

NBER WORKING PAPER SERIES

PROCYCLICAL FISCAL POