also to fiscal policies that are more procyclical. First, it is useful to characterize the model's invariant distribution. Proposition 3 below states that if an invariant distribution exists, this distribution contains states in which  $T > 0$ , i.e. in the redistributive regime. This means that there are no *fiscal crisis traps*. Second, note that as  $p$  and  $\alpha$  decrease, the unconditional probability of being in a fiscal crisis increases. This is because the mean level of debt is higher in a more myopic policy environment.

Finally, I show through numerical simulations that for low values of  $\alpha$ , the economy converges to an invariant distribution that alternates stochastically between the fiscal crisis and redistributive regimes. (The numerical simulations are discussed in greater detail in Section 1.4.) High levels of debt (sequences of low wage realizations) bring the economy to a state where a fiscal crisis is more likely. At this point, further low wage realizations trigger a fiscal crisis, while high wage realizations allow the government to redistribute income. This gives procyclical transfers. But fiscal policy is procyclical even at lower levels of debt, when a fiscal crisis does not occur for any wage realization. This is because the incumbent would like to redistribute more today and increase the probability that a fiscal crisis explodes on its successor's watch. There are two reasons for this. First, the lower are  $p$  and  $\alpha$ , the more the incumbent discounts future transfers relative to transfers

today. The incumbent may not be in power in the following period, and disagrees with his successor. He thus only partially benefits from transfers in the future. Thus, he will transfer more than optimal, and also transfer more the higher is the wage realization. Second, once in a fiscal crisis, there is no longer disagreement between the two political factions. Thus a fiscal crisis is a means through which the incumbent can discipline his successor to behave in the current incumbent's interests. Making a fiscal crisis probable in the following period requires a higher transfer in periods when income is currently high, giving procyclical transfers.

With low values of  $\alpha$  and  $p$ , then, the economy reaches an invariant distribution with both frequent fiscal crises and periods of redistribution. The following proposition, whose proof can be found in Appendix A, summarizes this concept.

**Proposition 3** (No Fiscal Crisis Traps). *Let  $\beta(1+r) = 1$  and assume that  $w_t$  follows an i.i.d process. For any values of  $p \in [0, 1]$  and  $\alpha \in [0, 1]$ , if an invariant distribution exists, it contains states of nature for which the non-negativity constraint on transfers is non-binding. In other words, starting in any period  $t$ , the economy will eventually return to the redistributive regime almost surely.*

Insofar as the model has an invariant distribution, it 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 1.6 shows, the procyclicality of government transfers 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  $w_t$ . Facing this shock process, the lower panel shows the government's choice of transfers  $T_t$  as a percent of GDP when  $\alpha = 0.8$  and  $\alpha = 0.4$ . The model is simulated to match the business cycle features of Argentina (Section 1.4 provides more detail on the parameterization of the model). The former value of  $\alpha$  is sufficiently high to give countercyclical policies, while the latter gives procyclical policies.

In both cases a fiscal crisis is a rare occurrence. 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 redistribution.

The two governments differ, rather, in their conduct in the redistributive regime. Governments in the more cohesive polity ( $\alpha = 0.8$ ) decrease transfers during business cycle booms (episodes A, D, and G), giving them room to increase transfers during the recessions that follow (episodes B, E, and H). Governments in the more polarized polity increase transfers in business cycle booms, forcing them to decrease

transfers in mild recessions. They are forced to do so to avoid a full-blown fiscal crisis due to a relatively moderate recession.

The decision rule for transfers  $T$  is shown in Figure 1.7, for  $\alpha = 0.8$  in the upper panel and for  $\alpha = 0.4$  in the lower panel. The decision rule is a function of the debt stock  $b$  and is displayed for the best and worst business cycle shock realizations  $\bar{w}$  and  $\underline{w}$ . Again, it is apparent that fiscal crises occur only in the worst of times, when the government's debt stock threatens to violate the government's intertemporal budget constraint. However, note how the decision rule differs in the redistributive regime in the two cases. For  $\alpha = 0.8$ , the government almost always redistributes more income when wages are low. For  $\alpha = 0.4$ , on the other hand, for high debt stocks, there is greater redistribution in response to high wages, creating procyclical policies. These figures give some intuition for the results of the numerical simulations of the following section.

#### 1.4. Numerical Simulation

This section conducts a quantitative analysis of the model's dynamics. The time inconsistency inherent in the political structure of the model poses some computational challenges. In the previous section, I followed Krusell, Kuruscu and Smith (2002) in restricting attention to equilibrium paths with differentiable policy functions. Here too, 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 this context, because the non-negativity constraint on transfers creates kinks in the policy functions. The computational algorithm, described in Appendix B, therefore uses finite-horizon backward induction. I 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 Section 1.3.3.4. 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.

#### 1.4.1. 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. I assume that the productivity shock follows a lognormal process, so that  $w_t = e^{z_t}$ , where  $z_t$  is a random variable, following an

AR(1) process:

$$z_t - \bar{z} = \rho(z_{t-1} - \bar{z}) + \epsilon_t. \quad (1.19)$$

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 model is simulated in three environments. First, parameter values are chosen to match the business cycle features of the United States. Second, the model is simulated with the business cycle features of the United States and with an ad hoc borrowing constraint. An extreme borrowing limit is imposed: the government may only save, and may not hold any amount of external debt, so that  $\bar{b} = 0$ . This is in contrast to all other simulations, where  $\bar{b}$  is set to the natural debt limit, as in (1.8). Third, I parametrize the model to match the business cycle features of Argentina, as an example of an emerging market economy.

Parameter values are summarized in Table 1.5. For the U.S., I 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 is common in the RBC literature for developing countries, and as suggested by Mendoza (1995), I parametrize the model with Argentina's business cycle features using terms of trade as the exogenous shock.



Using the International Monetary Fund's (IMF) World Economic Outlook (WEO) data for the period 1970-2003, Argentina's shock process can be thus be represented as  $\rho = 0.56$  and  $\sigma = 0.079$ . These values are also very similar to estimates obtained when looking at the actual output process of Argentina, as in Arellano (2008), for example. This implies a business cycle that is significantly more volatile than in the U.S. I find that the other differences between the values of economic parameters of the U.S. and Argentina do not have significant effects on the cyclicity of fiscal policy in the model, so that the main role of the "Argentina" simulations is to assess the role of differences in business cycle volatility.

I 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 the benchmark simulation, I 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). Determining an exogenous average borrowing rate for Argentina is trickier. Spreads on Argentine sovereign bonds have ranged from 300 to 6000 basis points in recent years. When rates are as prohibitive as at the higher end of this range, it is hard to separate the borrowing rate from a de-facto constraint on external borrowing. Moreover, borrowing rates are likely endogenous to

the government's policy choices. Empirical evidence on sovereign spreads in Latin America show that 400 basis points is a typical spread (see for example Table 3 in Eichengreen and Mody, 1998). Based on this evidence I set  $r = 6.4\%$ . I have simulated the model for a wide range of interest rates; none of the results presented here are particularly sensitive to the specific borrowing rate chosen, or to the introduction of a debt-elastic interest rate schedule.

While the political friction introduces a degree of myopia, the benchmark simulations without the political friction would be non-stationary if  $\beta = 1 + r$ . I therefore choose  $\beta$  to match the debt-to-GDP ratios of the United States and Argentina in the benchmark model. This gives  $\beta = .976$  for the U.S. and  $\beta = .934$  for Argentina. I set the ratio of government consumption to GDP at its average level between 1970 and 2003. Based on WEO data, this average ratio is 11 percent for the United States and 4.5 percent for Argentina.

Turning to political parameters, I leave political cohesion  $\alpha$  as a free parameter. However, for ease of presentation, I choose benchmark values for  $p$  and look at the effects of changes in  $\alpha$  for a given level of  $p$ . We will later revisit the interaction between the two political parameters. The 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 retains the presidency in an election year was 0.64 in the 20th century. Adjusting this to reflect the annual frequency of the model gives

$p = 0.9$ . 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. A casual reading of Argentine presidential history indicates that the probability that a given political faction remains in power in a given year is approximately 0.8, whether the government is replaced through elections or force. As we will see, the simulation's qualitative results are not sensitive to the specific choice of  $p$ .

#### 1.4.2. Results

Figures 1.8-1.10 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 trend. Simulations are of 1000 periods, with the first 900 discarded to minimize the effects of initial conditions.

The curves' intersection with the  $y$  axis are results of the benchmark specification, in which  $\alpha = 1$ , so that there is full agreement between political parties and no political distortion is present. To facilitate comparison with the data, the actual

correlation between (the cyclical components of) GDP and government expenditure in the U.S. and Argentina are shown in dotted lines. Figure 1.8 gives results for the correlation between government expenditures and GDP. Figure 1.9 shows the correlations between tax revenues and GDP. Figure 1.10 shows the correlations between the deficit and GDP.

When parametrized with the business cycle features of the United States, the model predicts highly countercyclical government expenditures and deficits when no political distortion is present. The model requires only a small degree of political polarization (0.95 for expenditures and 0.8 for deficits) to match the features of fiscal cyclicity in U.S. data. Moving along the  $x$  axis, as political polarization increases, government spending becomes less countercyclical, and eventually procyclical. Deficits become less countercyclical, and eventually acyclical, as political polarization increases. The model can thus explain the fact that government expenditures and deficits are countercyclical in countries that are more politically cohesive, but procyclical and acyclical, respectively, in more polarized political environments.

Consistent with the data, the model shows highly procyclical revenues with little differences across countries. At the same time, 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, because the tax base is highly procyclical.

In this model, simulated tax rates do become more countercyclical as  $\alpha$  decreases, but this does not have a sizeable effect on the cyclicity of revenues.

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. simulation. In fact, except for extremely polarized political environments ( $\alpha < 0.3$ ) the model predicts policies that are more *countercyclical* in the volatile Argentine environment. This is because the need for intertemporal insurance for households increases with higher business-cycle volatility. The model matches the observed correlation between government expenditure and GDP in the Argentine data for  $\alpha = 0.6$ . The model has greater difficulty in matching the observed cyclicity of deficits in Argentina. The conclusion emerging from this set of simulations is that one would expect more countercyclical fiscal policies in more volatile business cycle environments, all else equal.

Next, I tighten the borrowing constraints, so that governments have no access to borrowing. They can, however, save freely at the exogenous interest rate  $r$ . Figures 1.8-1.10 show that borrowing constraints have no effect on the cyclicity of fiscal policy unless the political friction is also present. In the benchmark simulations ( $\alpha = 1$ ) government expenditures and deficits remain highly countercyclical,

even though borrowing constraints are binding in half of the simulated periods. Interestingly, borrowing constraints do appear to reinforce procyclical expenditures and deficits when the political friction is present. This indicates that political and financial market frictions might reinforce each other, but I do not find support for the idea that borrowing constraints alone play an important role in explaining fiscal procyclicality.

Figure 1.11 shows the interaction between the two political parameters. It shows simulation results for the Argentina parametrization for a range of values for  $p$  (the probability of the incumbent remaining in power in the following period), with  $\alpha$  (political cohesion) changing along the  $x$  axis. According to the World Bank's Database of Political Institutions (Beck et al, 2001), few countries have had annual turnover rates higher than 30 percent at an annual frequency, implying a value of  $p \cong 0.7$ . I 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.

Figure 1.11 also demonstrates the utility of quantitative analysis in the understanding of political economy phenomena. Alesina and Tabellini (1990) predict that government indebtedness increases in both turnover ( $1 - p$ ) and political polarization ( $1 - \alpha$ ). Here, too, both parameters are necessary conditions for distorted

policies to appear. 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 more frequent than observed in reality, the cyclicity of government expenditures remains virtually unchanged for values of  $\alpha > 0.9$ . Thus a cohesive polity can expect to benefit from efficient 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.

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 countercyclical expenditures and deficits. This is true even in volatile macroeconomic environments, and even when borrowing constraints are frequently binding. The introduction of a political distortion can match the procyclical policies observed in developing countries, when political polarization is sufficiently high ( $\alpha$  is sufficiently low).

## 1.5. Conclusions

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. The theory presented here raises questions regarding the power of these explanations. It provides an alternative political explanation and demonstrates that polarized political environments may yield procyclical fiscal policies. Quantitative simulations of the model are able to capture a number of the salient differences in the cyclicity of fiscal policy across countries.

The theory of this paper also has some interesting implications for the current economic downturn. The model's simulations, as shown, for example, in Figure 1.6, indicate that governments in highly polarized political environments will conduct procyclical fiscal policies both during business cycle peaks and during recessions. But the simulations also indicate that relatively cohesive polities may conduct procyclical policies in deep protracted recessions. As the current recession unfolds, it will be interesting to see which governments will demonstrate a capacity and willingness to conduct countercyclical measures.



## CHAPTER 2

# **Procyclical Fiscal Policy in Developing Countries: Truth or Fiction?**

Over the last 10 years, a large and growing literature has argued that there is a fundamental difference between how fiscal policy is conducted in developing countries compared to industrial countries. While fiscal policy in industrial countries is either acyclical or countercyclical, fiscal policy in developing countries is, by and large, procyclical. Gavin and Perotti (1997) were the first to call attention to the fact that fiscal policy in Latin America is procyclical. Talvi and Végh (2005) then claimed that procyclical fiscal policy seems to be the rule in all of the developing world. In fact, in Talvi and Végh's (2005) study, the correlation between the cyclical component of government consumption and GDP is positive for each of the 36 developing countries in their sample (with an average of 0.53). In sharp contrast, the average correlation for G7 countries is zero. By now, a large number of authors have reached similar conclusions, to the point that the procyclicality of fiscal policy in developing countries has become part of the conventional wisdom.<sup>1</sup>

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<sup>1</sup>See, among others, Mailhos and Sosa (2000), Braun (2001), Sanchez de Cima (2003), Lane (2003), Kaminsky, Reinhart, and Végh (2004), Alesina and Tabellini (2005), Manasse (2006),

Perhaps the more convincing evidence that this idea has indeed become conventional wisdom is the explosion of theoretical models trying to explain such a puzzle. In other words, why would developing countries pursue a procyclical fiscal policy that might exacerbate the business cycle? An all too brief review of the literature reveals that explanations follow two main strands: (a) imperfections in international credit markets that prevent developing countries from borrowing in bad times (Gavin and Perotti, 1997; Riascos and Végh, 2003; Guerson, 2003; Caballero and Krishnamurthy, 2004; Mendoza and Oviedo, 2006; and Susuki, 2006) and (b) political economy explanations, typically based on the idea that good times encourage fiscal profligacy or rent-seeking activities (Tornell and Lane, 1998, 1999; Talvi and Végh, 2005; Alesina, Campante, and Tabellini, 2008; and the theory of the previous chapter).

But do we really know what we think we know? Is it really the case that government spending responds positively in a causal sense to the business cycle in developing countries? While a positive correlation between the cyclical component of government consumption and GDP certainly gives no indication of causality, the literature has implicitly assumed that the causality goes from the business cycle

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Sturzenegger and Wernek (2006), Strawczynski and Zeira (2007), and Section 1.1. of this dissertation.

to fiscal policy. But is this a reasonable inference? No, according to the insightful comments of Roberto Rigobon on Kaminsky, Reinhart, and Végh (2004). In fact, Rigobon has argued that the structure of shocks in developing and industrial countries is such that it is more likely that reverse causality explains the observed patterns in the data (i.e., fiscal policy is driving output). In a similar vein, the numerous papers that have purported to establish that fiscal policy is procyclical by regressing some measure of fiscal policy on some measure of the business cycle while controlling for other factors have essentially ignored the problem of endogeneity.<sup>2</sup> Could accounting for endogeneity make the procyclical results disappear? This is precisely the argument made by Jaimovich and Panizza (2007), who claim that, once GDP has been suitably instrumented for, causality runs in the opposite direction (i.e., from fiscal policy to GDP). But, surprisingly enough, there is little systematic work in this area. This would seem to be a major shortcoming, given that if fiscal policy in developing countries is not really procyclical, all the existing theory would be essentially irrelevant.<sup>3</sup>

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<sup>2</sup>We note exceptions like Braun (2001), Lane (2003), Galí and Perotti (2003), and Strawczynski and Zeira (2007).

<sup>3</sup>Notice that, theoretically, fiscal policy is expansionary in both Keynesian and neoclassical models. In the standard neoclassical model (see, for instance, Baxter and King (1993)), an increase in government purchases is expansionary because the negative wealth effect reduces consumption and leisure, thus increasing labor and, by increasing the marginal productivity of capital, investment.

In addition to the obvious academic interest of this question, its relevance for public policy is hard to understate. In fact, the ability to transition from a procyclical fiscal policy to an acyclical or countercyclical policy is viewed as a badge of macroeconomic honor in the developing world and as a sign that the country belongs to an exclusive club that relies on sound fiscal and monetary policies.<sup>4</sup> If procyclical fiscal policy simply reflects reverse causality, then this way of thinking is unfounded.

The main purpose of this paper is then to ask whether fiscal policy is really procyclical in developing countries, or does causality run the other way and previous researchers have just misidentified a standard expansionary effect of fiscal policy. To tackle this question in depth, we turn to quarterly data. Previous empirical literature in this area has used annual data. While annual data may be sufficient to explore the basic correlations and for some empirical approaches, we will see that the identification assumptions underlying our VAR regressions are valid for quarterly, but not annual, data. To this effect, we assemble a database with quarterly data that encompasses 49 countries (27 developing and 22 industrial) and which, depending on the country in question, goes as far back as 1960. After developing some simple econometric models, we subject our data to an array of econometric

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<sup>4</sup>See Arellano (2006) for the case of Chile and Strawczynski and Zeira (2007) for the case of Israel.

tests aimed at disentangling causality. While a particular methodology may not be fully convincing in and of itself, we attempt to reach our conclusions by a preponderance of evidence. We thus resort to instrumental variables, GMM, simultaneous equations, and time series techniques (Granger causality and impulse responses).<sup>5</sup>

In addition to focusing on the issue of causality, our methodology allows us to identify empirically a critical channel underlying this literature, which has been entirely disregarded so far. Implicit in the current literature is the idea that procyclical fiscal policy is sub-optimal because it exacerbates the business cycle – what Kaminsky, Reinhart, and Végh (2004) have dubbed the “when it rains, it pours” phenomenon. If changes in fiscal policy did not affect output, then – at least from a purely macroeconomic point of view – procyclical fiscal policy should not be a cause for concern. As part of our econometric tests, we will be able to test whether changes in government spending affect output. In other words, we will be able to ascertain whether the when-it-rains-it-pours idea is empirically relevant.

After discussing some conceptual and methodological issues in Section 2.1, Section 2.2 develops empirical models that illustrate some of the main ideas at stake and formalize the equations that will be estimated in the following sections. Section 2.3 discusses our data sets and variables of interest. Section 2.4 sets the

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<sup>5</sup>As a reference point – and for the purposes of comparing with the existing literature – we also carry out many of the estimations using an annual dataset.

empirical stage by replicating (with quarterly data) existing results that are obtained by regressing changes in (the log of) real government consumption on (the log of) real GDP. Section 2.5 turns to instrumental variables as a way of dealing with the endogeneity problem. We follow Jaimovich and Panizza (2007) in using the weighted GDP growth of countries' trading partners as an instrument for GDP (and also add additional instruments). Unlike Jaimovich and Panizza, however, we find that government consumption is indeed procyclical in developing countries in contrast to the acyclical government consumption observed in high-income countries. These results are consistent with the findings of the existing literature, and are strengthened when we use GMM to estimate the same system. Section 2.6 estimates a simultaneous equations system by OLS. Here we find evidence of both the procyclicality of fiscal policy in developing countries and of an expansionary effect of fiscal policy. Section 2.7 develops our VAR estimations. We start with Granger causality tests that reject the hypothesis that the business cycle does not Granger-cause government consumption. We then show impulse responses which, again, are broadly consistent with the idea that an output shock leads to higher government spending.

After this exhaustive battery of econometric tests, we can summarize our results as follows:

- There is ample econometric evidence to indicate that procyclical fiscal policy in developing countries (defined as a positive response of government spending to an exogenous expansionary business cycle shock) is truth and not fiction. IV, GMM, (OLS) simultaneous equations estimations, Granger-causality tests, and impulse responses all offer strong support for this proposition.
- The econometric evidence on the cyclicity of government consumption in high-income countries is mixed, and depends on the specification. Our IV and GMM estimations suggest that government consumption is acyclical in high-income countries, while our OLS and VAR estimates indicate that government consumption actually procyclical, contrary to the current conventional wisdom. While the focus of our paper is on fiscal policy in developing countries, our results on high-income countries suggest that further research may be warranted on the cyclicity of government consumption in the industrialized world.
- In contrast, the econometric evidence on total government spending in high-income countries is more robust. While a simple IV regression is inconclusive, the GMM, OLS and VAR specifications show that total government spending is countercyclical in high-income countries, and that it

contrasts sharply with the cyclicality of government spending in developing countries. This provides further support the observation in Chapter 1, that the main difference between fiscal policy in high-income and developing countries is in government transfers, which are the main expenditure category making up the difference between government spending and consumption.

- We also find evidence of an expansionary effect of fiscal policy on output in both developing and high income countries. The implied fiscal multipliers peak at 0.63 for developing countries and 0.91 for high-income countries.<sup>6</sup> At least for developing countries, then, this provides clear evidence that the when-it-rains-it pours phenomenon is empirically relevant (i.e. procyclical fiscal policy amplifies the underlying business cycle) and should indeed be a serious public policy concern.

## 2.1. Conceptual and methodological issues

This section discusses some important methodological issues that arise in this area.

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<sup>6</sup>The figure for high income countries is roughly consistent with the estimates of 0.90 and 1.29 (depending on the methodology) for the United States reported by Blanchard and Perotti (2002, Table 4) and somewhat higher than the estimate of 0.52 for a panel consisting of Australia, Canada, United Kingdom, and United States reported in Ravn, Schmitt-Grohe, and Uribe (2007).



### 2.1.1. How do we measure fiscal policy?

Conceptually – and in line with Kaminsky, Reinhart, and Végh (2004) – we think that it only makes sense to measure fiscal policy by looking at policy *instruments*. After all, if one is interested in macroeconomic policy, one should focus on instruments rather than outcomes (which lie outside the policymakers’ control). In theory, at least, the two key fiscal policy instruments are government consumption (as opposed to government spending, which would include transfers which consist largely of automatic stabilizers, and debt service, which are the government’s contractual obligations) and tax *rates* (as opposed to tax *revenues*, which respond endogenously to the business cycle). While many studies in the literature look at the fiscal deficit (see, for example, Alesina, Campante, and Tabellini, 2008), we feel that this not an appropriate measure of fiscal policy precisely because of the cyclicity of tax revenues. In other words, even if fiscal *policy* were completely acyclical (i.e., even if the path of government consumption and tax rates were independent of the business cycle), the fiscal balance would be in surplus in good times (as the tax base expands) and in deficit in bad times (as the tax base contracts). An econometrician looking at the fiscal balance may thus conclude that fiscal policy is countercyclical (i.e., the government is trying to actively smooth the business cycle) when in reality the government is engaged in a completely neutral

fiscal policy and smoothing both government consumption and tax rates, in the spirit of Barro's (1979) neoclassical prescriptions.

Focusing on the fiscal balance might also lead to erroneous conclusions when comparing the cyclicity of fiscal policy across countries. For instance, several papers conclude that fiscal policy is more procyclical in developing countries than in industrial countries because the correlation of the fiscal balance with the business cycle is positive in industrial countries and less so – or negative – in developing countries (Gavin and Perotti, 1997; Alesina, Campante and Tabellini, 2008). This inference is not warranted, however, because it might be the case that government consumption and tax rates behave similarly but tax revenues are more procyclical in industrial than in developing countries.

Since, unfortunately, there is no readily available cross-country data on tax *rates*, we will restrict our attention to the spending side. While, for the above reasons, our main focus will be on government consumption, we will also look at overall government spending for several reasons. First, since much of the existing literature has focused on government spending, it provides a useful reference point. Second – and as discussed below – looking at government spending allows us to infer something about the cyclical behavior of transfers, which provides insights into how much governments insure the private sector against the business cycle.

In terms of measuring government consumption, notice that if we had a perfect price deflator for government consumption, cyclical changes in relative prices would not affect real government consumption. In practice, of course, we do not have such refined price indices and it is thus likely that changes in relative prices do affect measured government consumption. For instance, in developing countries the relative price of non-tradable goods is typically procyclical. Since the public wage bill is a major component of government consumption, deflating nominal government consumption by the CPI index will most likely imply that measured government consumption increases in good times and falls in bad times.

For the purposes of this paper government consumption is deflated using a deflator specific to government consumption, whenever available (mainly high-income countries and large developing countries; see Appendix C for more details). Elsewhere, we have no choice but to use the CPI index. For countries where several indices are available, all of our results are robust to using either the government consumption deflator, the GDP deflator, or the CPI index.

### **2.1.2. Breaking down government spending**

For the purposes of our discussion, it proves useful to break down government spending as follows:

$$\begin{aligned} \text{government spending} &= \text{government consumption} + \text{public investment} \\ &+ \text{transfers} + \text{debt service.} \end{aligned}$$

With this simple fiscal accounting as background, a couple of points are worth mentioning.<sup>7</sup>

First, notice that this breakdown does not necessarily coincide with the one used by, for example, Galí and Perotti (2003) in their study of fiscal policy in the European Union. Their main breakdown is between cyclical (or non-discretionary or automatic) and cyclically-adjusted (or discretionary) government spending. They focus on the discretionary component on the grounds that this is the better measure of the fiscal stance. In our view, however, the distinction between discretionary and non-discretionary spending is not relevant for our purposes. What matters is the actual response of government consumption to the cycle, rather than whether this response comes about as part of some explicit discretionary fiscal policy rule or some legal constraint that requires the government to increase spending in some states of nature (e.g., to provide more school lunches in bad times).

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<sup>7</sup>It is important to keep in mind that, in country and international organizations' publications, government spending is often labeled differently. In IFS, for instance, it is referred to as "government expenditure." (The reader is referred to Appendix C for details.)

Second, while not our main focus, whenever data are available we will check the cyclicity of public investment and debt service and use that information to infer the cyclicity of transfers. Our conjecture is that transfers will be countercyclical (as is the case, for instance, for unemployment insurance or food stamp programs), particularly in industrial countries or relatively well-off developing countries with a social safety net in place. In other words, even when fiscal policy is not actively used to smooth the business cycle, it is possible that the government is trying to insure the private sector from business cycle fluctuations. Since we find that, on average, debt service is acyclical and public investment is procyclical – the acyclicity or countercyclicity of government spending must reflect the countercyclical nature of transfers.

### **2.1.3. Is it really the case that “when it rains, it pours”?**

As is apparent from the existing literature, fiscal procyclicality in developing countries constitutes a puzzle in search of an explanation because both the Keynesian and the neoclassical theoretical perspectives suggest that it cannot be optimal to reinforce the business cycle by expanding fiscal policy in good times and contracting it in bad times (i.e., what Kaminsky, Reinhart, and Végh, 2004, have dubbed the “when it rains, it pours” phenomenon).

In a Keynesian world, due to sticky prices or wages, the economy does not adjust immediately to its full-employment level of output in response to output shocks. In such a model, an increase in government consumption would increase aggregate demand and lead to higher output. The optimal fiscal policy is thus *countercyclical*. In this world, *reducing* government consumption in a recession (the “pour” component) would reduce output even further. For empirical purposes, we will capture this Keynesian world in Models 1, 2, and 3 of next section.

In a neoclassical world, an optimal fiscal policy would imply constant tax rates over the business cycle in the spirit of Barro (1979). In terms of government consumption, the optimal policy would depend on the specification of the model. Clearly, if government consumption entered preferences separably, then a smooth path would be optimal. On the other hand, if government consumption were a substitute (complement) for private consumption, then it would optimally be countercyclical (procyclical). While, theoretically, one can indeed think of scenarios in which government consumption could be a substitute (think of government-provided school lunches) or complement (think of government-provided port services) to private consumption, we believe that in practice the substitutable component will be mainly reflected in transfers (food stamps, unemployment insurance) and the complementarity in public investment (providing better roads in good times), neither of which are part of government consumption. Hence, at a first

approximation, we will think of optimal government consumption in a neoclassical world as being uncorrelated with the business cycle. In this light, procyclical government consumption would also be sub-optimal. A recurrent explanation in the literature for this sub-optimal response is the presence of some political distortion, which leads to higher government consumption as a second-best response. We will capture this world in Model 4 below.

According to standard neoclassical theory, an increase in government consumption would also be expansionary. Consider, for example, the model of Baxter and King (1993). An increase in government spending leads to a short (and long) run increase in output because the resulting negative wealth effect induces households to consume less goods and less leisure (i.e. labor supply goes up). The increase in labor supply increases the marginal productivity of capital thus leading as well to an increase in investment.

Our econometric evidence for an expansionary effect of government consumption could thus be capturing either a Keynesian or neoclassical model. In either case, however, the finding of procyclical government spending is evidence of a sub-optimal response. In a Keynesian world, this output effect would reinforce the shock hitting the economy and in a neoclassical world it would represent an undesirable source of output fluctuations. Both our simultaneous equations and VAR

regressions below will enable us to measure the expansionary impact of government consumption.

## 2.2. Empirical models

This section lays out some simple empirical models that will provide a useful guide to our empirical estimations.

### 2.2.1. Model 1: A contemporaneous fiscal rule

The simplest model to think about issues of reserve causality is the following:

$$g_t = \beta y_t + \varepsilon_t, \quad (2.1)$$

$$y_t = \phi g_t + \mu_t, \quad (2.2)$$

where  $g_t$  and  $y_t$  are (the cyclical components of) government spending (or consumption) and output;  $\beta$  ( $\beta \geq 0$ ) and  $\phi$  ( $\phi \geq 0$ ) are parameters; and  $\varepsilon_t$  and  $\mu_t$  are i.i.d shocks with mean 0 and variance  $\sigma_\varepsilon^2$  and  $\sigma_\mu^2$ , respectively, with  $E\mu_t\varepsilon_t = 0$ . Equation (2.1) captures a fiscal reaction function whereby government spending responds to contemporaneous output, with the coefficient  $\beta$  representing the cyclical stance of fiscal policy: if  $\beta < 0$ , fiscal policy is countercyclical; if  $\beta = 0$ , fiscal policy is acyclical; and if  $\beta > 0$ , fiscal policy is procyclical. Equation (2.2) allows



for an expansionary effect of government consumption on output. The shocks  $\varepsilon_t$  and  $\mu_t$  capture fiscal and output shocks, respectively. We assume that  $|\beta\phi| < 1$ .<sup>8</sup>

We can interpret most of the current literature as having estimated some version of equation (2.1). With some notable exceptions (Braun, 2001; Lane, 2003; and Jaimovich and Panizza, 2007), problems related to the endogeneity of  $y_t$  have been cast aside. As Rigobon's (2004) insightful comments show, ignoring the problem of endogeneity can lead to a highly misleading picture. To see this, solve for the reduced form of system (2.1) and (2.2) to obtain:

$$y_t = \frac{\phi\varepsilon_t + \mu_t}{1 - \phi\beta}, \quad (2.3)$$

$$g_t = \frac{\beta\mu_t + \varepsilon_t}{1 - \phi\beta}. \quad (2.4)$$

It follows that the covariance between  $g_t$  and  $y_t$  is given by

$$Cov(y_t g_t) = \frac{1}{(1 - \phi\beta)^2} (\phi\sigma_\varepsilon^2 + \beta\sigma_\mu^2). \quad (2.5)$$

To fix ideas, suppose that there were no output shocks (i.e.,  $\sigma_\mu^2 = 0$ ). Then,

$$Cov(y_t g_t)|_{\sigma_\mu^2=0} = \frac{\phi\sigma_\varepsilon^2}{(1 - \phi\beta)^2} > 0.$$

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<sup>8</sup>As can be checked, this condition ensures that the ratio  $\sigma_g^2/\sigma_y^2$  is an increasing function of the ratio  $\sigma_\varepsilon^2/\sigma_\mu^2$ .

Hence, even if fiscal policy were countercyclical ( $\beta < 0$ ), the correlation between  $y_t$  and  $g_t$  would be positive (as typically reported in the literature), but the claim that this captures procyclical fiscal policy would clearly be false. In general, equation (2.5) implies that the sign of the covariance between  $y_t$  and  $g_t$  depends on whether fiscal or output shocks dominate. If fiscal shocks dominate, the covariance will be positive; if output shocks dominate (and  $\beta < 0$ ), the covariance will be negative.

For normative purposes, suppose that we think of this model as capturing a Keynesian world, where  $y_t$  denotes deviations of output from the full-employment level. What does the model tell us about the desirability of countercyclical fiscal policy? Let  $\theta_t \equiv \phi\varepsilon_t + \mu_t$ . Then  $E(\theta_t) = 0$  and  $\sigma_\theta^2 = \phi^2\sigma_\varepsilon^2 + \sigma_\mu^2$ . It follows from (2.3) that

$$\begin{aligned} E(y_t) &= 0, \\ \text{Var}(y_t) &= \frac{\sigma_\theta^2}{(1 - \phi\beta)^2}. \end{aligned} \tag{2.6}$$

Take  $\phi$  as given. Since, by assumption,  $|\beta\phi| < 1$ , the range of  $\beta$  is given by  $\beta \in (-1/\phi, 1/\phi)$ . Given that  $\text{Var}(y_t)$  is a strictly increasing function of  $\beta$  in the range  $(-1/\phi, 1/\phi)$ , a policymaker whose objective is to minimize the variance of output will set a negative value of  $\beta$  such that  $\phi\beta \rightarrow -1$ . In that case, the variance

of output is given by

$$\lim_{\beta \rightarrow -1/\phi} \text{Var}(y_t) = \frac{\sigma_\theta^2}{4}.$$

An acyclical policy ( $\beta = 0$ ) would imply that  $\text{Var}(y_t) = \sigma_\theta^2$  and any procyclical fiscal policy would imply that  $\text{Var}(y_t) > \sigma_\theta^2$ . This simple model thus rationalizes the idea that procyclical fiscal policy in developing countries is a puzzle to the extent that a countercyclical policy would be more effective in stabilizing output.

Notice, incidentally, that countercyclical fiscal policy is optimal only if government spending impacts output (i.e.,  $\phi > 0$ , which implies that the when-it-rains-it-pours channel is present). If  $\phi = 0$ , then fiscal policy is irrelevant and the procyclicality discussion would be devoid of macroeconomic policy implications.

Naturally, from an econometric point of view, equation (2.1) cannot be estimated by OLS because the covariance between  $y_t$  and  $\varepsilon_t$  is not zero. Indeed, by substituting (2.1) into (2.2), it follows that

$$E(\varepsilon_t y_t) = \frac{\phi}{1 - \phi\beta} \sigma_\varepsilon^2 > 0. \quad (2.7)$$

We will therefore proceed in the following way. In Section 2.5, we will estimate equation (2.1) by instrumental variables. As instruments for output, we will use the weighted growth of countries' trading partners and lagged GDP growth. In Section 2.6, we use these same instruments – and, in addition, the real interest

rate on U.S. treasury bills – to estimate equations (2.1) and (2.2) as a system of simultaneous equations using GMM.<sup>9</sup>

### 2.2.2. Model 2: A lagged fiscal rule

Suppose now that (a) government spending responds to *lagged* rather than contemporaneous output and (b) output is determined by lagged output and current government spending:

$$g_t = \beta y_{t-1} + \varepsilon_t, \quad (2.8)$$

$$y_t = \alpha y_{t-1} + \phi g_t + \mu_t, \quad (2.9)$$

where  $\varepsilon_t$  and  $\mu_t$  are i.i.d with mean zero and variance  $\sigma_\varepsilon^2$  and  $\sigma_\mu^2$ , respectively, and

$$E\mu_t\varepsilon_t = 0.$$

Substituting (2.8) into (2.9), we obtain

$$y_t = (\alpha + \beta\phi)y_{t-1} + \theta_t, \quad (2.10)$$

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<sup>9</sup>We exploit that fact that, unlike Jaimovich and Panizza (2007), our system is overidentified, allowing us to estimate all structural parameters. We also improve on their results by using a GMM estimator. The 2-stage-least-squares estimator is a special case of the GMM estimator, but not the most efficient. We estimate the variance-covariance matrix of the system using the method of Newey and West (1987), which takes into account both heteroskedasticity and autocorrelation. See section 6 for further discussion.

where  $\theta_t \equiv \phi\varepsilon_t + \mu_t$ . Assuming that  $|\alpha + \beta\phi| < 1$ , we can express (2.10) as

$$y_t = \sum_{j=0}^{\infty} (\alpha + \beta\phi)^j \theta_{t-j}.$$

Then we have

$$\begin{aligned} E(y_t) &= 0, \\ \text{Var}(y_t) &= \frac{\sigma_{\theta}^2}{1 - (\alpha + \beta\phi)^2}. \end{aligned}$$

Suppose that the policymaker's objective is to minimize output variability for given values of  $\alpha$  and  $\phi$ .<sup>10</sup> This is tantamount to maximizing  $1 - (\alpha + \beta\phi)^2$ . The solution is

$$\beta^{opt} = -\frac{\alpha}{\phi}.$$

By implementing this optimum, the variance of output is reduced to  $\sigma_{\theta}^2$ . An acyclical or procyclical policy is clearly suboptimal. Intuitively, suppose that there is a negative shock to output. If fiscal policy is neutral (i.e., acyclical), the autoregressive structure implies that output will be persistently low for a while. But if fiscal policy is countercyclical, the increase in  $g$  will partly offset the fall in output.

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<sup>10</sup>As in model 1, notice that if  $\phi = 0$ , then fiscal policy cannot affect the variability of output and the issue of optimal fiscal policy becomes moot.

From an econometric point of view, notice that equations (2.8) and (2.9) can be estimated by OLS since

$$E(\varepsilon_t y_{t-1}) = 0,$$

$$E(\mu_t y_{t-1}) = 0,$$

$$E(\mu_t g_t) = 0.$$

We will estimate this system for quarterly data in Section 2.6.

### 2.2.3. Model 3: An expectational fiscal rule

Now assume yet another – and highly plausible – fiscal rule, in which current government spending responds to the expectation of  $y_t$  conditional on  $y_{t-1}$  and  $g_t$ . The idea is that since policymakers cannot observe today's output, they use their best forecast of today's output in order to set fiscal policy. Formally:

$$g_t = \beta E[y_t | \Omega_t] + \varepsilon_t, \tag{2.11}$$

where  $E[y_t|\Omega_t]$  denotes the expected value of  $y_t$  conditional on the information set  $\Omega_t$  which, by assumption, contains lagged output and contemporaneous government spending (i.e.,  $\Omega_t = \{y_{t-1}, g_t\}$ ). The output equation is still given by (2.9), and we continue to assume that  $\alpha + \phi\beta < 1$  and  $|\phi\beta| < 1$ .

If expectations are rational,  $E[y_t|\Omega_t]$  will be computed using the true model. Using (2.9), it follows that

$$E[y_t|\Omega_t] = \alpha y_{t-1} + \phi g_t. \quad (2.12)$$

Substituting (2.12) into (2.11),

$$g_t = \frac{\alpha\beta}{1 - \beta\phi} y_{t-1} + \frac{\varepsilon_t}{1 - \beta\phi}. \quad (2.13)$$

The equations to be estimated would then be (2.9) and (2.13). While these equations are econometrically the same as those to be estimated for Model 2 – given by (2.8) and (2.9) – in this case the coefficient on  $y_{t-1}$  does not capture  $\beta$ . To recover  $\beta$ , we need to compute the following (denoting by  $\tilde{\beta}$  the coefficient on  $y_{t-1}$  in equation (2.13)):

$$\beta = \frac{\tilde{\beta}}{\alpha + \phi\tilde{\beta}}.$$

In sum, the coefficient  $\beta$  (which captures the stance of fiscal policy) will differ between Models 2 and Model 3. But note that  $\beta > 0$  if and only if  $\tilde{\beta} > 0$ , so our conclusions regarding the cyclical nature of fiscal policy would be the same with both models.

Assuming again that this model captures a Keynesian world, what is the optimal fiscal policy? Substituting (2.13) into (2.9) yields:

$$y_t = \sum_{j=0}^{\infty} \left( \frac{\alpha}{1 - \phi\beta} \right)^j \theta_{t-j},$$

where

$$\theta_t \equiv \frac{\phi}{1 - \beta\phi} \varepsilon_t + \mu_t.$$

Hence,

$$\text{Var}(y_t) = \frac{(1 - \phi\beta)^2}{(1 - \phi\beta)^2 - \alpha^2} \sigma_{\theta}^2.$$

It is easy to check that  $\text{Var}(y_t)$  is a strictly increasing function of  $\beta$ . Hence, the optimal fiscal policy will be to set a value of  $\beta$  as low as possible; that is,  $\beta \rightarrow -1/\phi$ , which implies that  $\phi\beta \rightarrow -1$ .



#### 2.2.4. Model 4: A political economy model

Since there are several political economy explanations of procyclical fiscal policy in the literature (Tornell and Lane, 1998, 1999; Talvi and Végh, 2005; Alesina, Campante, and Tabellini, 2008; and the theory of Chapter 1), it will prove helpful to reinterpret a slight variation of Model 1 along such lines. While the various models differ in the details, the basic idea is that fiscal surpluses are “bad” in the sense that they generate political pressures or rent-seeking activities that tend to increase spending in good times.

To capture this scenario, let the primary surplus be given by

$$S_t \equiv \eta y_t - g_t, \tag{2.14}$$

where  $\eta y_t$  are tax revenues, which are assumed to be proportional to output. In turn, government spending is given by

$$g_t = \bar{g} + \beta S_t + \varepsilon_t, \tag{2.15}$$

where  $\bar{g}$  is the (exogenously-given) level of government spending in the absence of any political distortion and  $\beta$  denotes the magnitude of the existing “political

distortion.” We expect  $\beta \geq 0$ . Substituting (2.14) into (2.15), we obtain:

$$g_t = \frac{\bar{g}}{1 + \beta} + \frac{\beta\eta}{1 + \beta}y_t + \frac{\varepsilon_t}{1 + \beta}. \quad (2.16)$$

The second equation in this model would remain unchanged (relative to Model 1) and would still be given by equation (2.2).

The system to be estimated (given by equations (2.2) and (2.16)) would be the same as in Model 1 but, of course, the interpretation of the coefficient on  $y$  in equation (2.16) would be different. While we cannot “identify”  $\beta$ , if the estimated coefficient is positive we would infer that  $\beta > 0$  since, in practice,  $\eta > 0$ .<sup>11</sup> A positive coefficient would thus be interpreted as evidence of a “political distortion” and a positive  $\phi$  as evidence of an expansionary effect of government consumption.<sup>12</sup>

### 2.2.5. Model 5: A simple VAR

**2.2.5.1. Set-up.** In Model 2, we assume that output follows an AR(1) process and that government consumption can only respond to output with a one-quarter lag. A natural extension is to allow for both output and government consumption to follow a vector-autoregressive process including more lags. In Section 2.7 we

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<sup>11</sup>See, for example, Section 1.1 and Talvi and Vegh (2005). The latter find a correlation of 0.47 between (the cyclical components of) GDP and tax revenues in a sample of 56 countries (industrial and developing).

<sup>12</sup>Notice, of course, that the question of the optimal value of  $\beta$  does not apply because, by construction,  $\beta$  is capturing some pre-existing political distortion.

estimate the following system:

$$AY_t = \sum_{k=1}^j C_k Y_{t-k} + Bu_t, \quad (2.17)$$

where the vector  $Y_t = \begin{pmatrix} g_t \\ y_t \end{pmatrix}$  includes the two variables of interest. The 2x2 matrix  $C_k$  estimates the own- and cross-effects of the  $k^{th}$  lag of the variables on their current observation. The matrix  $B$  is diagonal, so that  $u_t$  is a vector of orthogonal, i.i.d. shocks to government consumption and output. Finally, the matrix  $A$  allows for the possibility of simultaneous effects between  $g_t$  and  $y_t$ .

To fix ideas, notice that Model 2 is, in fact, a particular case of (2.17). To see this, let  $j = 1$  and  $A$  and  $C_1$  be given by

$$A = \begin{pmatrix} 1 & 0 \\ a_{21} & 1 \end{pmatrix},$$

$$C_1 = \begin{pmatrix} 0 & \beta \\ 0 & \alpha \end{pmatrix},$$

with  $a_{21} = -\phi$ . Then, the system (2.17) is identical to the one given by (2.8) and (2.9). Following Blanchard and Perotti (2002), the assumption that  $a_{12} = 0$

(reflecting the assumption that  $y_t$  does not affect  $g_t$  contemporaneously) is common in the VAR estimates of the effectiveness of fiscal policy.

**2.2.5.2. Impulse Responses.** In order to compare our VAR results with the results from our OLS, IV, and GMM regressions, we need to be careful in interpreting the impulse responses.<sup>13</sup>

The impulse response of  $g$  to an output shock after one quarter is defined as  $\partial g_{t+1}/\partial \mu_t$ . Leading (2.8) and then substituting (2.9) into (2.8), we obtain:

$$g_{t+1} = \alpha\beta y_{t-1} + \phi\beta g_t + \beta\mu_t + \varepsilon_{t+1}.$$

Hence:

$$\frac{\partial g_{t+1}}{\partial \mu_t} = \beta. \tag{2.18}$$

In other words, the impulse response function (one period out, in the VAR(1) system described above) captures precisely the coefficient of the fiscal reaction function. The impulse response in period two (given by  $\partial g_{t+2}/\partial \mu_t$ ), however, is a complicated function of the structural parameters. To see this, use (2.9) into (2.8) to obtain:

$$g_{t+2} = (\alpha\beta + \beta^2\phi)(\alpha y_{t-1} + \phi g_t + \mu_t) + \beta\phi\varepsilon_{t+1} + \beta\mu_{t+1} + \varepsilon_{t+2}.$$

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<sup>13</sup>While the logic that follows is not new (see, for instance, Blinder (2004)), it is worth spelling it out in the context of our particular application.

Hence:

$$\frac{\partial g_{t+2}}{\partial \mu_t} = \alpha\beta + \beta^2\phi. \quad (2.19)$$

This gives us the *full* dynamic response of  $g$  to the output shock after two periods, which comprises the following two factors:

- (1) The fiscal policy rule response to additional changes in output in the following period, due to the autoregressive process that output follows  $(\alpha\beta)$ .
- (2) The second-order effect of the fiscal policy rule's response to the fiscal policy's expansionary effect in the first period  $(\beta^2\phi)$ .

Note that there is no *direct effect* of the output shock on government consumption through the fiscal policy rule in (2.19), stemming from our assumption that the system is VAR(1). Fiscal policy's direct response to the  $\mu_t$  shock already occurred in the first period. If we wanted to capture this entire effect, we would look at the cumulative impulse response function in period two, defined as:

$$\frac{\partial g_{t+1}}{\partial \mu_t} + \frac{\partial g_{t+2}}{\partial \mu_t} = \beta + \alpha\beta + \beta^2\phi.$$

However – and to conserve space – we will not be plotting the cumulative effect.

The second value of our impulse responses will therefore correspond to (2.19).<sup>14</sup>

**2.2.5.3. Interpretation.** As equation (2.1) makes clear, when we perform IV or GMM estimations and estimate the parameter  $\beta$ , we are measuring how government consumption reacts contemporaneously to *all* output movements, whether anticipated or not. In other words the IV and GMM estimations are able to address the issue of causality but not of forecastability, as by definition, we would not be able to forecast an unanticipated shock to output and hence the fiscal response. In contrast, in the VAR estimations, we will be isolating the effects of unanticipated output shocks on government consumption. As discussed in McCallum (1999), whether this particular exercise is valuable depends on the importance of unanticipated output shocks for government consumption compared to the effects of systematic (i.e., forecastable) changes in output. Since this is clearly an open question at this point, we remain agnostic on this issue and choose to use different techniques that allow us to investigate the effects on government consumption of both forecastable and unforecastable changes in output.

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<sup>14</sup>Needless to say, comparisons between the impulse responses and the other regressions will be further complicated by the fact that we are running a VARs with more lags than a VAR(1), for which all the above analysis is given. With a VAR(T) (T>3), the 4-quarter lagged impulse response of  $g$  to  $\mu$  ( $\partial g_{t+4}/\partial \mu_t$ ) is a complex formula including  $\beta_1 \dots \beta_4$ ,  $\alpha_1 \dots \alpha_3$  and  $\phi_1 \dots \phi_3$ . But the key message remains the same: the impulse response in the first period out captures  $\beta$ , whereas all ensuing values capture a complicated combination of structural parameters.

### 2.3. The data

In order to explore carefully the question of fiscal cyclicity, we use a quarterly data set measuring government spending, the business cycle, and control variables. A detailed description of the data appears in Appendix C. The data comprises 27 developing countries and 22 high-income countries. Income groupings are primarily based on the World Bank's classification in 2006.<sup>15</sup> To ensure the integrity of quarterly data, only developing countries who subscribe to the International Monetary Fund's (IMF's) Special Data Dissemination Standard are included. Only those years for which data was originally collected at quarterly frequency are included, and countries with less than 8 years (32 quarters) of data have been excluded. The coverage spans from as early as Q1 of 1960 to as late as Q4 of 2006, but varies from country to country. Similar results obtain when we use a balanced panel spanning the quarters 1996Q1 to 2006Q3. The main data source is the IMF's International Financial Statistics (IFS) database; as needed, we use national sources as well as the database of Agenor *et al* (2000) to expand the coverage.

The main variables of interest in exploring the cyclicity of fiscal policy are real central government spending, real general government consumption, and real GDP.

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<sup>15</sup>Israel was classified as a high-income country in 2006, but was a developing country for some of the sample period. Korea graduated into the high-income category in 2001. The Czech Republic became a high-income country in 2007. We classify these three countries as "developing" since they met this criterion for much of the sample. The exclusion of these three countries from the developing country sample or inclusion in the high-income sample does not alter our results.

As mentioned earlier, an exploration of the cyclicity of fiscal policy should focus on indicators that are under direct control of the fiscal authorities: government spending and tax rates. Since time series on tax rates are available for only a small number of countries, we focus on government spending: total expenditures and government consumption.

There is a trade-off in the choice of the government spending measure. While the use of a general government measure is more inclusive, as it includes both central and local governments, the use of central government spending is more in accordance with the principle of looking at fiscal policy instruments that are directly under the control of a single fiscal agent. On the other hand, total central government spending includes more spending categories, such as government investment and transfers, but also interest payments, which makes this measure more noisy. Much of the literature on the cyclicity of fiscal policy has used real central government spending (e.g. Kaminsky, Reinhart and Végh, 2004 and Alesina, Campante and Tabellini, 2008), while much of the literature on the effectiveness of fiscal policy in high-income countries has looked at government consumption or a combination of government consumption and investment (e.g. Blanchard and Perotti, 2002; and Perotti, 2004).



### 2.3.1. Variables of interest

Indices of real government spending and real government consumption are created as follows. We obtain real data directly from national sources, whenever available. For the remaining countries, we deflate nominal government spending measures with the consumer price index (CPI). Nominal government spending variables, normalized to one in a base quarter, are deflated using a CPI index with a similar base year. Measures of real government spending and consumption deflated by the CPI, the GDP deflator, or reported directly from national sources are highly correlated for countries where more than one of these variables are available.

Real gross domestic product is taken directly from national accounts.

As additional controls and instruments, we include exogenous shocks that may drive the business cycle. We instrument GDP with international financial conditions using a measure of global interest rates. Specifically, we use the real return on 6-month Treasury bills.<sup>16</sup> As in Jaimovich and Panizza (2007), we also use an instrument representing real external shocks, namely an index of the real GDP growth of each country's trading partners. The construction of this variable is discussed in Appendix C.

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<sup>16</sup>We use an adaptive-expectations measure of real interest rates. Results are identical with an ex-post measure of real interest rates.

All series (except for interest rates) are in logs and, when not reported in seasonally-adjusted terms, seasonally-adjusted using the X-11 algorithm. Seasonally adjusting the data using seasonal dummies yields similar results.

### **2.3.2. Annual data**

For estimations at the annual frequency, we use the dataset of Kaminsky, Reinhart, and Végh (2004). The data sources are different (primarily the IMF's World Economic Outlook). A detailed description of the data can be found in Kaminsky, Reinhart and Végh (2004). The sample of countries (21 high-income and 81 developing countries) and years (1961-2003) is larger. We sacrificed consistency of data sources between the quarterly and annual samples for the sake of a larger sample size.

## **2.4. Stylized facts**

Table 2.1 presents the basic stylized facts of our quarterly sample. The table presents regressions of (changes in the logs of) measures of real government spending against GDP. Results are of panel regressions with country fixed effects. The first column revisits the familiar stylized fact that government spending is procyclical in developing countries, regardless of the spending measure studied.

The results are statistically significant at the 99 percent confidence level. The second column presents the results of similar regressions for high-income countries. While government consumption is mildly procyclical, it is far less procyclical than in developing countries. We can reject at the 99 percent confidence level that the coefficient is the same for the two income groups. Total government spending, on the other hand, is acyclical. The estimation is, however, very imprecise, due to the smaller sample size.<sup>17</sup>

Table 2.2 shows similar results using annual data. All measures of government spending are highly procyclical in developing countries. In high-income countries, total government spending is acyclical, but government consumption and investment are procyclical. The main difference between high-income countries and developing countries is in total government spending, where we can establish that government spending is more procyclical in developing countries (with 99 percent confidence). The difference between the other measures in high-income and developing countries is not statistically significant.

In the last row of this table, we provide evidence of the acyclicity of interest payments in both income categories. This indicates that the cyclicity of debt

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<sup>17</sup>Appendix Table A1 in a longer version of this paper (Ilzetki and Végh (2008) ) repeats the OLS regression for government spending using industrial production as a proxy for output, which increases our sample size. The estimated parameters are virtually unchanged and we can still reject at the 99 percent confidence level that the cyclicity of government spending in the two income groups is the same.

service is not driving the cyclicity of total government spending. We conjecture that, in high-income countries, government spending is less countercyclical than government consumption largely because of transfers (most likely the automatic stabilizers that are in place in high-income countries).

In summary, a basic OLS regression reconfirms that government consumption and total spending are procyclical in developing countries. In high income countries, government consumption is procyclical but government spending is acyclical. With quarterly data, we can reject the hypothesis that the cyclicity of government spending and consumption is the same in the two income groups.

## 2.5. An Instrumental Variables Approach

We now turn to the question of causality. Is fiscal *policy* procyclical in developing countries, or is reverse causality driving these results? A natural approach is the use of instrumental variables to disentangle the direction of causality. Such an approach has been suggested by Rigobon (2004) and Jaimovich and Panizza (2007). We first conduct a similar exercise as in Jaimovich and Panizza (2007), using our quarterly data set.

To formalize our strategy, consider the estimation of equation (2.1) using panel data:

$$g_{i,t} = \alpha_1 + \beta y_{i,t} + \varepsilon_{1i,t}, \quad (2.20)$$

where  $y_{i,t}$  is the output of country  $i$  in quarter  $t$ ,  $g_{i,t}$  is real government consumption, and  $\beta$  is the parameter of interest, which reflects the cyclical nature of government consumption. Tables 1 and 2 estimate (2.20) using OLS regressions and find that government consumption is procyclical in developing countries. However, as (2.7) indicates, this estimate may be biased.

The typical procedure to correct for this bias when estimating the parameter  $\beta$  is to find a set of instrumental variables  $Z$  that are correlated with  $y$ , but such that  $E Z_{j,i,t} \varepsilon_{1i,t} = 0$ , where  $Z_{j,i,t}$  is the  $t^{\text{th}}$  observation on instrumental variable  $j$  for country  $i$ . This is precisely the strategy employed in Braun (2001), Lane (2003), Galí and Perotti (2003), and Jaimovich and Panizza (2007). As in the latter, we include the GDP growth of countries' trading partners as an instrument; as in the first three, we also include lagged GDP growth as an instrument. Finally, we add a third instrument: the real return on 6-month on six-month U.S. Treasury bills. We use this as a measure of global liquidity conditions that have an effect on the growth of small open economies.

Jaimovich and Panizza (2007) argue that the first of these instruments is valid. Trading partners' growth is correlated with output. There is no a priori reason to

suspect that external trade shocks have an effect on government spending except through the business cycle channel. Finally, it is unlikely that government spending of smaller economies has an effect on the growth rates of their trading partners, which include mainly larger economies. Similarly, the interest rate in the financial center may have an impact on the output of smaller countries, but we would not expect it to have a direct effect on government consumption. However, insofar as borrowing rates are correlated across countries, it does affect debt service, which is a component of total government spending. We therefore exclude this instrument when attempting to estimate the cyclicalities of total government spending. Finally, given that this interest rate may be affected by government expenditure in the United States (which is included in our high-income sample), we also exclude this instrument in estimating the cyclicalities of government spending in high-income countries.

In a panel regression with country fixed effects, we regress the change in (log) real government consumption on the change in (log) real GDP, where we instrument for the latter using the variables discussed above. We find that the contemporaneous value and one lag of trading partners' growth and one lag of the real interest rate on U.S. Treasuries have the best predictive power for GDP. In effect, we are estimating  $\beta$  in equation (2.1), using instrumental variables to correct for the potential bias suggested by (2.7).

As in Jaimovitch and Panizza, the estimates in a 2 stage least squares (2SLS) regression are inaccurate, with large standard errors. We further improve our estimates using GMM regressions. The 2SLS estimator is a special case of the GMM estimator, with the limitation that the variance-covariance matrix is restricted to be diagonal. Since heteroskedasticity and autocorrelation are both distinct possibilities in a dynamic panel of the sort used here, the 2SLS estimator is asymptotically less efficient than a more generalized GMM estimator. In our GMM estimations, we use a Newey-West (1987) estimate of the covariance matrix, which addresses both heteroskedasticity and autocorrelation.

The results are summarized in Tables 2.3 and 2.4. The OLS regressions, shown in the first row of each table, repeat the second and first rows of Table 2.1, respectively. Real government consumption is procyclical in both income groups, but far more so in developing countries. Total government expenditure is procyclical in developing countries, and appears to be countercyclical in high-income countries (although we cannot reject the hypothesis that government spending is acyclical there).

The next two rows report the results of the 2SLS and GMM regressions. Standard errors are in parenthesis. Table 2.3 summarizes the results for government consumption. In developing countries, the IV regressions confirm that government consumption is procyclical, with point estimates that are very similar to those

obtained in the OLS regression. For high-income countries, the IV regressions reaffirm the notion that government consumption is pretty much acyclical. The results for high-income countries imply that the 95 percent confidence interval is  $[0.15, -0.37]$ , indicating that with a high degree of confidence, we can assert that government consumption is either countercyclical or at most mildly procyclical. In the GMM regression, we can moreover reject at the 95 percent confidence level that government consumption in developing countries is no more procyclical than in high-income countries. In summary, the IV regressions reaffirm the conventional wisdom that government consumption is procyclical in developing countries, but acyclical in high-income countries.

Turning to total government spending, Table 2.4 summarizes the results. Unfortunately, the results for government spending in developing countries are rather inconclusive. The point estimates are in fact negative, indicating *countercyclical* government expenditures. However, the standard errors are very large, so that we cannot reject the null that government spending in developing countries is procyclical, countercyclical or acyclical. This results is similar to the one found by Jaimovich and Panizza (2007): they too obtain negative point estimates for the cyclicity of government spending in developing countries, but also have large standard errors, so that inferences on the cyclicity of fiscal policy are hard to



draw.<sup>18</sup> On the other hand, the instrumental variables regressions do support the notion that total government spending is countercyclical in high-income countries. In fact, the point estimates in the IV regressions show government expenditure decreasing more aggressively due to an increase in output than the OLS regressions estimated. (Only the GMM estimate is statistically significant, though.) In summary, the IV regressions reaffirm that government spending is countercyclical in high-income countries but gives inconclusive results for developing countries.

The lower panel in both tables gives the results of the first stage of the regressions. The coefficient estimates are highly statistically significant have the expected signs: trading partners' growth leads to higher GDP growth, high interest rates in the U.S. lead to lower growth, and GDP is positively autocorrelated. The coefficients are also jointly highly significant. However, in all reported regressions the F-statistics in the first stage are slightly lower than the threshold required to reject the hypothesis of weak instruments, based on the test proposed by Stock and Yogo (2002). Using the Sargan test, we can reject the hypothesis that system is overidentified in all the GMM regressions and in the 2SLS regression for government spending in high-income countries.

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<sup>18</sup>For the sake of comparison, in a working paper version (Ilzetzki and Végh, 2008) of this chapter we recreate Jaimovich and Panizza's (2007) results using annual data (see Table A2). As in Jaimovich and Panizza (2007), the standard errors are very large making inference from their results very difficult.

## 2.6. Simultaneous equations – OLS

The models estimated in the previous two sections assumed that government consumption responds to output within the same period. As we suggested, this approach makes sense with either annual data or with quarterly data to the extent that government spending can react to business cycle conditions within a quarter (if, for example, there is some form of automatic stabilization).

In this section, we assume that government consumption can only respond to business-cycle conditions with a one-quarter lag. This is similar to the identifying assumption in Blanchard and Perotti (2002), which we use in the VAR estimations of the following section. We estimate equations (2.8) and (2.9), using OLS with fixed effects. As indicated in section 2.2 OLS is not a biased estimator in this case.

The results are summarized in Table 2.5. Government consumption shows a highly statistically significant procyclical reaction (with a one-quarter lag) to output in both developing countries and high-income countries. There is also evidence that, in developing countries, government consumption has an expansionary effect on output.

## 2.7. A VAR approach

We now conduct panel vector autoregressions in an attempt to obtain further evidence on the dynamic reaction of fiscal policy to the business cycle. In the regressions that follow, we estimate Model 4:

$$AY_{i,t} = \sum_{k=1}^j C_k Y_{i,t-k} + Bu_{i,t}, \quad (2.21)$$

where  $Y_{i,t}$  is a vector of variables, reported for country  $i$  at quarter  $t$ . The vector  $Y$  includes the cyclical components of real government consumption and real GDP, as well as additional variables. Cyclical components are measured as deviations from the linear-quadratic trend. We obtain similar results when using differences in logs as in the previous estimations. We run bivariate regressions, in which the vector  $Y$  includes only the two endogenous variables of main interest. This specification is helpful since in some cases the two main variables are available for longer horizons than the other variables. This is also closer to the simple specification in Blanchard and Perotti (2002). In separate regressions – and for comparison purposes – we also control for the real return on 6-month U.S. Treasuries and the weighted growth of each country’s trading partners.

The matrix  $C_k$  measures the response of the variables in  $Y$  to a  $k$ -quarter lagged change in the model’s variables. For example, the appropriate element of

the matrix  $C_k$  will be an estimate of the lagged fiscal policy response (in terms of government consumption) to changes in GDP. The term  $\varepsilon_{i,t} = A^{-1}Bu_{i,t}$  is a vector of error terms reflecting one-period forecast errors of  $Y$ . As is common, we decompose this error term into a vector of structural shocks  $u_{i,t}$ . The matrix  $B$  is assumed to be diagonal, so that each structural shock has a direct effect on only one variable in  $Y$ . However, the matrix  $A$  reflects contemporaneous effects of the variables on one another.

We estimate (2.21) in the two specifications described (“bivariate” and “full”, the latter with additional controls). In each case, the number of included lags (ranging from 1 to 8 quarters) was determined based on the Schwartz information criterion. The choice of lags does not affect the results. We also included country fixed effects.<sup>19</sup>

### 2.7.1. Granger causality

We begin our time series analysis by conducting a Granger causality test of the two variables of interest. Table 2.6 reports these results. The top panel presents results

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<sup>19</sup>As Nickell (1981) has suggested, dynamic models with fixed effects may provide biased estimates. While this bias cannot be dismissed entirely for dynamic panels with short time series, Judson and Owen (1999) estimate that a VAR based on OLS with cross-sectional dummy variables provides less biased estimates than Arellano-Bond (1991) type estimators, in unbalanced panels with at least 30 longitudinal observations. This condition is met for all countries in our sample.

for developing countries and the bottom for high-income countries. We report the results of Wald tests for the exclusion of lags of real GDP from the regression where real government consumption is the dependent variable and conversely for the exclusion of lags of real government consumption from the real GDP regression.

A robust result emerging from the test is that we can reject at the 99 percent confidence level for both income groups the null that the business cycle does not Granger-cause government consumption. Meanwhile, the null that government consumption does not Granger cause GDP is rejected only in the full specification for both high income countries and developing countries. This provides evidence that the co-movement of these two variables is likely due to a policy response, rather than a reverse effect of government consumption on output.

### **2.7.2. Impulse responses**

The system described by (2.21) is under-identified without further assumptions about the matrix  $A$ . We make the following identifying assumptions:

- (1) Government consumption requires at least one quarter to respond to GDP (and other variables). This assumption, whose logic is founded on the fact

that fiscal policy has inherent implementation lags, follows Blanchard and Perotti (2002).<sup>20</sup>

- (2) As before, we assume that the real interest rate on 6-month U.S. Treasuries and the weighted growth of countries' trading partners cannot be affected by other variables (or each other). We exclude the U.S. from the high-income country sample to make the exogeneity of these variables more plausible in this income group.

The estimated impulse responses for developing countries are shown in Figures 2.1-2.2. Dotted lines reflect two-standard-deviation bands. Figures 2.1 and 2.2 present the responses of GDP and government consumption, respectively, to a 10 percent impulse to the two variables. In Figure 2.1, a 10 percent positive shock to government consumption leads to a statistically significant effect on output of about 0.96 percent on impact and a peak effect in quarter 3 of 1.1 percent. Given an average share of government consumption in GDP in our sample of developing countries of 17.4 percent, these figures translate into multipliers of 0.55 on impact and 0.63 at the peak. On the other hand, Figure 2.2 shows that a 10 percent shock

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<sup>20</sup>Notice that this identifying assumption is not necessarily inconsistent with the GMM results of Table 2.5 since in that case the contemporaneous impact of output on government spending captures both anticipated and unanticipated changes in output whereas in the VAR case the contemporaneous effect refers only to unanticipated changes. In other words, it seems plausible to argue that while *anticipated* changes in output can affect government spending contemporaneously (through fiscal rules), *unanticipated* changes cannot (due to implementation lags).

to GDP leads to an increase of around 3 percent in government consumption after two quarters. We thus see evidence of both procyclical government consumption and an expansionary effect of fiscal policy. Taken together, these effects imply that procyclical fiscal policy tends to reinforce the underlying business cycle.<sup>21</sup>

Figures 2.3 and 2.4 repeat the exercise for high-income countries. Figure 2.3 shows that a 10 percent shock to government consumption leads to a significant output effect on impact of 0.72 percent and to a peak effect in quarter 9 of 1.7 percent. Given an average ratio of government consumption to GDP in our sample of high income countries of 18.6 percent, these figures translate into multipliers of 0.39 on impact and 0.91 at the peak. At the same time a 10 percent shock to GDP does not appear to have a statistically significant effect on government consumption in the first four quarters following the shock. In the long term, however, government consumption does increase by close to 5 percent. This medium-term procyclicality of government consumption has been observed elsewhere (see Ravn

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<sup>21</sup>Our identifying assumption relies on the fact that government consumption cannot respond contemporaneously to shocks. The same identifying assumption is not valid for total government spending, since this variable also includes automatic stabilizers, which may respond to business cycle shocks within the same quarter. In spite of that, we show in Ilzetzki and Végh (2008) that the result regarding the procyclicality of government consumption in developing countries carries over to total government spending. This result holds regardless of whether government spending or GDP is ordered first. The working paper version also includes the impulse responses for the full model (i.e., adding trading partners' growth and real interest rates on 6-month Treasuries) and shows that the same results carry over.

and Simonelli, 2007, figure 1-A for example).<sup>22</sup> Thus government consumption shows a procyclical response with long delays.

Figures 2.5-2.8 repeat the exercise of Figures 2.1-2.4, this time with the full specification. The results are robust to the inclusion of the additional controls.

Finally, Figures 2.9-2.12 present the results of bivariate VAR regressions with total government spending instead of government consumption. An interesting contrast emerges: regardless of the ordering of the variables, total government spending appears to respond *countercyclically* in high-income countries, but *procyclically* in low income countries. This is consistent with the idea that, in high-income countries, the countercyclicality of transfer renders government spending (as opposed to government consumption) countercyclical.

## 2.8. Conclusions

This chapter has used a novel quarterly data set comprising 49 countries and spanning the period 1960-2006 to analyze whether the positive correlation between (the cyclical components of) government consumption and output commonly identified in the literature does indeed capture procyclical fiscal policy (i.e., a causal effect of output on government spending) or instead reflects reverse causality (i.e.,

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<sup>22</sup>Figure 1-A in Ravn and Simonelli (2007) in fact shows the impulse response of government consumption to a TFP shock, while here the shock is to GDP. Still, the results are qualitatively similar.



a causal effect of government consumption on output). We have used various econometric methods to address this issue: instrumental variables, GMM, OLS estimation of simultaneous equations, Granger causality tests, and impulse responses from an estimated VAR.

We find overwhelming support for the existence, in developing countries, of a causal positive relation from output to government consumption. Our analysis thus leaves no doubt that fiscal policy is indeed procyclical in developing countries. Some commentators on the macroeconomic policies of developing countries have argued that in the past decade, many developing countries have finally got their "fiscal house in order". Our dataset sheds some light on these assertions. Figure 2.13 shows the cyclicity of government consumption in a number of developing countries before and after the year 2000. We see that with some minor exceptions government consumption in developing countries is no less procyclical than it had been in the past. However, given the great growth spurt in the developing world in the period 2000-2006, the true test of the capacity of developing countries to conduct countercyclical fiscal policies will be found in these countries' response to the current global economic slowdown.

Interestingly enough – and contrary to the typical finding in the literature – we also find substantial evidence of procyclicality of government consumption, but not of total government expenditure, in high-income countries. Together with

the recent debates on fiscal policy in high-income countries, with some countries currently showing a desire for large discretionary fiscal stimuli, and others expressing reticence, it is apparent that the question of the cyclical properties of fiscal policy in industrialized countries is far from settled. Specifically, the role of government transfers—constituting the main difference between government spending and consumption—appears to be an important avenue for future research.

Finally, by taking into account possible reverse causality, we have also identified a significant expansionary effect of government consumption on output in developing countries (a channel that has been disregarded so far in the literature). This provides empirical support for the when-it-rains-it-pours hypothesis: procyclical government consumption in developing countries implies that fiscal policy exacerbates the business cycle. We also find some support for this channel in high-income countries.

## Tables and Figures

**Table 1.1**  
 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, and the time period of the correlation varies from country to country.

In the case of several developing countries only short time periods are available. The reported cyclicity of interest expenditure is therefore only indicative that the cyclicity of government expenditure is not driven by interest payments, rather than being a precise measurement of its cyclicity.

**Table 1.2**  
Correlation between Government Expenditure and GDP  
Comparison along the business cycle

Developing Countries	
All Periods	.37
Excluding Crises	.33
Periods with Output Above Trend	.25
Periods with Output Below Trend	.29

Annual data. Cyclical component estimated using Hodrick-Prescott filter.  
Source: IMF WEO. Correlations are between 1970 and 2003.  
Crisis periods are defined as periods when the cyclical component of GDP is two or more standard deviations below trend.  
n=81

**Table 1.3**  
Average Ethnic Fractionalization  
Standard Errors in Parenthesis

	Countries with countercyclical government expenditures	Countries with procyclical government expenditures
	.26 (.052)	.49 (.029)
n	20	82

Source: Fractionalization data from Alesina et al (2003).  
Fiscal data from IMF WEO. Correlations are between 1970 and 2003.  
Cyclical components estimated using a Hodrick-Prescott filter.

**Table 1.4: Determinants of Fiscal Procyclicality**

Dependent Variable: Correlation btw. Government Expenditure and Output

	1	2	3
GDP per Capita (in thousands)	-0.15 *** (0.02)		-0.09 *** (0.02)
Ethnic Fractionalization	-	0.38 *** (0.13)	0.25 ** (0.12)
Government Stability	-	-0.07 * (0.04)	-0.07 * (0.04)
n	93	92	84
Adj. R-squared	.36	.13	.39

Standard errors in parenthesis, \*, \*\*, \*\*\* denote significance at 10, 5, and 1 percent level, respectively.

HP-filtered cyclical components of total real central government expenditures and real GDP

from 1970 to 2003, using IMF WEO data. Correlation is between the cyclical components.

PPP GDP per capita in US\$ in 1970 is from the Heston, Summers, and Aten (2002) database.

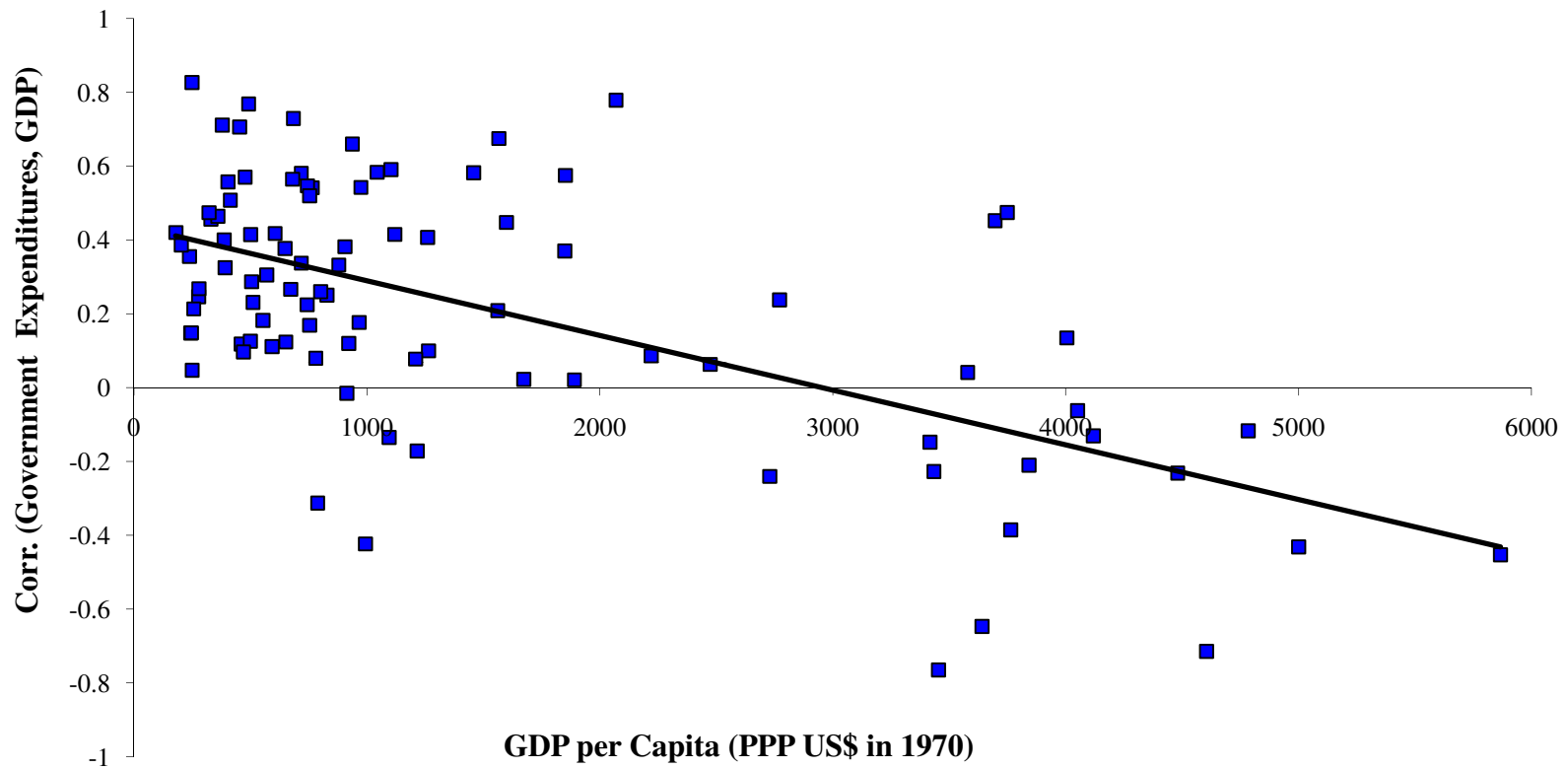
The index of ethnic fractionalization is taken from Alesina et al (2003).

The government stability index is from the International Country Risk Guide (2004).

**Table 1.5**  
**Parameter Values**

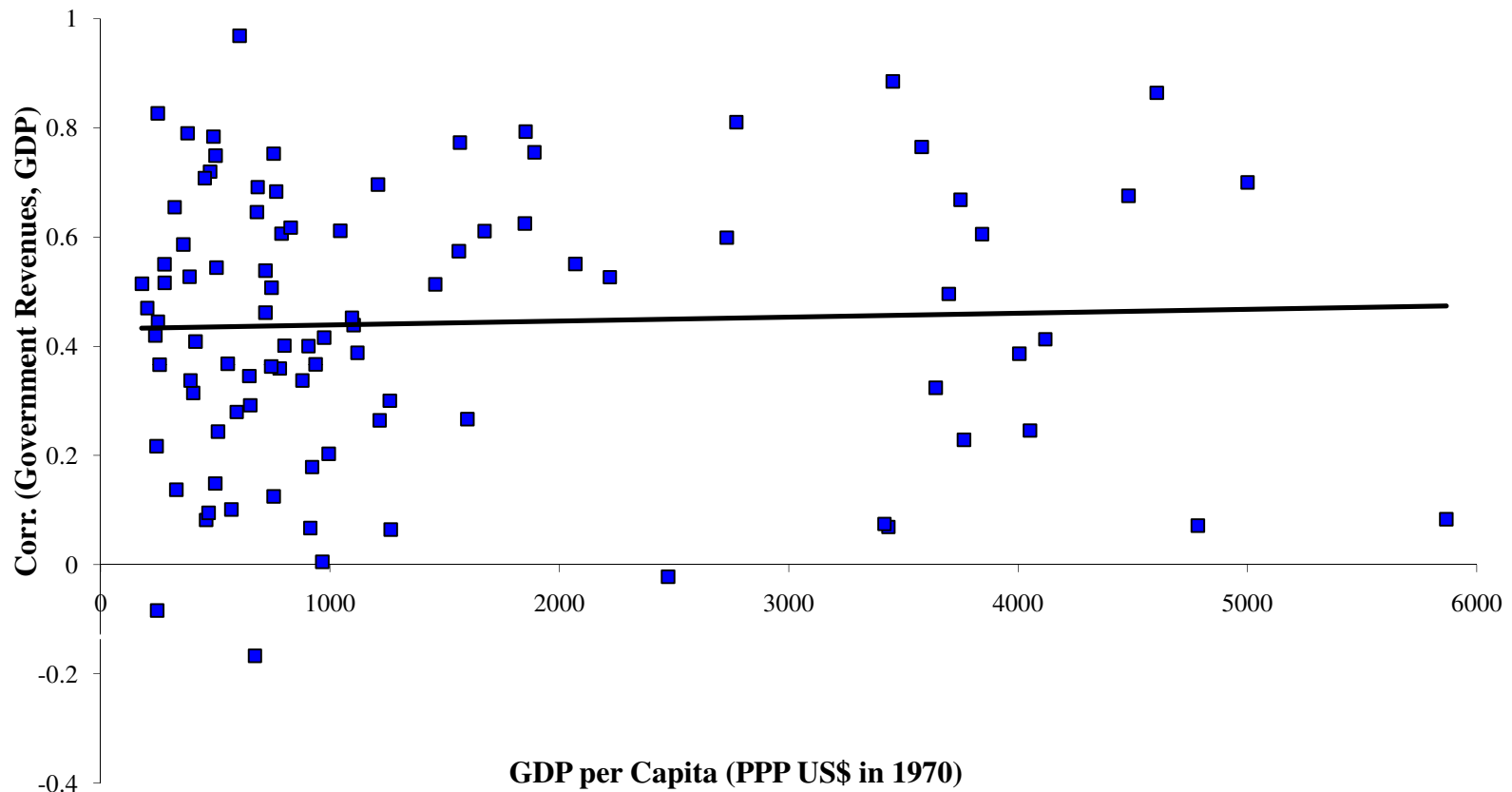
Parameter	Value (U.S./Argentina)	Source
$\sigma$	.0144 / .079	Cooley and Precott (1995), adapted to annual data/ Author's estimate from IMF WEO data
$\rho$	0.81 / 0.56	Cooley and Precott (1995), adapted to annual data/ Author's estimate from IMF WEO data
$\gamma$	2	
$\varepsilon$	1.7	Greenwood, Hercowitz, and Huffman (1998)
$r$	2.4% / 6.4%	Average annual real yield on 10-year U.S. Treasury Bonds (source: IMF) augmented by 400 basis points which was a typical bond spread for Latin American Economies in the 1990s (Table 3 in Eichengreen and Mody (1998) )
$\beta$	0.976 / .934	Set to match the average debt-to-GDP ratios between 1970 and 2003 of 43% in the U.S. (source: Congressional Budget Office) / 19% in Argentina (source: World Bank Debt Tables and IFS).
$g/GDP$	11% / 4.5%	Average central government consumption as a percent of GDP over the period in the U.S./Argentina
$p$	0.9 / 0.8	Average probability that incumbent's party retains office in a given <i>year</i> in the U.S. / Argentina in the 20th century.

**Figure 1.1: Cyclicalities 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.

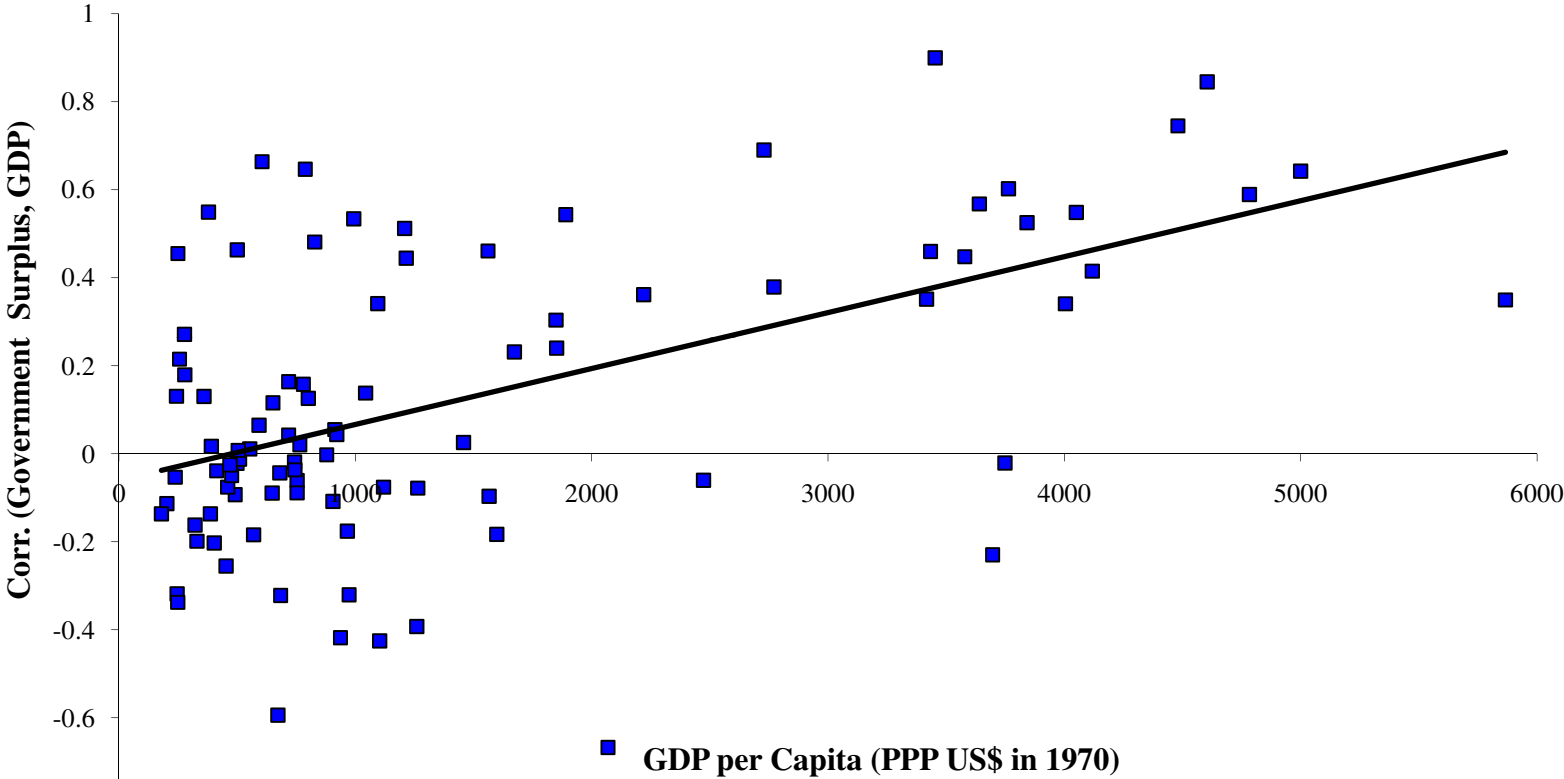
**Figure 1.2: Cyclical components of Government Revenues vs. GDP per Capita**



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.

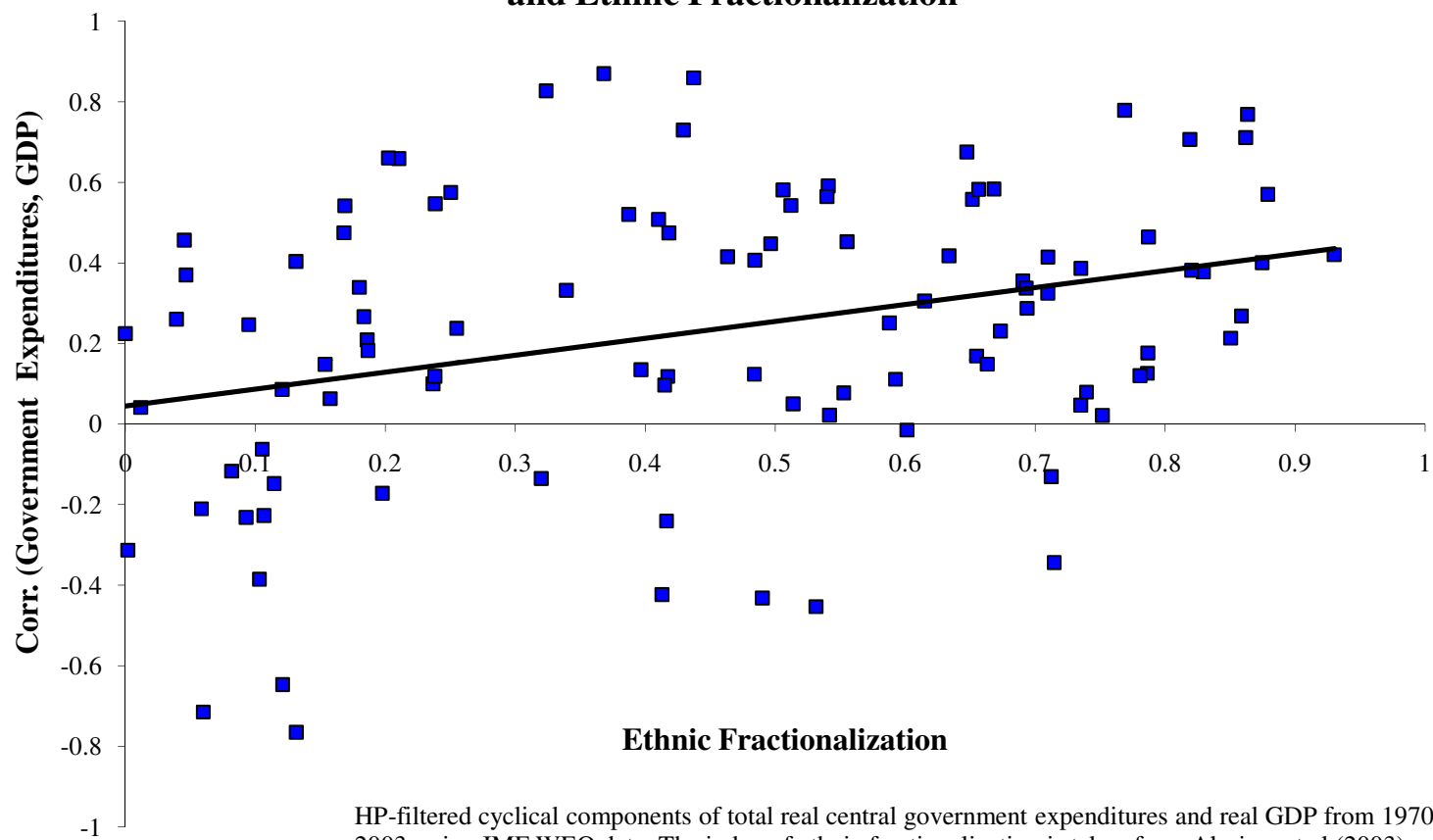


**Figure 1.3: Cyclicality of Government Surplus vs. GDP per Capita**

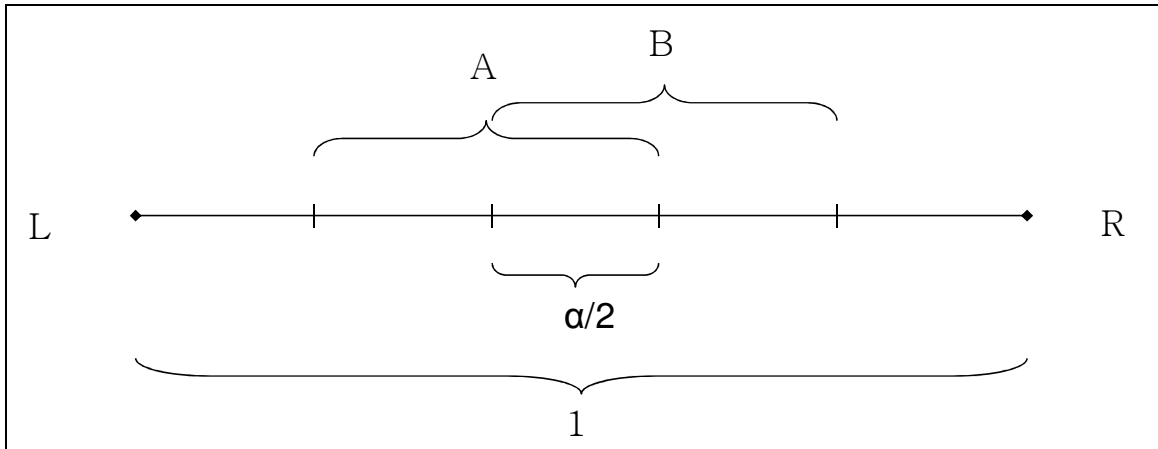


HP-filtered cyclical components of total real central government surplus and real GDP from 1970 to 2003, using IMF WEO data. PPP GDP per capita in US\$ in 1970 is from the Heston, Summers, and Aten (2002) database.

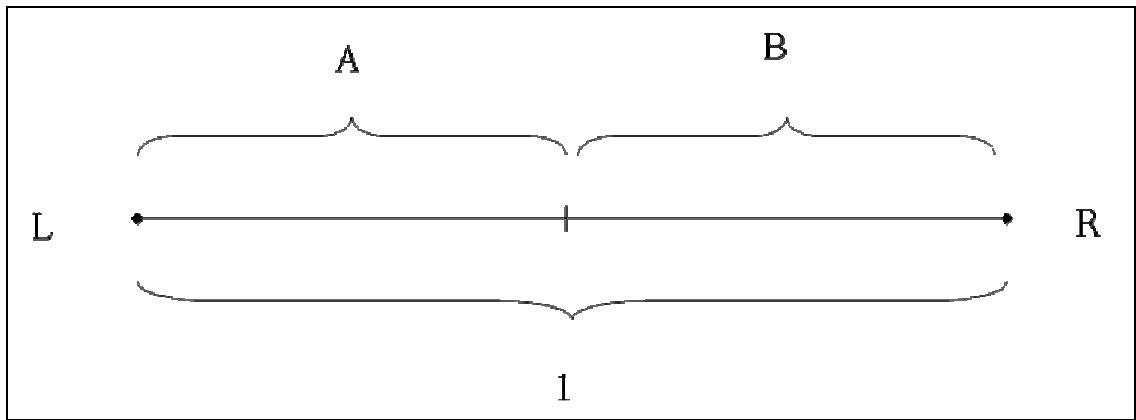
**Figure 1.4: Cyclicity of Government Expenditures and Ethnic Fractionalization**



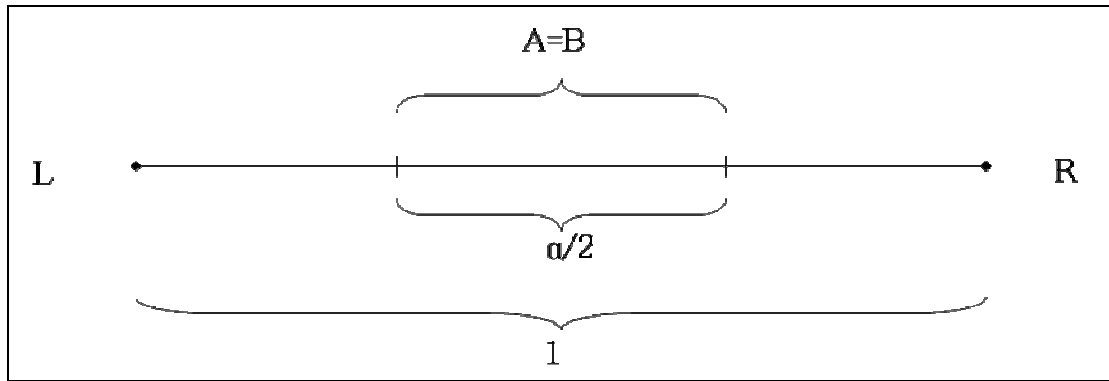
**Figure 1.5: Political Structure**



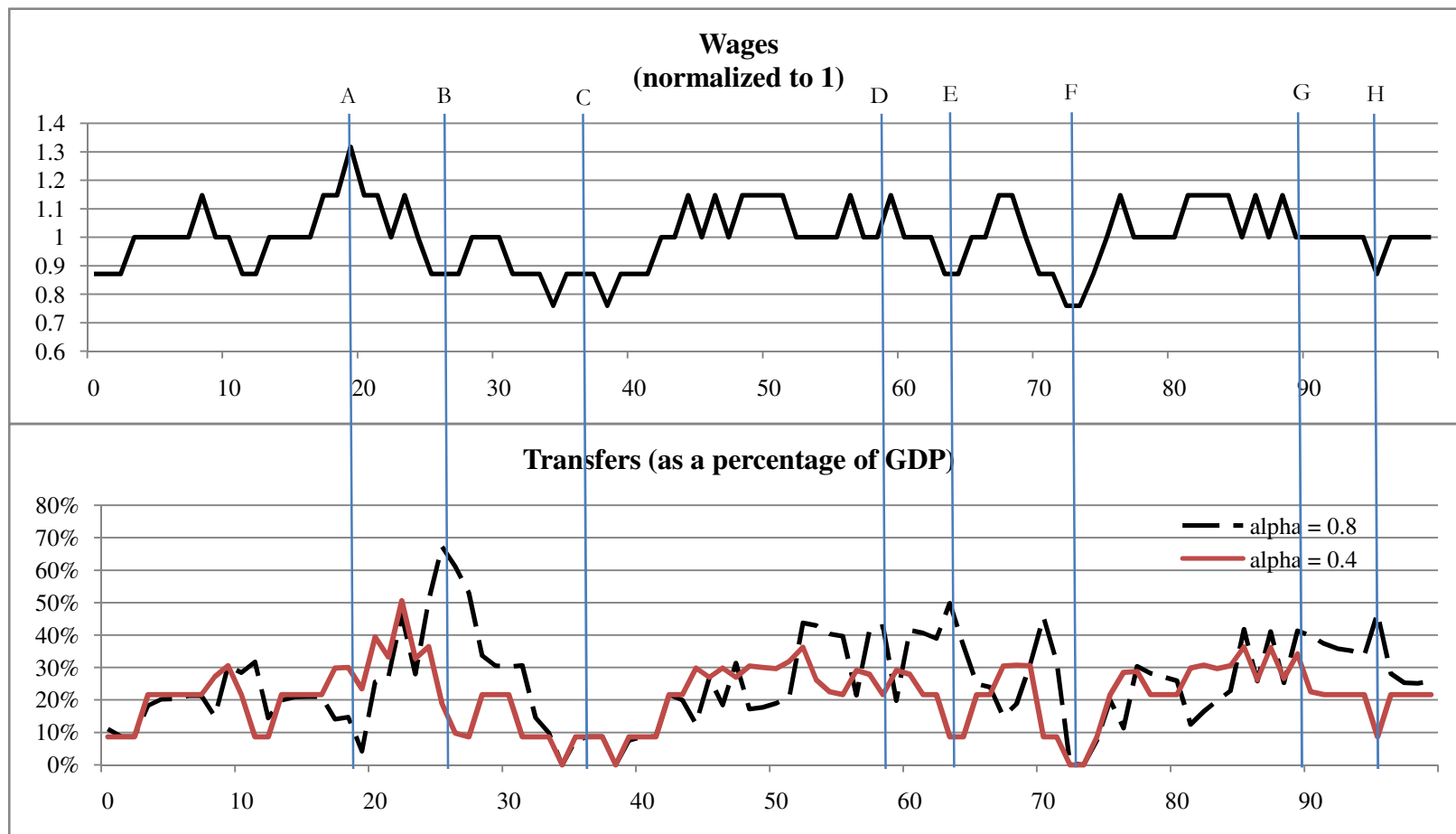
$\alpha=0$



$\alpha=1$

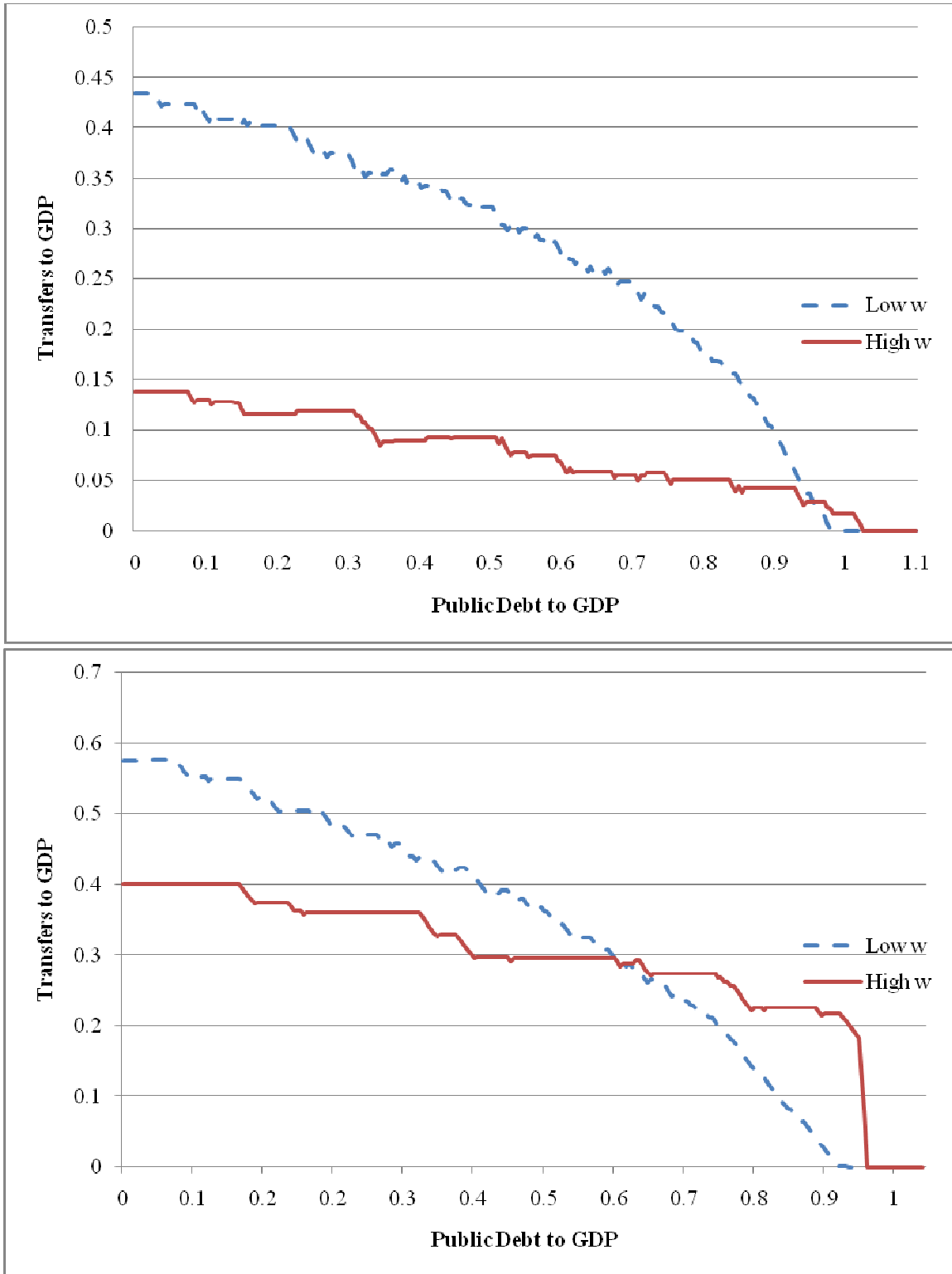


**Figure 1.6: Response of Government Transfers (T) to Wage Shocks**  
 $\alpha=0.8$  and  $\alpha=0.4$



**Figure 1.7: Decision Rule for Government Transfers (T)**

$\alpha=0.8$  (upper panel) and  $\alpha=0.4$  (lower panel)



**Figure 1.8: Government Expenditures and Political Cohesion**

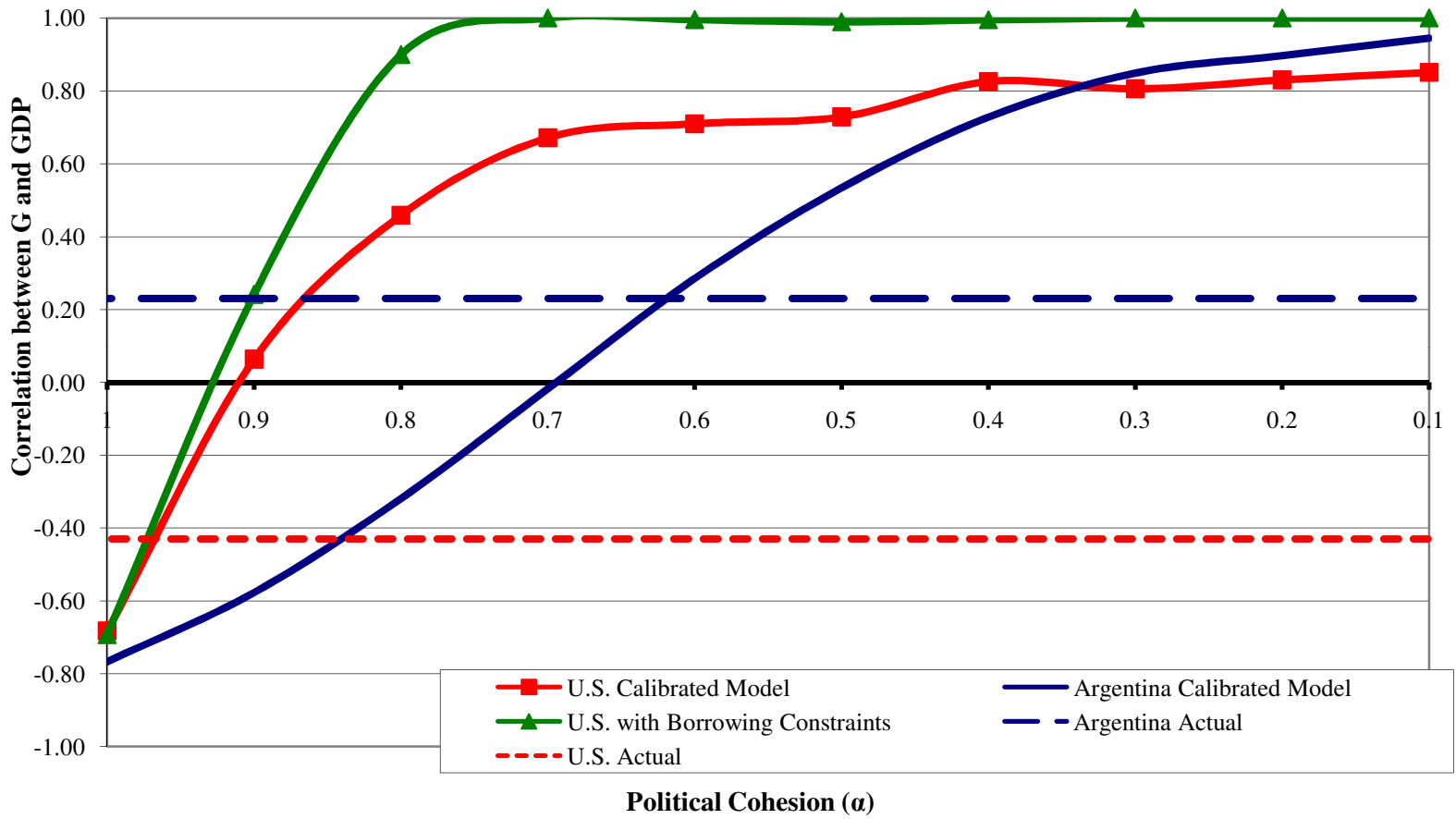


Figure 1.9: Government Revenues and Political Cohesion

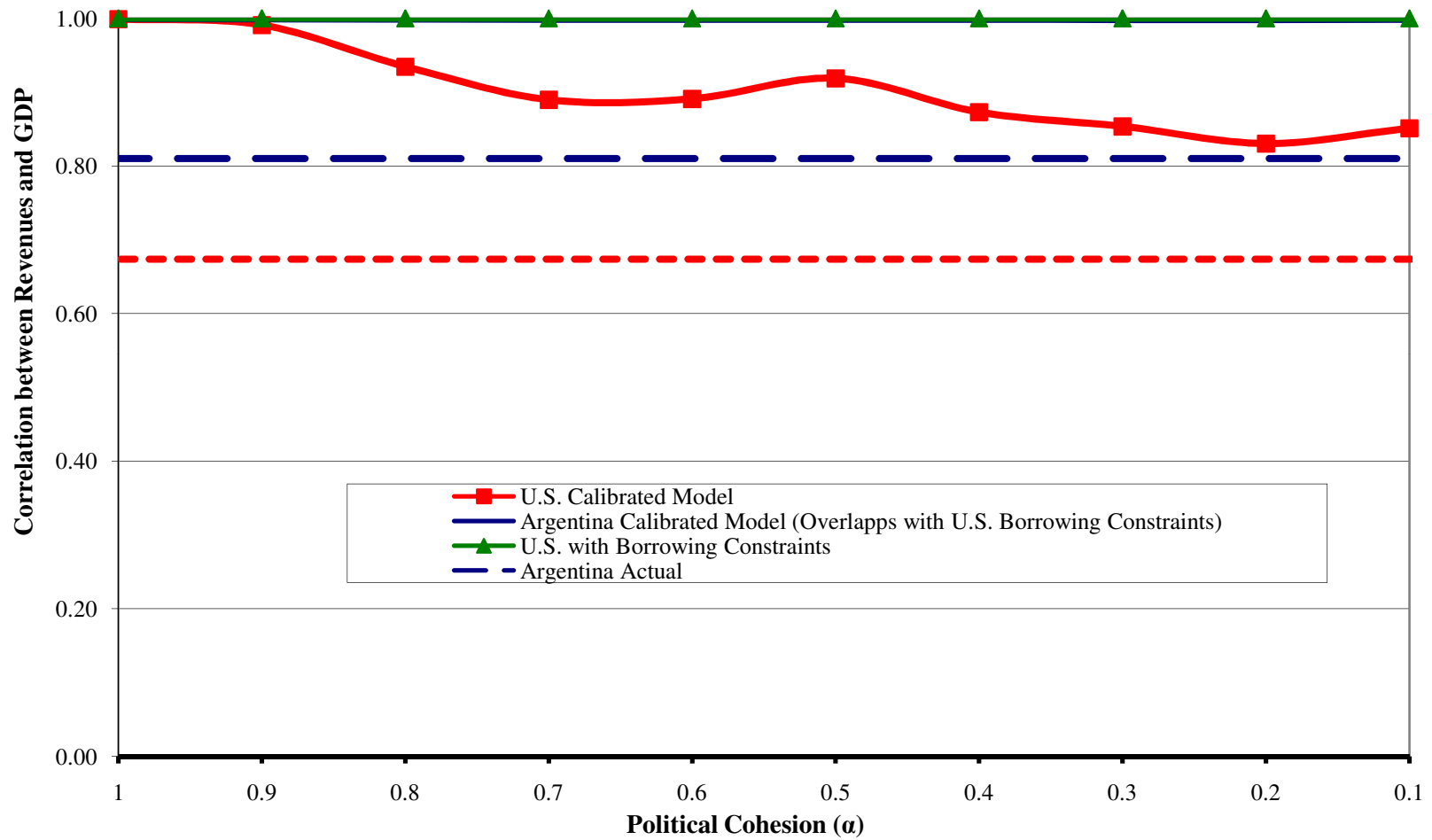
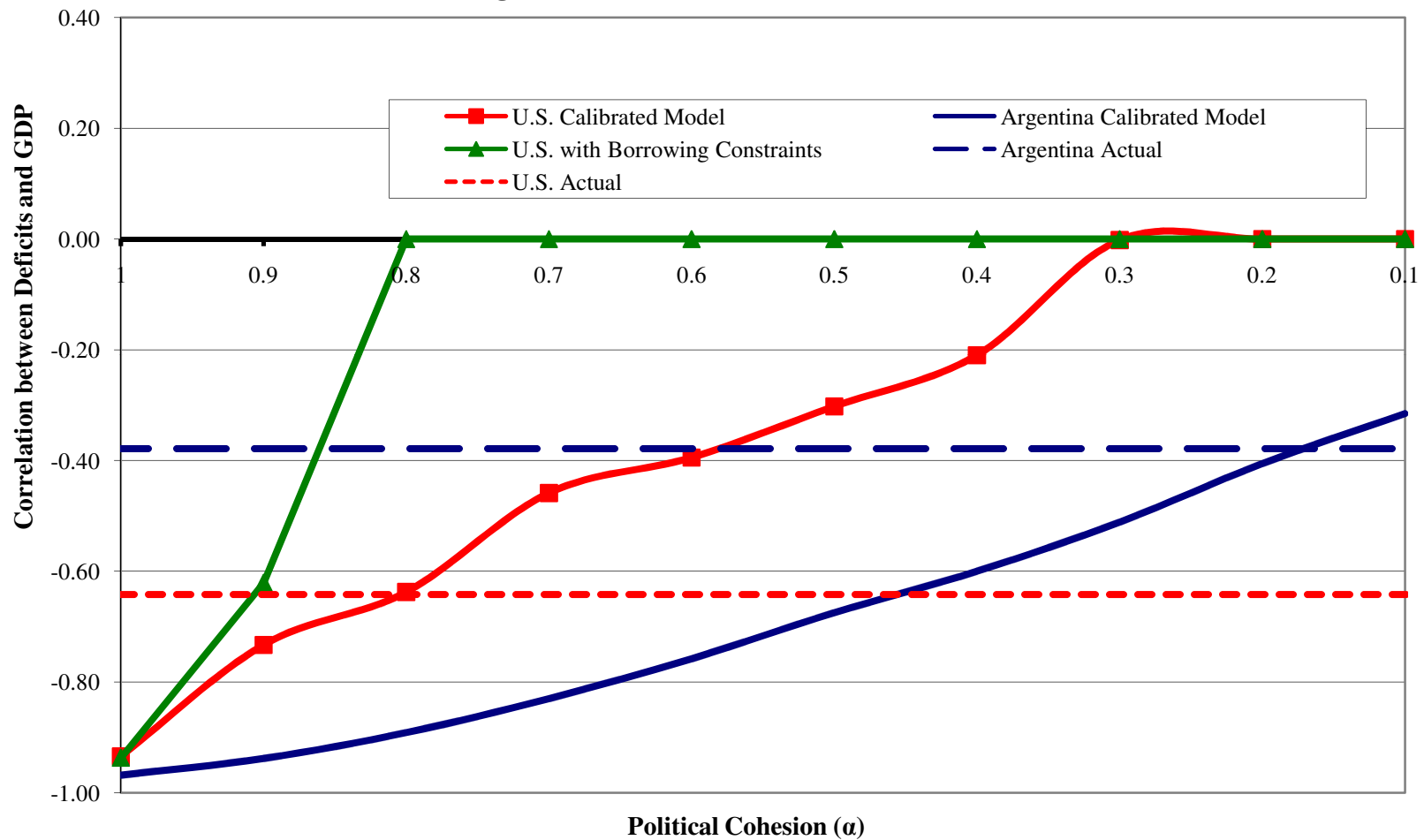
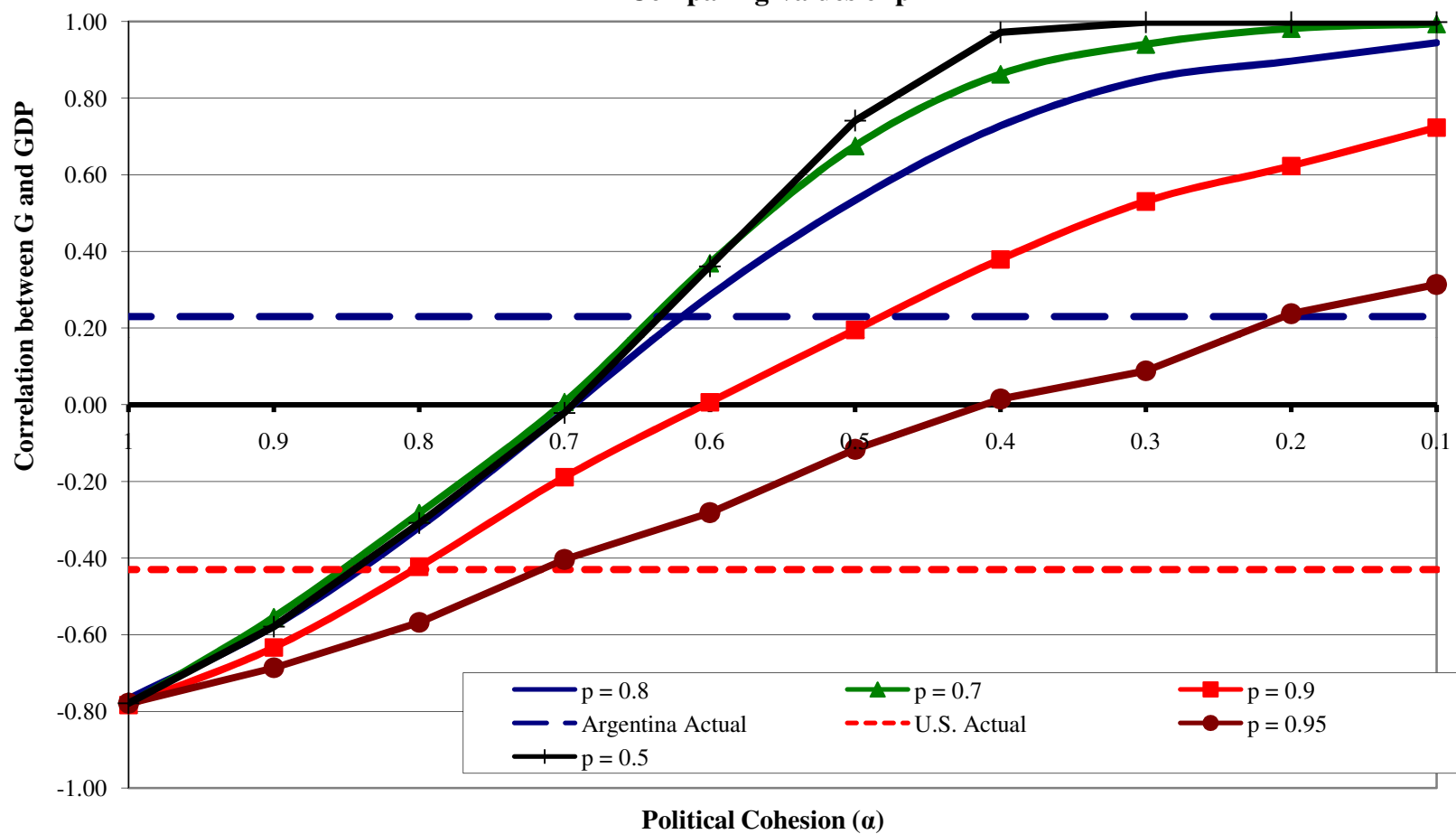


Figure 1.10: Government Deficit and Political Cohesion





**Figure 1.11: Government Expenditures and Political Cohesion  
Comparing Values of p**



**Table 2.1: Stylized Facts**

Dependent Variable: Change in Log Real Government Spending Variable

Independent Variable: Change in Log Real GDP

	Developing Countries	High-Income Countries
Government Spending	0.51 *** (0.13)	-0.05 (0.37)
Government Consumption	0.48 *** (0.06)	0.11 *** (0.03)
n (Spend.)	1286	852
n (Consum.)	1598	1946

Standard errors in parenthesis, \*, \*\*, \*\*\* denote significance at 10, 5, and 1 percent level, respectively.

**Table 2.2: Cyclicity of Government Spending--Composition**  
 Dependent Variable: Change in Log Real Government Spending Variable  
 Independent Variable: Change in Log Real GDP  
 Annual Data

	Developing Countries	High-Income Countries
Government Spending	0.93 *** (0.05)	0.08 (0.11)
Government Consumption	0.31 *** (0.14)	0.51 *** (0.07)
Government Capital Formation	1.31 *** (0.14)	1.22 *** (0.37)
Interest Payments	-0.07 (0.28)	-0.09 (0.30)
n (Expend.)	3139	754
n (Consum.)	2945	789
n (Interest)	1178	509

Standard errors in parenthesis, \*, \*\*, \*\*\* denote significance at 10, 5, and 1 percent level, respectively.

**Table 2.3: OLS and IV Estimates: Government Consumption**

Dependent Variable: Change in Real Government Consumption

Instrumented Variable: Change in Real GDP

Instruments: Weighted GDP Growth of Trading Partners , the Real Interest Rate on 6-month U.S. Treasuries, and lagged GDP Growth

	Developing Countries	High-Income Countries
OLS	0.50 *** (0.07)	0.14 *** (0.04)
2SLS	0.47 * (0.27)	-0.07 (0.15)
GMM	0.58 ** (0.23)	-0.11 (0.13)
n	1293	1572

Standard errors in parenthesis, \*, \*\*, \*\*\* denote significance at 10, 5, and 1 percent level, respectively.

**First Stage**

Dependent Variable: Change in Real GDP

	Developing Countries	High-Income Countries
Trading Partners' Growth	2.09 *** (0.30)	0.46 *** (0.08)
Trading Partners' Growth (-1)	0.99 *** (0.31)	0.60 *** (0.15)
Real U.S. Treasuries	-0.17 *** (0.037)	-
Lagged GDP Growth	0.13 *** (0.025)	0.05 ** (0.02)
F-Statistic	7.0	10.1

The critical value for Stock and Yogo weak instruments test is 11.59

**Table 2.4: OLS and IV Estimates: Government Spending**  
 Dependent Variable: Change in Real Government Expenditure

Instrumented Variable: Change in Real GDP

Instruments: Weighted GDP Growth of Trading Partners , the Real Interest Rate on 6-month U.S. Treasuries, and lagged GDP Growth

	Developing Countries	High-Income Countries
OLS	0.62 *** (0.14)	-0.34 (0.56)
2SLS	-0.24 (0.52)	-1.81 (1.50)
GMM	-0.41 (0.43)	-1.56 ** (0.77)
n	1051	701

Standard errors in parenthesis, \*, \*\*, \*\*\* denote significance at 10, 5, and 1 percent level, respectively.

### First Stage

Dependent Variable: Change in Real GDP

	Developing Countries	High-Income Countries
Trading Partners' Growth	2.05 *** (0.30)	0.95 *** (0.13)
Trading Partners' Growth (-1)	0.84 *** (0.31)	0.38 *** (0.13)
Real U.S. Treasuries	-	-
Lagged GDP Growth	0.15 *** (0.02)	0.17 *** (0.04)
F-Statistic	6.4	10.2

The critical value for Stock and Yogo weak instruments test is 11.59

**Table 2.5: OLS Estimates--Simultaneous Equations**

Equation 1: Dependent Variable--(Detrended Log) Real Government Consumption

Independent Variable: (Detrended Log) Real GDP (1Q Lagged)

	Developing Countries	High-Income Countries
GDP (-1)	0.38 *** (0.03)	0.53 *** (0.02)
n	1608	1947

Equation 2: Dependent Variable--(Detrended Log) Real GDP

Independent Variables: (Detrended Logs of) Real Government Consumption and Real GDP (1Q lagged)

	Developing Countries	High-Income Countries
Government Consumption	0.05 *** (.01)	0.01 (0.01)
GDP(-1)	0.87 *** (0.01)	0.93 *** (0.01)

Standard errors in parenthesis, \*, \*\*, \*\*\* denote significance at 10, 5, and 1 percent level, respectively.

**Table 2.6**  
Wald Test for Granger Causality/Block Exogeneity  
Reported Chi-Squared (p-statistic in parenthesis)

<b>Developing Countries</b>		
Excluded Variable	Bivariate	Full
Real Government Consumption	6.96 (0.14)	14.00 *** (0.72)
Real GDP	35.1 *** (0.00)	34.1 *** (0.00)
n	1517	1297

\* Null rejected with 90% confidence

\*\* Null rejected with 95% confidence

\*\*\* Null rejected with 99% confidence

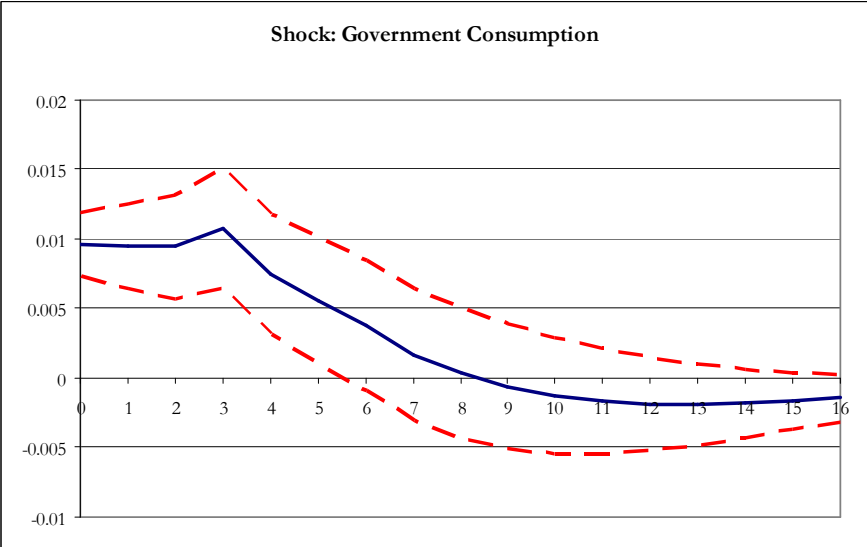
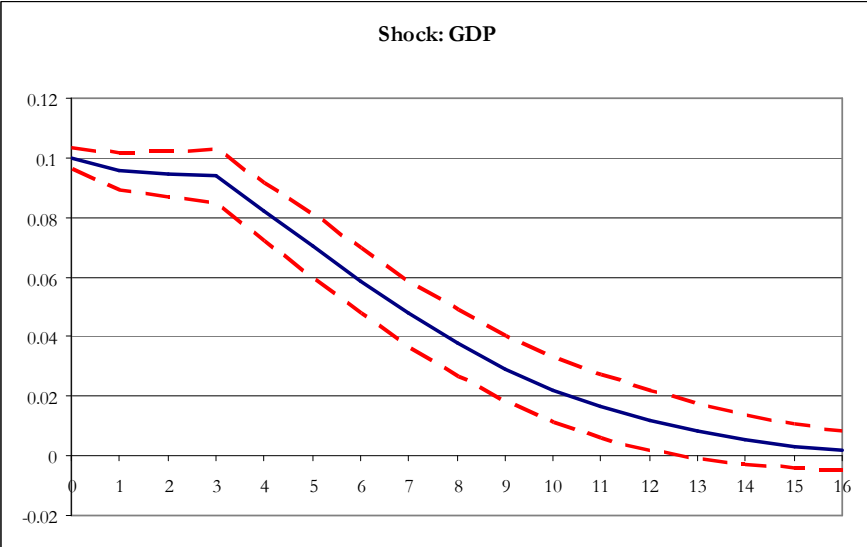
<b>High-Income Countries</b>		
Excluded Variable	Bivariate	Full
Real Government Consumption	12.6 (0.13)	20.5 *** (0.00)
Real GDP	61.5 *** (0.00)	42.8 *** (0.00)
n	1685	1374

\* Null rejected with 90% confidence

\*\* Null rejected with 95% confidence

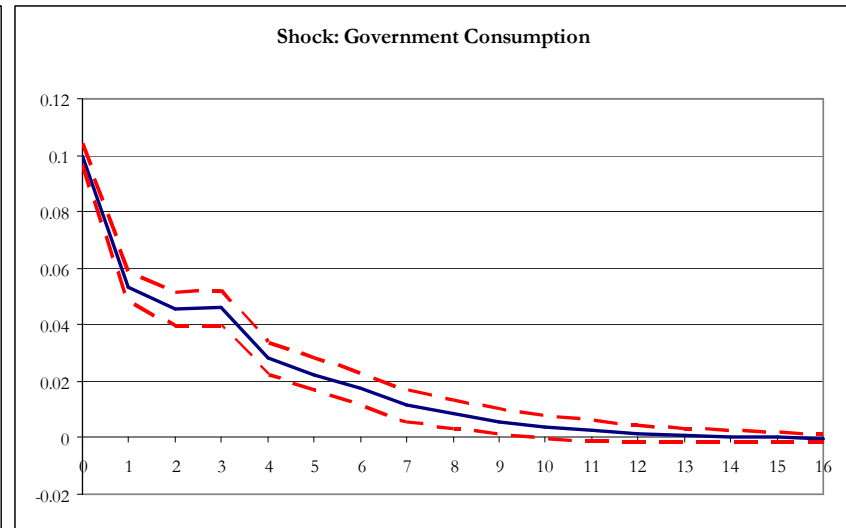
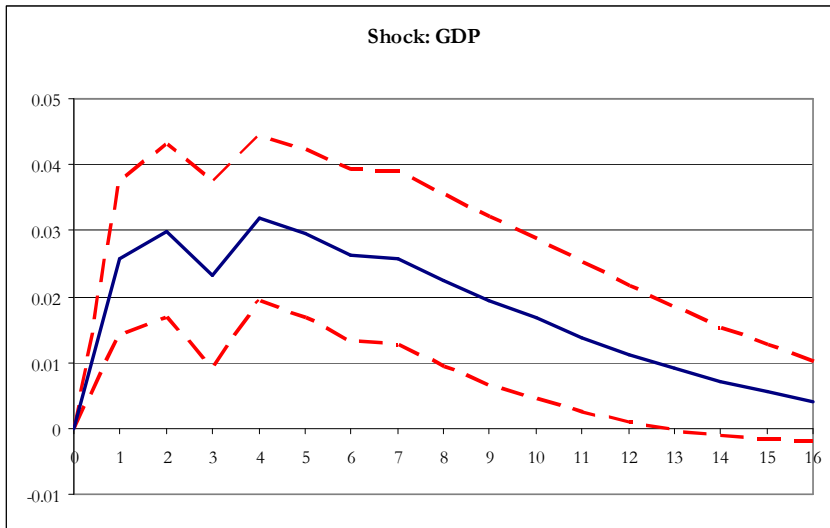
\*\*\* Null rejected with 99% confidence

**Figure 2.1**  
**Developing Countries**  
**Bivariate VAR**  
**Response of Real GDP to Shocks**

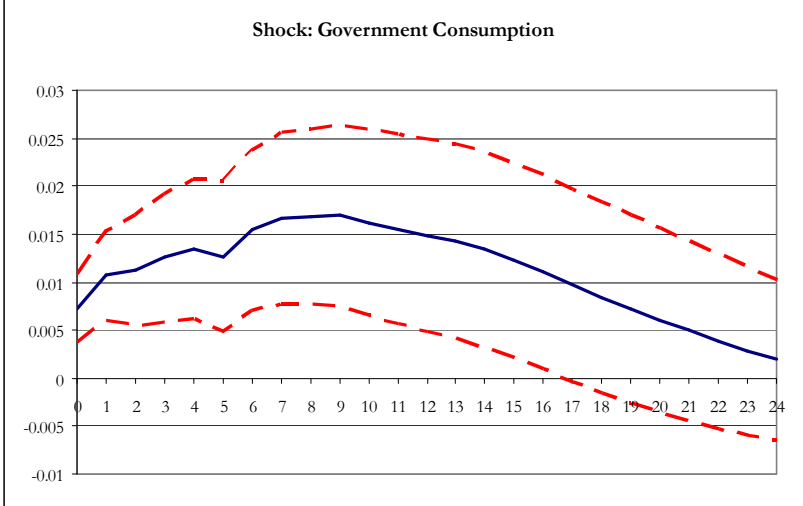
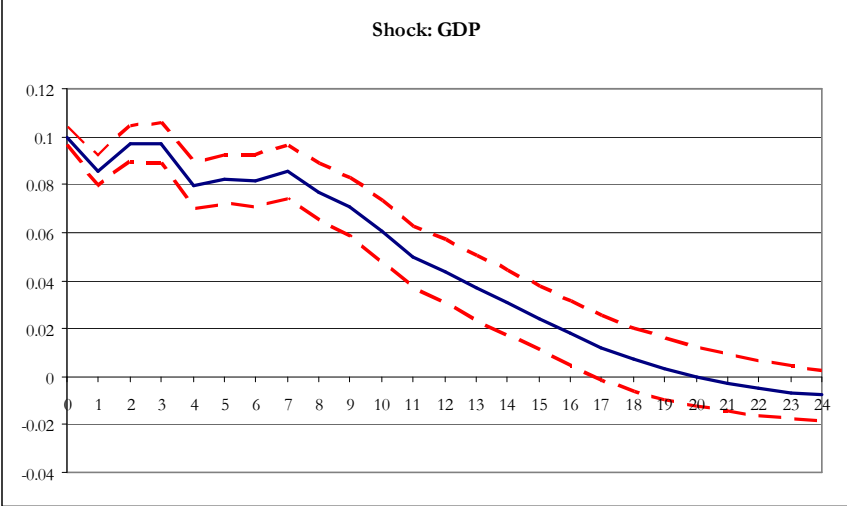




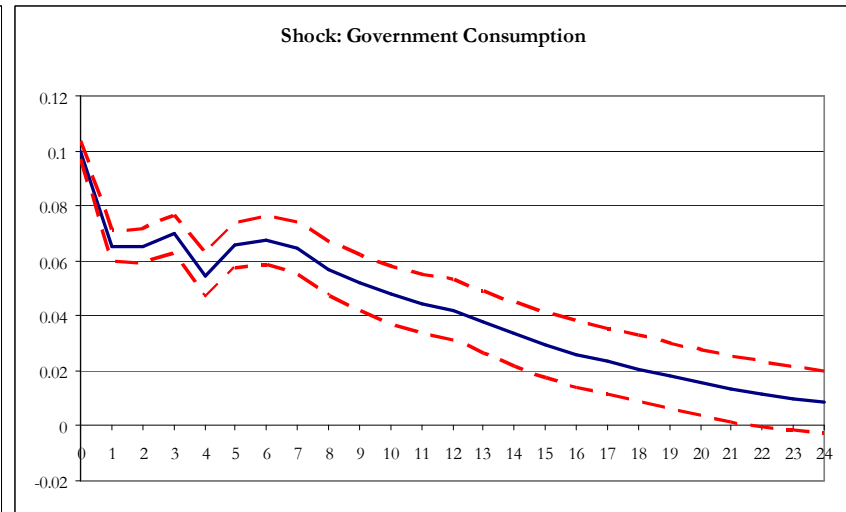
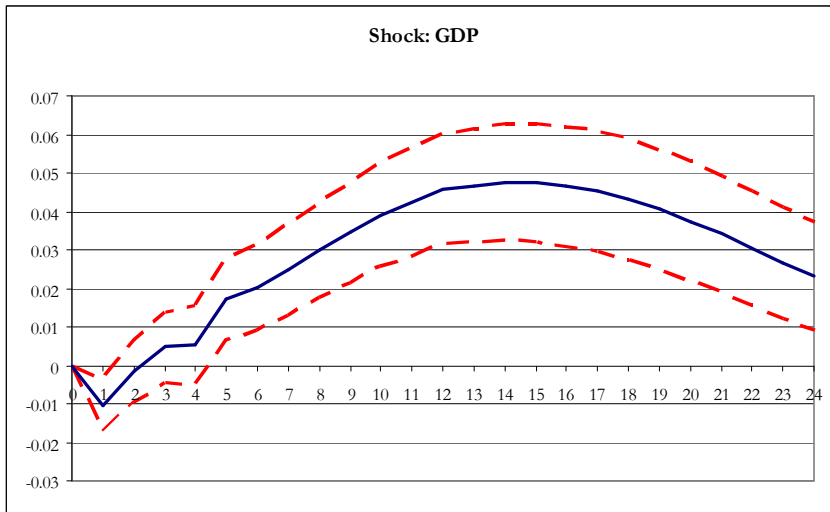
**Figure 2.2**  
**Developing Countries**  
**Bivariate VAR**  
**Response of Real Government Consumption to Shocks**



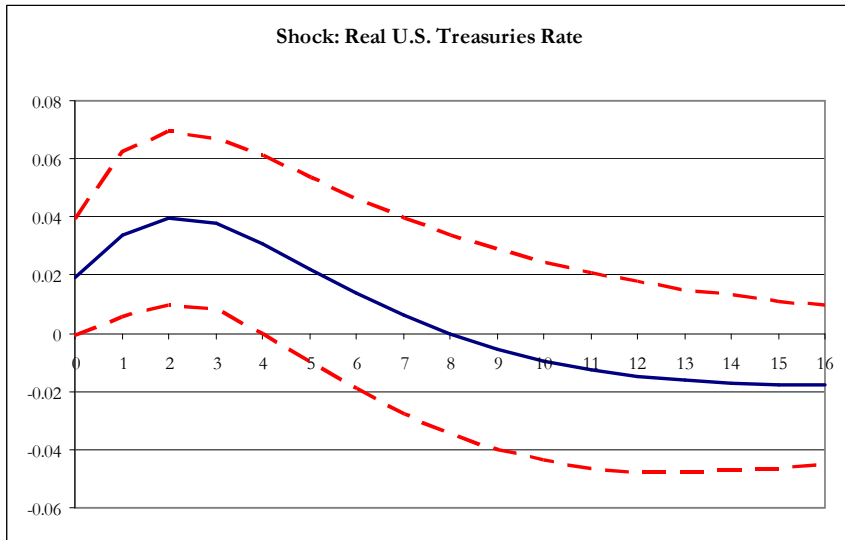
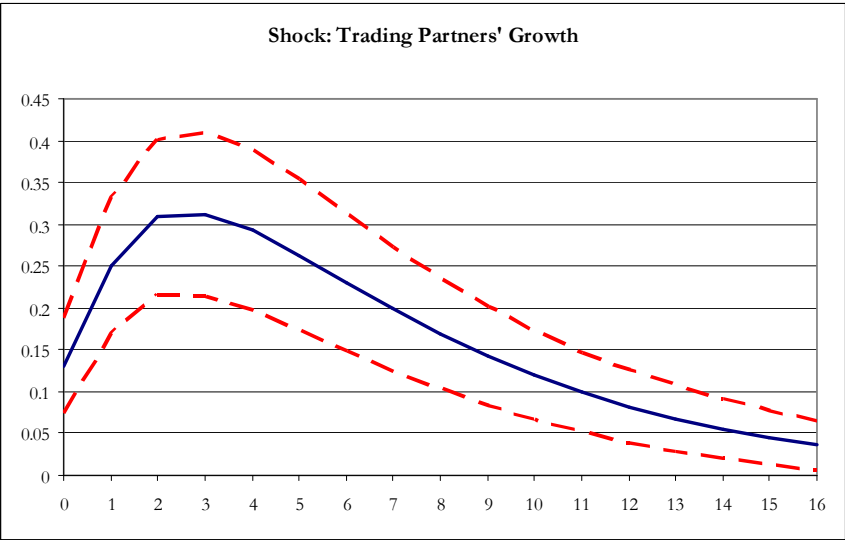
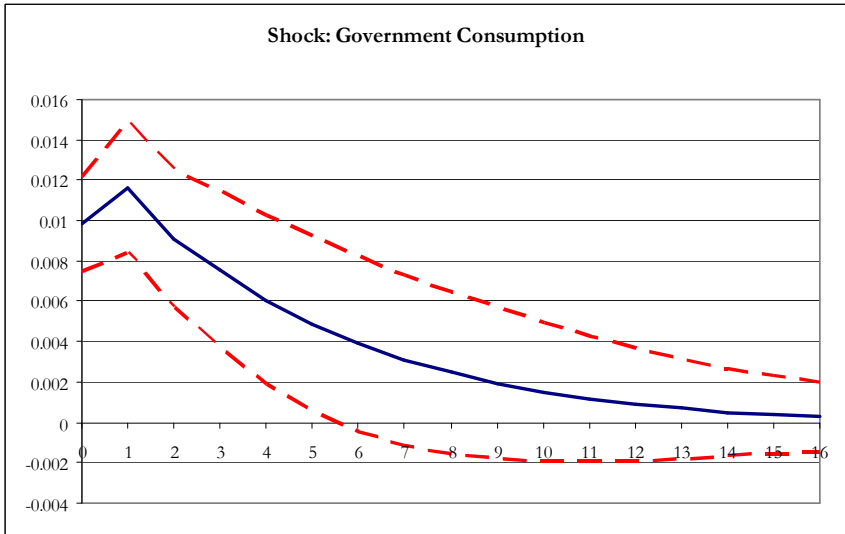
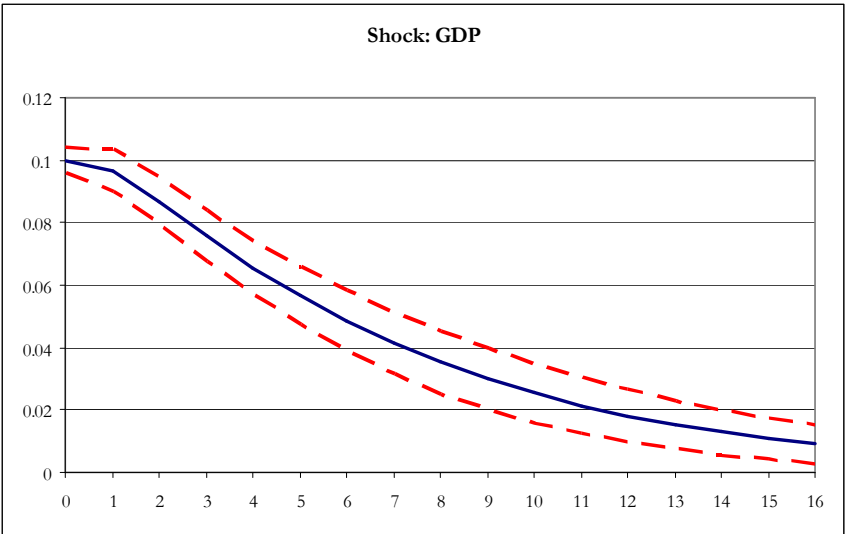
**Figure 2.3**  
**High-Income Countries**  
**Bivariate Regression**  
**Response of Real GDP to Shocks**



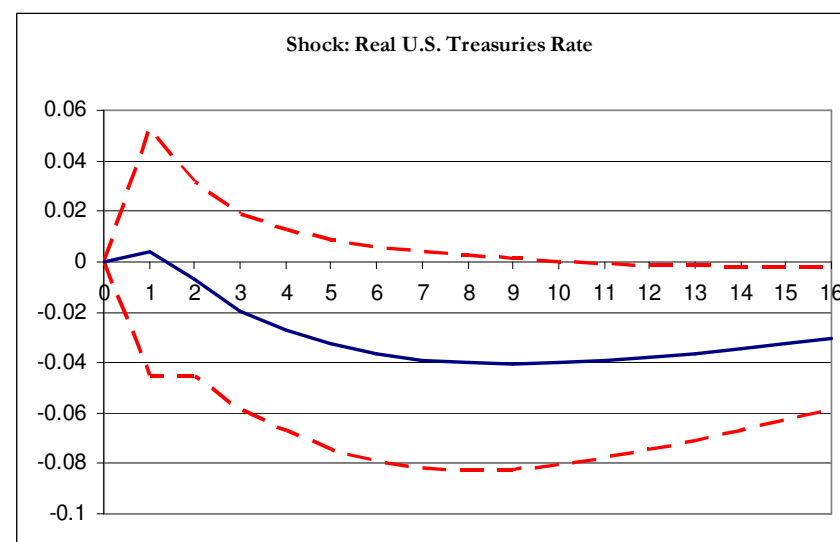
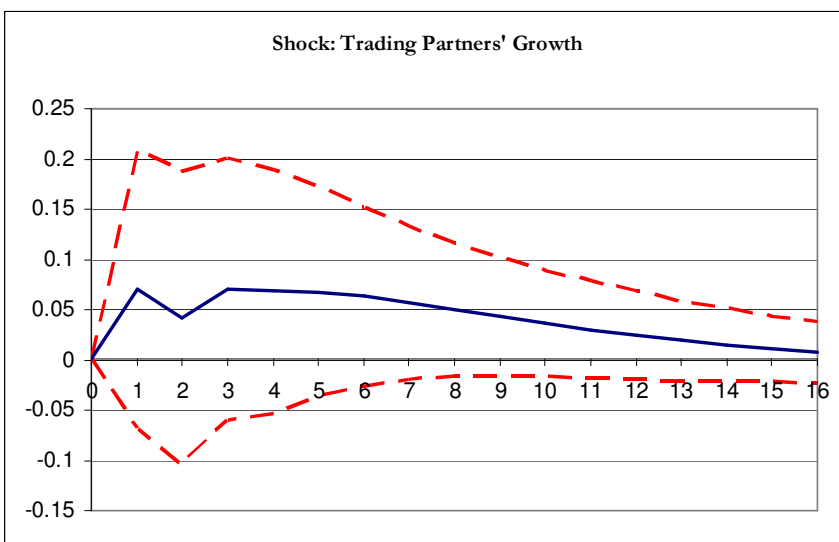
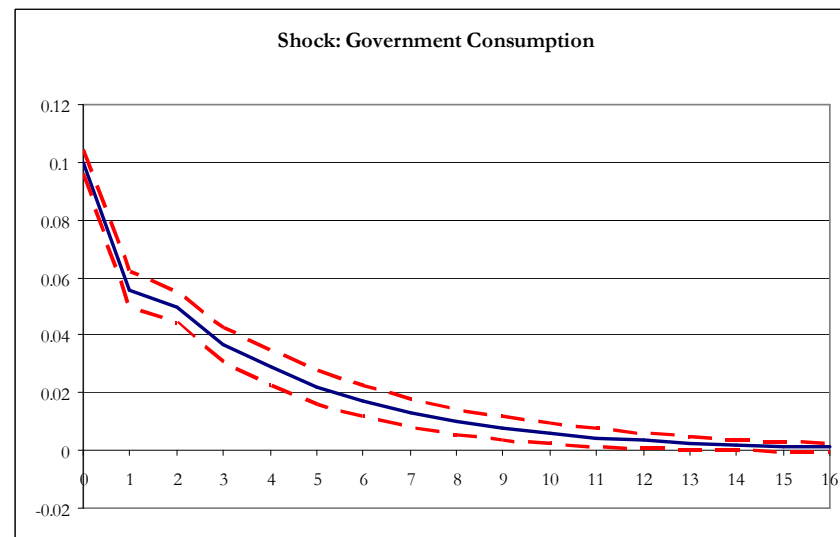
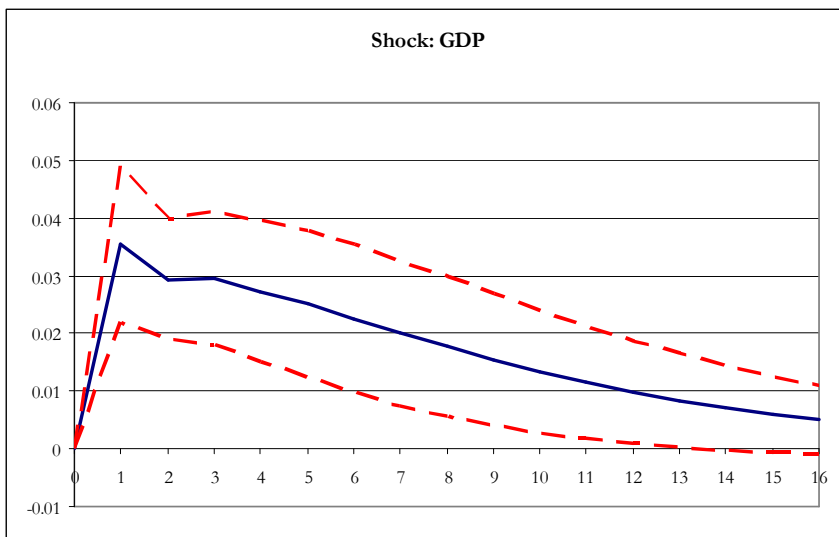
**Figure 2.4**  
**High-Income Countries**  
**Bivariate Regression**  
**Response of Real Government Consumption to Shocks**



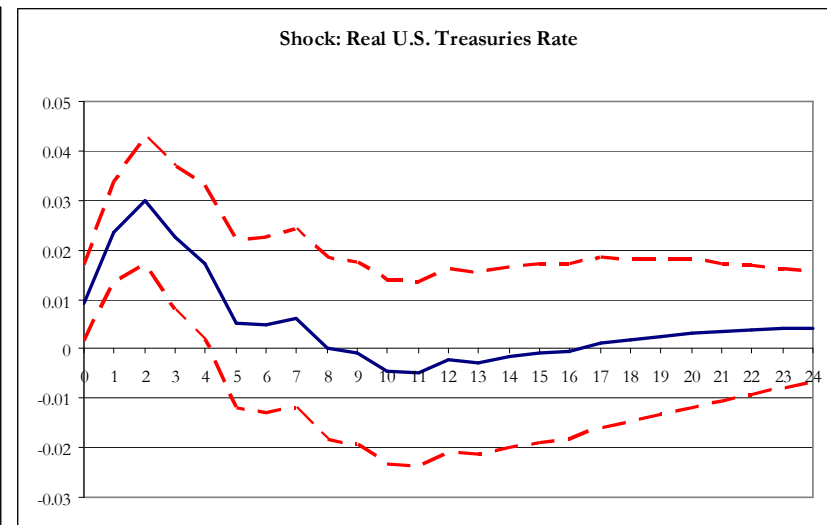
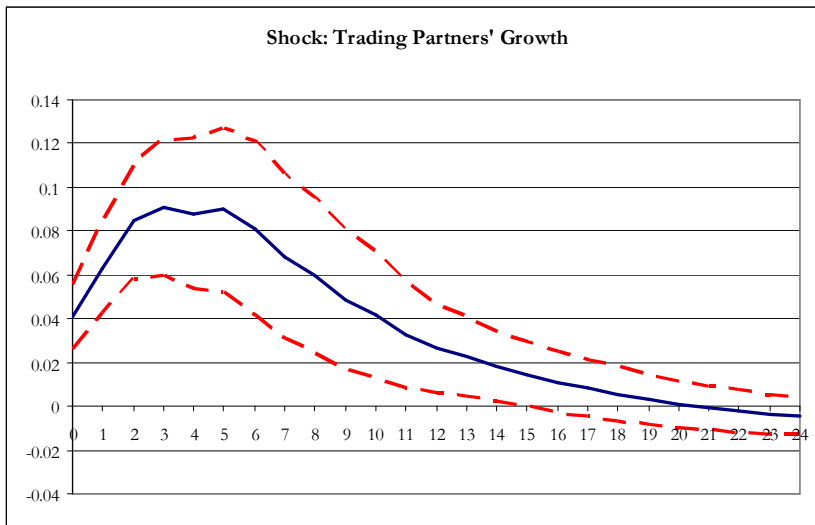
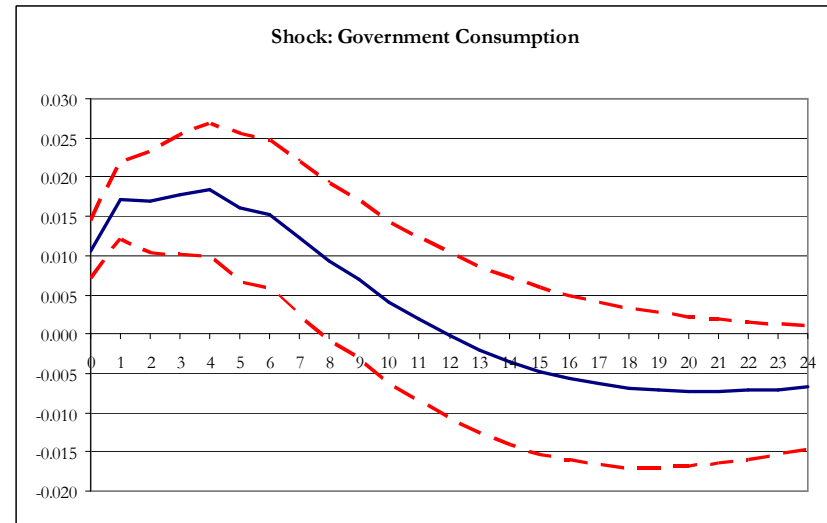
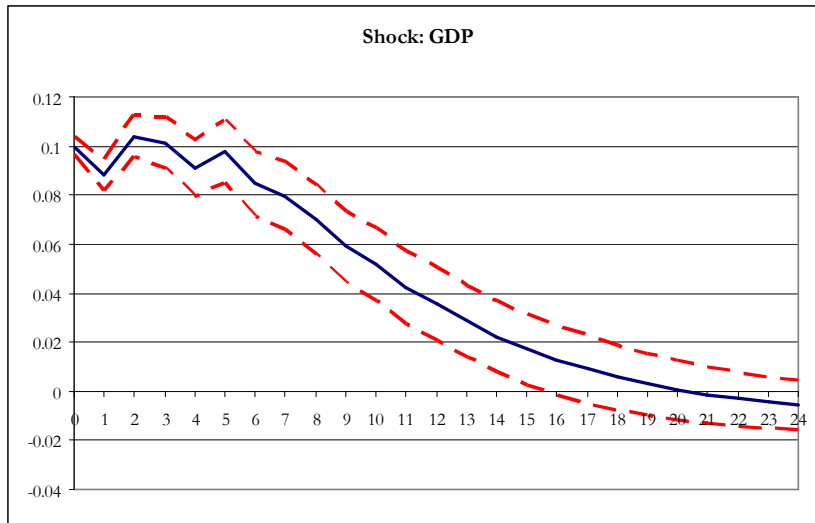
**Figure 2.5**  
**Developing Countries**  
**Full Specification**  
**Response of Real GDP to Shocks**



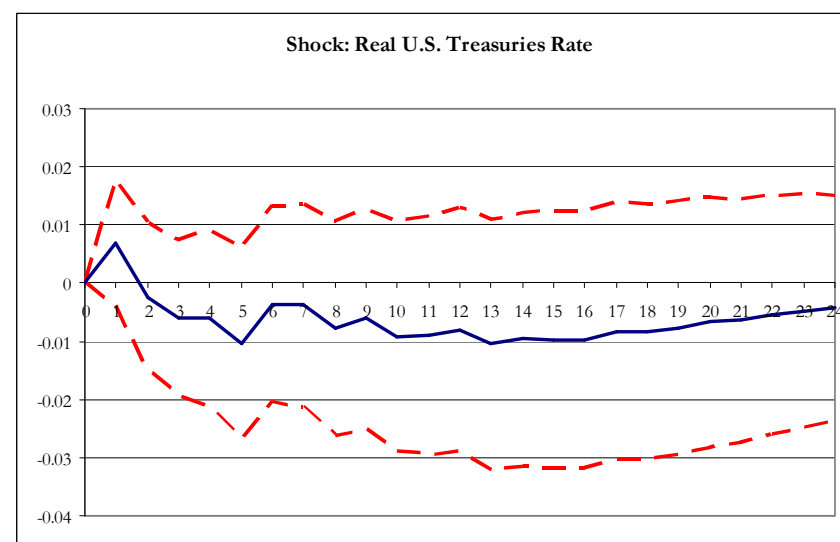
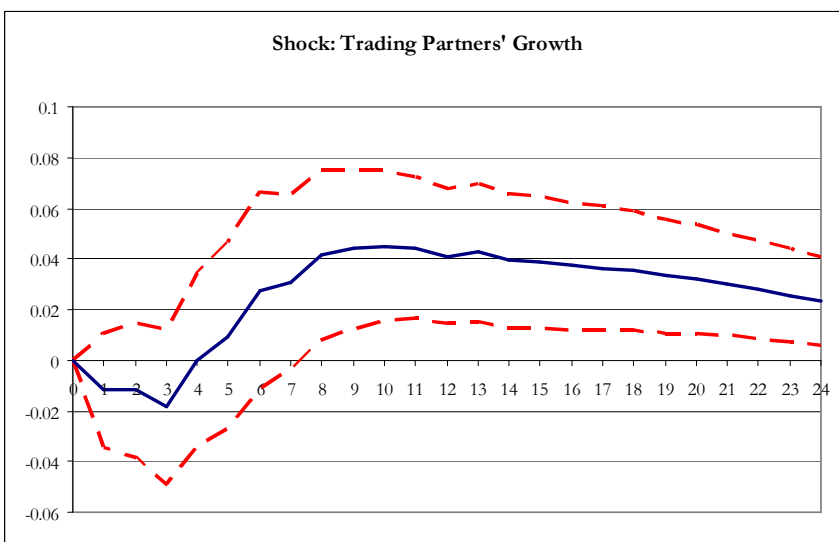
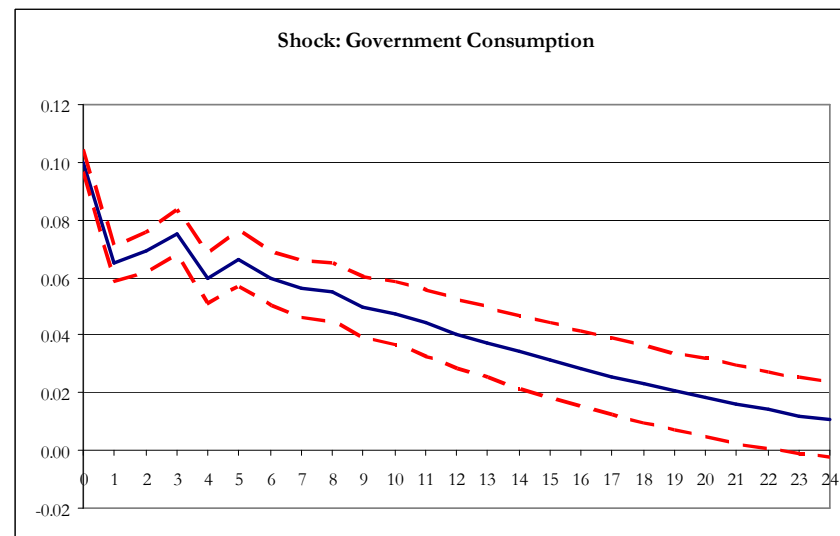
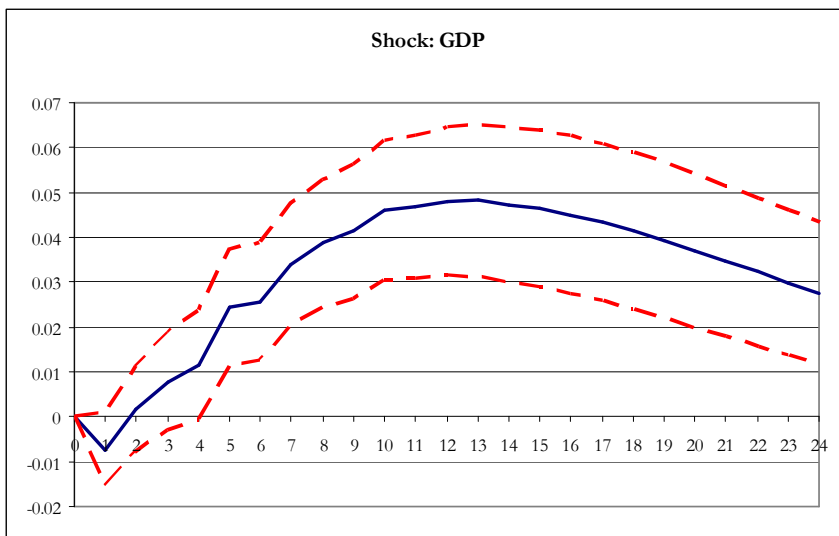
**Figure 2.6**  
**Developing Countries**  
**Full Specification**  
**Response of Real Government Consumption to Shocks**



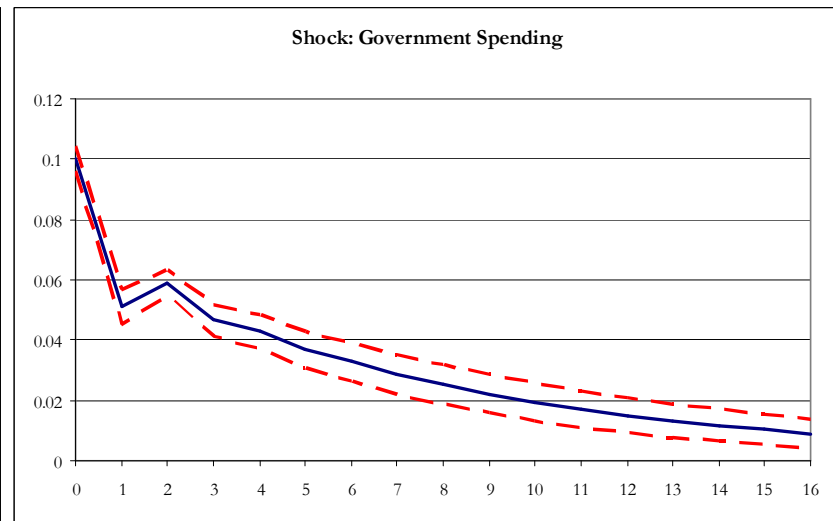
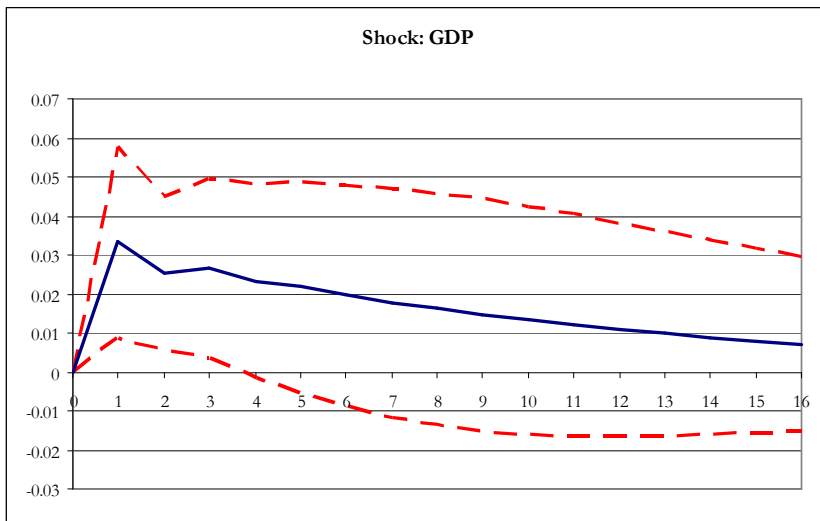
**Figure 2.7**  
**High-Income Countries**  
**Full Specification**  
**Response of Real GDP to Shocks**



**Figure 2.8**  
**High-Income Countries**  
**Full Specification**  
**Response of Real Government Consumption to Shocks**

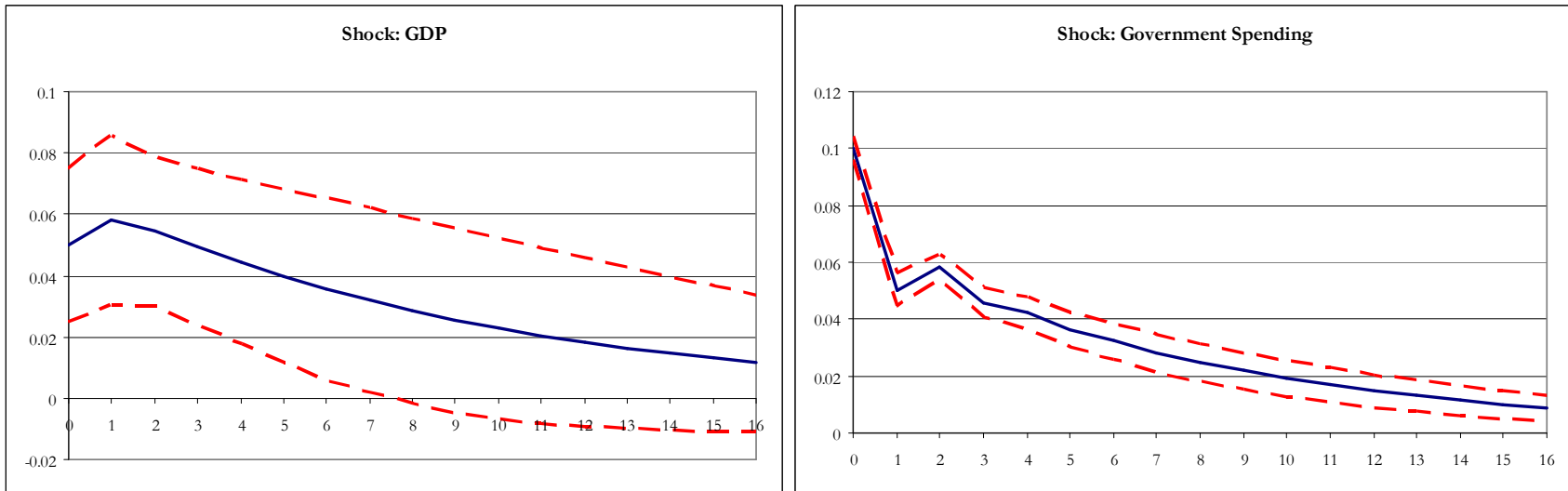


**Figure 2.9**  
**Developing Countries**  
**Bivariate Regression with Government Spending**  
**Response of Real Government Spending to Shocks**  
**Government Spending Ordered First**

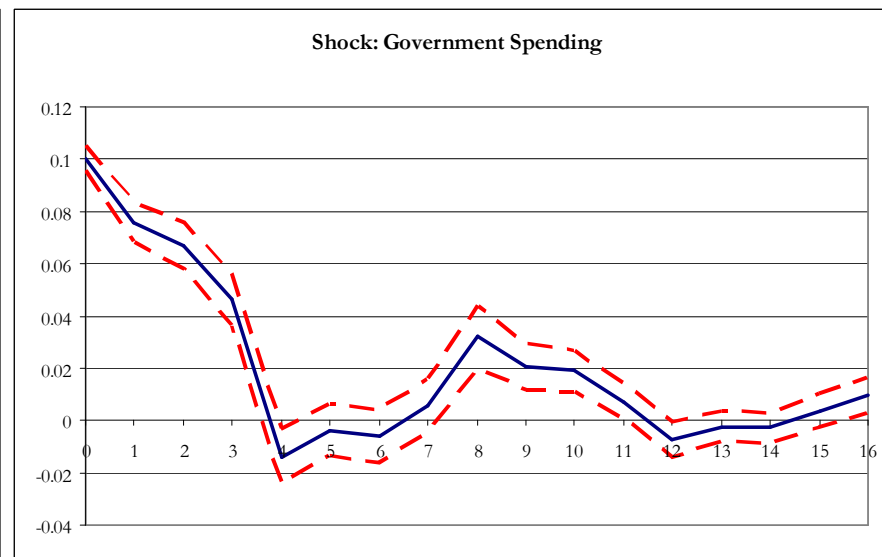
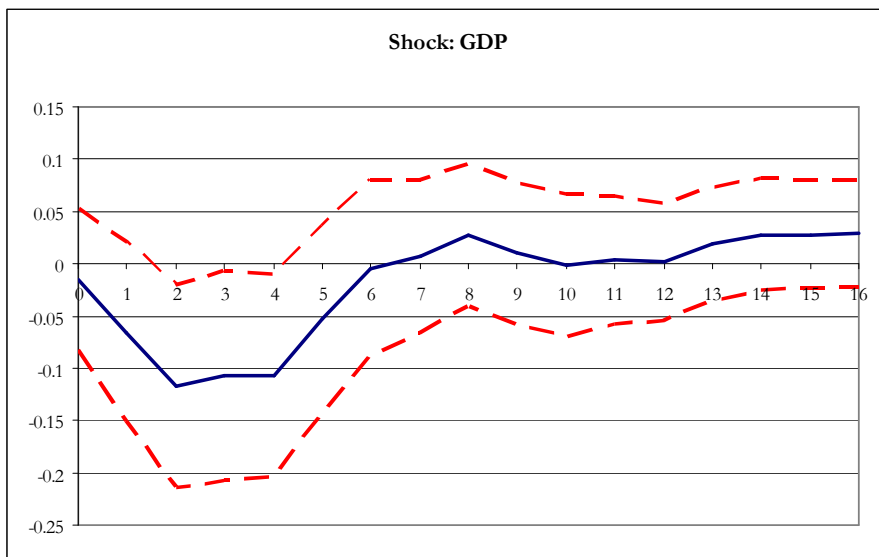




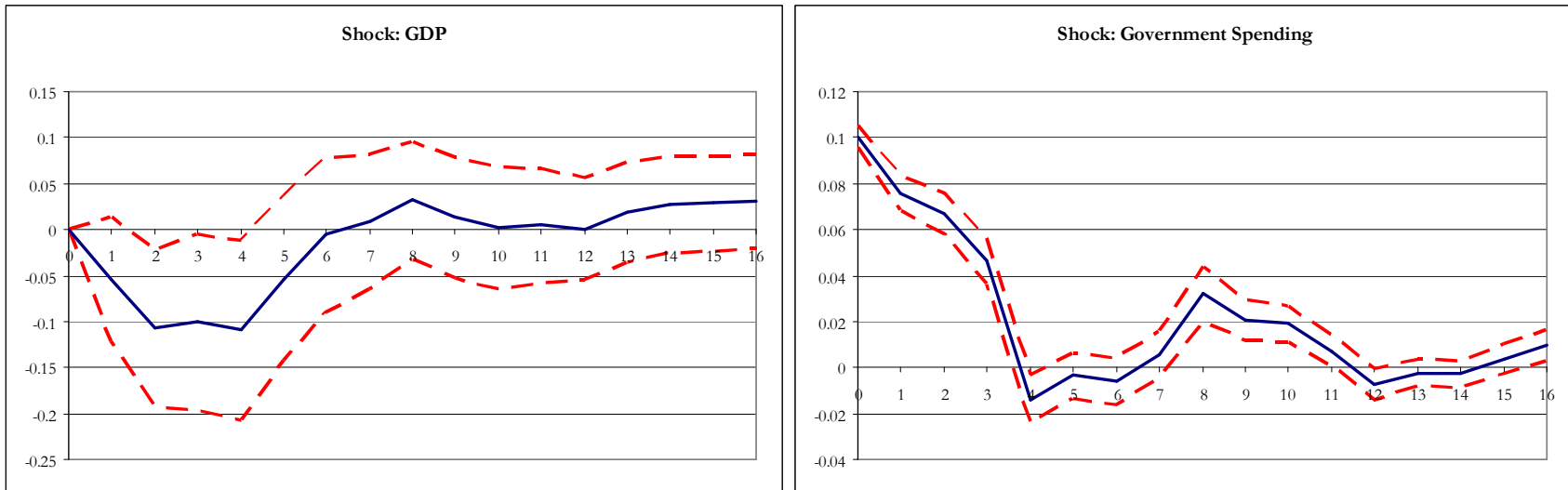
**Figure 2.10**  
**Developing Countries**  
**Bivariate Regression with Government Spending**  
**Response of Real Government Spending to Shocks**  
**Real GDP Ordered First**



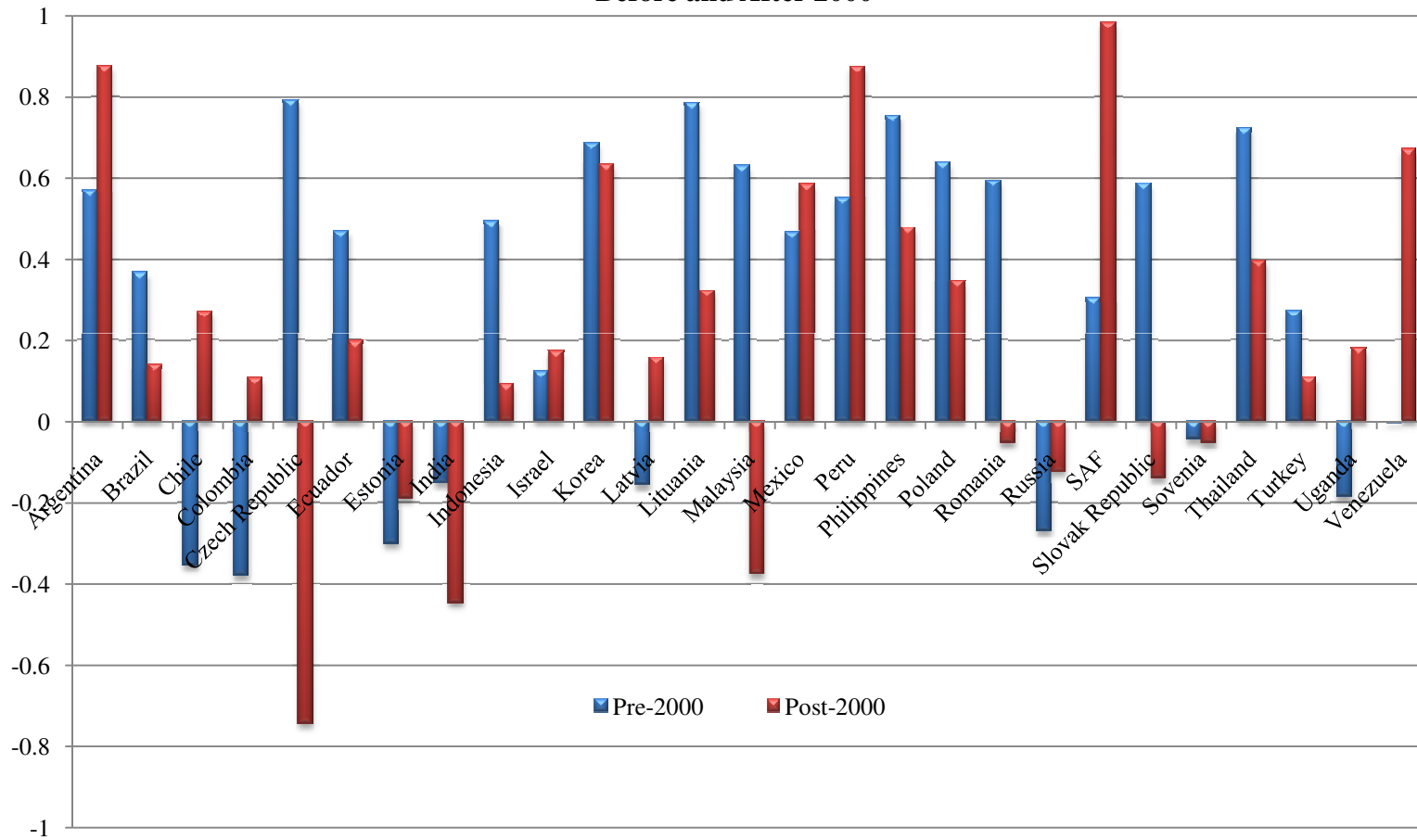
**Figure 2.11**  
**High-Income Countries**  
**Bivariate Regression with Government Spending**  
**Response of Real Government Spending to Shocks**  
**Government Spending Ordered First**



**Figure 2.12**  
**High-Income Countries**  
**Bivariate Regression with Government Spending**  
**Response of Real Government Spending to Shocks**  
**Real GDP Ordered First**



**Figure 2.13: Correlation between Government Consumption and GDP  
Before and After 2000**



## APPENDIX A

### Proofs and Derivations

#### A.1. 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.*

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

$$V(b, w) = \max_{\tau, T, b'} u(T, \tau) + \beta EV(b', w')$$

subject to

$$b' + w^{\varepsilon+1} \tau (1 - \tau)^\varepsilon = \frac{T}{2} + (1 + r)b + g,$$

$$T \geq 0$$

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. These are at the transitions between the redistributive and the fiscal crisis regimes.

Think then of the function  $V(b, w)$  as being a sum of two separate value functions, each for one of the fiscal regimes, with 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 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 the envelope theorem implies:

$$V_b(b, w) = -(1 + r) \Lambda, \quad (\text{A.1})$$

where  $\Lambda$  is the Lagrange multiplier on the government's budget constraint. Without loss of generality, let group  $A$  be the transfer recipient in the redistributive regime. The first order conditions of the government's maximization problem (see below) imply:

$$\Lambda = \frac{1 - \tau}{1 - \tau - \varepsilon \tau} \left[ \frac{[(1 - \tau) w]^{\varepsilon+1}}{\varepsilon + 1} + T \right]^{-\gamma}.$$

This function is continuous at both  $T^A = 0$  and  $T^B = 0$ . The function  $V(b, w)$  is then continuously differentiable 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 the value function is (decreasing in and) concave in  $b$ . In the analysis that follows, we will casually use the 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.

The cyclicity of debt can be obtained by conducting comparative statics on the following two equations, which follow from the government's first order conditions:

$$b' + w^{\varepsilon+1}\tau(1-\tau)^\varepsilon \geq \frac{T}{2} + (1+r)b + g \quad (\text{A.2})$$

and

$$\frac{1-\tau}{1-\tau-\varepsilon\tau} \left[ \frac{[(1-\tau)w]^{\varepsilon+1}}{\varepsilon+1} + T \right]^{-\gamma} + \beta EV_b(b', w') = 0. \quad (\text{A.3})$$

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

$$\frac{\partial b'}{\partial w} + (\varepsilon+1)w^\varepsilon\tau(1-\tau)^\varepsilon = \frac{1}{2} \frac{\partial T}{\partial w}$$

and

$$\gamma(\lambda^A)^{\frac{\gamma+1}{\gamma}} \left[ (1-\tau)^{\varepsilon+1}w^\varepsilon + \frac{\partial T}{\partial w} \right] = \frac{\beta}{2} EV_{bb}(b', w') \frac{\partial b'}{\partial w},$$

respectively, where  $\lambda^A$  is the marginal utility of consumption for households in the government's constituency, as defined in (1.3). Combining the two gives:

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

which implies  $\frac{\partial b'}{\partial w} < 0$ .

Next consider a fiscal crisis. Here  $T = 0$ , so that differentiating (A.2) and (A.3) by  $w$  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

$$\begin{aligned} & \left[ \frac{\varepsilon}{(1-\tau-\varepsilon\tau)^2} \lambda^A + \gamma \frac{(1-\tau)^{\varepsilon+1} w^{\varepsilon+1}}{1-\tau-\varepsilon\tau} (\lambda^A)^{\frac{\gamma+1}{\gamma}} \right] \frac{\partial \tau}{\partial w} \\ & - \gamma \frac{(1-\tau)^{\varepsilon+2} w^\varepsilon}{1-\tau-\varepsilon\tau} (\lambda^A)^{\frac{\gamma+1}{\gamma}} + \beta EV_{bb}(b', w') \frac{\partial b'}{\partial w} = 0. \end{aligned}$$



These now combine to give:

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

giving  $\frac{\partial b'}{\partial w} < 0$ , so that in both regimes, debt is countercyclical.  $\square$

## A.2. Proof of Proposition 2

**Proposition 2** (Borrowing Constraints). *Assume that shocks are i.i.d and either  $p = 1$  or  $\alpha = 1$ . For a given level of inherited debt  $b_{t-1}$ , if borrowing constraints are binding for some wage realizations and slack for other wage realizations, there exists a cutoff wage  $\tilde{w}(b_{t-1})$  below which borrowing constraints are binding and above which borrowing constraints are slack.*

**Proof.** First note that the natural debt limit will never be binding in equilibrium.

A binding natural debt limit puts a positive probability on a sequence where the government imposes a tax rate of  $\tau = \frac{1}{1+\varepsilon}$  in every subsequent period. (1.12) then gives  $\Lambda \rightarrow \infty$ .

We thus need only consider the ad hoc borrowing constraint  $b' \leq \bar{b}$ . For a given level of inherited debt,  $b$ , define  $\tilde{w}(b_{t-1})$  as either (1) the wage realization for which  $b' = \bar{b}$  is the solution to the government's maximization problem, without the ad-hoc borrowing constraint; or (2) the wage lowest wage realization for which  $b' < \bar{b}$ , if there is no wage rate for which  $b' = \bar{b}$  is the optimal choice. Proposition 1 shows that  $b'$  is decreasing in  $w$ . Thus  $\forall w > \tilde{w}(b)$  it must be the case that  $b' < \bar{b}$ . In case (1),  $\forall w < \tilde{w}(b)$ , Proposition 1 implies that the optimal choice of  $b'$  is  $b' > \bar{b}$ , so that the borrowing constraint is binding. In case (2),  $\forall w < \tilde{w}(b)$ , the borrowing constraint is binding by the definition of  $\tilde{w}$ . Thus borrowing constraints are binding for all wage realizations  $w < \tilde{w}(b)$ , but slack for all  $w > \tilde{w}(b)$ .  $\square$

### A.3. Proof of Proposition 3

**Proposition 3** (No Fiscal Crisis Traps). *Let  $\beta(1+r) = 1$  and assume that  $w_t$  follows an i.i.d process. For any values of  $p \in [0, 1]$  and  $\alpha \in [0, 1]$ , if an invariant distribution exists, it contains states of nature for which the non-negativity constraint on transfers is non-binding. In other words, starting in any period  $t$ , the economy will eventually 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. Given that  $T_t = 0 \forall t$ , and given that the government cannot discriminate

between households in its tax policy, it must be the case that  $\Omega(b_t, w_t) = V(b_t, w_t)$   $\forall t > \bar{t}$ . (1.13) and (1.15) then imply that (1.14) holds in this case. Looking at (1.14),  $\Lambda_t$  is a positive variable following a 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,  $\tilde{\Lambda}$ . The assumption that the invariant distribution contains only fiscal crisis states implies that  $\tilde{\Lambda} \geq \Lambda_{\min}$ , where  $\Lambda_{\min}$  is the lowest value for  $\Lambda$  that is still in the fiscal crisis regime:

$$\Lambda_{\min} = \left( \frac{[(1 - \tau^T) \bar{w}]^{\varepsilon+1}}{\varepsilon + 1} \right)^{-\gamma}.$$

Turning now to (1.13):

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

this equation is only a function of  $b'$ , because  $w_t$  is i.i.d. Given that  $EV_b(b', w')$  is decreasing in  $b'$  (see Appendix A.1), it must be the case that the same value of  $b' = \tilde{b}$  is chosen in each period.

Let  $\tilde{\tau}(w_t)$  denote the tax rate that ensures that the value  $\tilde{\Lambda}$  is obtained at each 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. Tax revenues are therefore increasing in wages:

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

With tax revenues increasing in wages, and a constant debt stock the budget constraint (1.6)

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

must be violated for some value of  $w_t$ .

Thus, if an invariant distribution existed where the economy remained in a fiscal crisis,  $\Lambda_t$  would follow a Martingale and would converge to as state  $\tilde{\Lambda} < \Lambda_{\min}$  that is in the redistributive regime. This contradicts the existence of a fiscal crisis trap invariant distribution.  $\square$

#### A.4. Derivation of the Generalized Euler Equation

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

$$V(b, w) = \max_{\tau, T, b'} u(T, \tau) + \beta [pEV(b', w') + (1-p)EW(b', w')]$$

s.t.

$$b' + w^{\varepsilon+1} \tau (1 - \tau)^{\varepsilon} = \frac{T}{2} + (1 + r) b + g,$$

$$T \geq 0,$$

and

$$\begin{aligned} W(b, w) &= \alpha u(T^*, \tau^*) + (1 - \alpha) u(0, \tau^*) \\ &\quad + \beta [(1 - p) EV(f(b, w), w') + pEW(f(b, w), w')], \end{aligned}$$

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

We now differentiate the two functions, without applying the envelope theorem<sup>1</sup>.

Beginning with  $V(b, w)$ ,

$$\begin{aligned} V_b(b, w) &= u_T(T, \tau) \frac{\partial T}{\partial b} + u_{\tau}(T, \tau) \frac{\partial \tau}{\partial b} \\ &\quad + \beta [pEV_b(f(b, w), w') + (1 - p)EW_b(f(b, w), w')] f_b(b, w). \end{aligned}$$

---

<sup>1</sup>We do so although it is easy to see, and we will verify, that the envelope theorem does apply in the case of  $V(b, w)$ .

Using the definition (1.3) and equation (1.4) this reads:

$$\begin{aligned}
 V_b(b, w) &= \lambda \left( \frac{\partial T}{\partial b} - w^{\varepsilon+1} (1 - \tau)^\varepsilon \frac{\partial \tau}{\partial b} \right) \\
 &\quad + \beta [pEV_b(f(b, w), w') + (1 - p)EW_b(f(b, w), w')] f_b(b, w).
 \end{aligned} \tag{A.4}$$

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

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

Now note that whenever  $T \geq 0$  is binding,  $\frac{\partial T}{\partial b} = 0$  and whenever  $T > 0$ ,  $\frac{\partial \tau}{\partial b} = 0$ , and  $\frac{1 - \tau - \varepsilon\tau}{1 - \tau} = \frac{1}{2}$  as (1.10) confirms. This last equation can then be written as

$$f_b(b, w) = \frac{1 - \tau - \varepsilon\tau}{1 - \tau} \left[ \frac{\partial T}{\partial b} - w^{\varepsilon+1} (1 - \tau)^\varepsilon \frac{\partial \tau}{\partial b} \right] + (1 + r). \tag{A.5}$$

Plugging this back into (A.4) yields:

$$\begin{aligned}
 V_b(b, w) &= \lambda \frac{1 - \tau - \varepsilon\tau}{1 - \tau} [f_b(b, w) - (1 + r)] \\
 &\quad + \beta [pEV_b(f(b, w), w') + (1 - p)EW_b(f(b, w), w')] f_b(b, w).
 \end{aligned}$$

Replacing (1.13) into the second line of this equation, and using (1.12) in the first gives:

$$V_b(b, w) = \Lambda [f_b(b, w) - (1 + r)] - \Lambda f_b(b, w) = -(1 + r) \Lambda. \quad (\text{A.6})$$

It is reassuring that this result is identical to the application of the envelope theorem to  $V(b, w)$ , as the envelope theorem should apply in this case. We now turn to  $W(b, w)$  where the envelope theorem does not apply.

$$\begin{aligned} W_b(b, w) &= \alpha u_T(T, \tau) \frac{\partial T}{\partial b} + \alpha u_\tau(T, \tau) \frac{\partial \tau}{\partial b} + (1 - \alpha) u_\tau(0, \tau) \frac{\partial \tau}{\partial b} \\ &\quad + \beta [(1 - p) EV_b(f(b, w), w') + pEW_b(f(b, w), w')] f_b(b, w). \end{aligned}$$

We can use (A.5) to obtain

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

Now note that when  $T > 0$ ,  $\frac{\partial \tau}{\partial b} = 0$ , so that the second term is equal to zero. On the other hand, when  $T = 0$ ,  $u_\tau(0, \tau) = -w^{\varepsilon+1} (1 - \tau)^\varepsilon \lambda$  while (A.5) 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:

$$W_b(b, w) = \beta [(1-p) EV_b(f(b, w), w') + pEW_b(f(b, w), w')] f_b(b, w) + \begin{cases} [f_b(b, w) - (1+r)] \Lambda & \text{for } T = 0 \\ \alpha [f_b(b, w) - (1+r)] \Lambda & \text{for } T > 0 \end{cases}$$

Analyzing the first line of this equation gives:

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

using (A.6) and (1.13) in the last step. This gives

$$W_b(b, w) = -\frac{p}{1-p} \left[ \Lambda + \beta(1+r) \frac{1-2p}{p} E\Lambda' \right] f_b(b, w) + \begin{cases} [f_b(b, w) - (1+r)] \Lambda & \text{for } T = 0 \\ \alpha [f_b(b, w) - (1+r)] \Lambda & \text{for } T > 0 \end{cases} \quad (\text{A.7})$$



We now use (A.6) and this last equation in (1.13) to obtain:

$$\begin{aligned} \Lambda = & \beta(1+r) \left[ \int_{w'|T'=0} \Lambda' dw' + (p + \alpha(1-p)) \int_{w'|T'>0} \Lambda' dw' \right] \\ & + \beta(1-p) \left[ \begin{aligned} & (1-p)\beta(1+r) E[\Lambda'' f_b(b', w')] - \\ & \left( \alpha \int_{w'|T'>0} f_b(b', w') \Lambda' dw' + \int_{w'|T'=0} f_b(b', w') \Lambda' dw' \right) \end{aligned} \right] \\ & - \beta p \{ p\beta(1+r) E[\Lambda'' f_b(b', w')] - E[\Lambda' f_b(b', w')] \}, \end{aligned}$$

which gives the GEE.

## APPENDIX B

### Computational Algorithm

I 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. I 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:

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

s.t.

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

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

calculated via

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

- (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

$$V^t(b_{t-1}, w_t) = \max_{\tau_t, T_t, b_{t+1}} \left\{ \begin{array}{l} u(T_t, \tau_t) \\ +\beta [pEV^{t+1}(b_t, w_{t+1}) + (1-p)EW^{t+1}(b_t, w_{t+1})] \end{array} \right\}$$

s.t.

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

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

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

- (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.

I 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. Five grid points are used for  $z$ , giving five 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  $t_{sim} = 1000$ . The simulations' results remain unchanged when  $\bar{t} = 1,000,000$ . The first 900 simulated periods are discarded, to minimize the effects of initial conditions, and moments are calculated using the remaining 100 periods.

For many 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.

## APPENDIX C

### **Data Appendix**

The annual sample uses the dataset of Kaminsky, Reinhart and Végh (2004).

A detailed description of the data is therein.

The countries are included in the quarterly sample and the length of the time series for each country are provided in Table C.1.

Following is a description of series and data sources:

#### **Real GDP**

For high-income countries, OECD developing countries, and Brazil, South Africa and Russia, real GDP was taken from OECD series CMPGDP VIXOBSA. This a seasonally adjusted index of real GDP, reported at quarterly frequency by national sources, in real local currency units. Real, seasonally adjusted GDP for Ecuador was obtained from the Central Bank of Ecuador. Industrial production was used as a proxy for real GDP in Uganda, and was obtained from the Bank of Uganda. For Chile and India, industrial production (see below) was used as a proxy for real GDP to expand the sample size. None of the paper's results are altered if real GDP from the IFS is used instead. For other countries, IFS series

99B.PZF was used. Non-seasonally adjusted series were de-seasonalized using the X-11 algorithm.

### **Industrial Production**

IFS series 66 was the main data source. The series was normalized to 1 for 1Q2000. Real GDP (see above) was used. Data for South Africa was obtained from the national statistical agency. Series were de-seasonalized using the X-11 algorithm.

### **CPI**

IFS series 64

### **Real Government Consumption**

For high-income countries and OECD developing countries, and Brazil, India, South Africa and Russia, real government consumption was taken from the OECD series for Government Final Consumption Expenditure, using a real index. Real government consumption for Argentina was taken from MECON, and for Chile, Ecuador, Israel and Venezuela from their respective central banks. Data for Ecuador and Israel was seasonally-adjusted by the central banks. Civilian government consumption was used for Israel. Venezuela's data on public consumption differs from other countries in that it includes government investment. We nevertheless leave Venezuela's data as reported. Excluding Venezuela from the sample does not impact any of the paper's results. Nominal government consumption for

Uganda was obtained from the Central Bank of Uganda. For other countries, IFS series 91F..ZF (nominal government consumption) was used. All nominal series were deflated using CPI. Deflating the series by the GDP deflator does not affect the paper's results. Non-seasonally adjusted series were de-seasonalized using the X-11 algorithm.

### **Real Government Spending**

IFS series 82 (government expenditure) was used. In the case of Chile, a series of non-interest spending that was available from IFS was used. For Israel, Malaysia, and Turkey data was obtained from their respective central banks. Data for Denmark and France was obtained from Eurostat. Series were expanded using the database of Agenor, McDermott, and Prasad. The series was normalized to 1 for 1Q2000 and then deflated using the CPI series, also normalized to 1 for 1Q2000.

### **Real Return on 6-month U.S. Treasury Bills**

IFS series 11160C..ZF. The real Treasury yield was created by deflating the returns on U.S. Treasuries by the CPI inflation rate of the previous 6-month period, using the above stated CPI series for the United States. This is a measure of expected real return based on adaptive expectations. Using an ex-post measure of the real return does not impact any of the paper's results.

### **Weighted GDP growth of Trading Partners**

Following Jaimovich and Panizza (2007) we create an index of the GDP growth of each country's trading partners as the growth in real GDP (see above) of each of the country's trading partners. Trade-partner growth was weighted by the share of the country's total exports to each of its trading partners (taken from the IMF's DOTS database). Finally, each country's weighted-trade-partner growth was deflated by the country's average ratio of exports to GDP over the entire period. This last statistic was created using annual data, with exports (total, to rest of the world) taken from the DOTS database, and nominal GDP in USD taken from the IMF's World Economic Outlook database.

### **Terms of Trade**

IFS series 74 (unit price of exports) divided by series 75 (unit price of imports).



**Table C.1: Length of Time Series by Country**  
For Real GDP and Government Consumption Series

<b>Developing Countries</b>	<b>Start Date</b>	<b>End Date</b>	<b>High-Income Countries</b>	<b>Start Date</b>	<b>End Date</b>
Argentina	93Q1	06Q4	Australia	60Q1	06Q4
Brazil	91Q1	06Q4	Austria	89Q1	06Q4
Chile	96Q1	06Q2	Belgium	95Q1	06Q4
Colombia	94Q1	06Q3	Canada	61Q1	06Q4
Czech Republic	96Q1	06Q4	Denmark	90Q1	06Q4
Estonia	93Q1	06Q3	Ecuador	90Q1	06Q4
India	90Q1	06Q3	Finland	90Q1	06Q4
Indonesia	93Q1	06Q3	France	78Q1	06Q4
Ireland	97Q1	06Q4	Germany	91Q1	06Q4
Israel	95Q1	06Q4	Iceland	97Q1	06Q4
Korea	70Q1	06Q4	Ireland	97Q1	06Q4
Latvia	90Q1	06Q3	Italy	81Q1	06Q4
Lithuania	95Q1	06Q3	Japan	94Q1	06Q4
Malaysia	92Q1	06Q3	Luxembourg	95Q1	06Q4
Mexico	84Q1	06Q3	Netherlands	95Q1	06Q4
Peru	91Q1	06Q3	New Zealand	88Q1	06Q4
Philippines	97Q1	06Q3	Norway	78Q1	06Q4
Poland	95Q1	06Q4	Portugal	95Q1	06Q4
Romania	98Q1	06Q3	Spain	95Q1	06Q4
Russia	95Q1	06Q4	Sweden	93Q1	06Q4
Slovak Republic	95Q1	06Q4	Switzerland	80Q1	06Q4
Slovenia	95Q1	06Q3	United Kingdom	60Q1	06Q4
South Africa	65Q1	06Q4	United States	60Q1	06Q4
Thailand	93Q1	06Q3			
Turkey	87Q1	06Q4			
Uganda	99Q1	06Q3			
Venezuela	97Q1	04Q4			

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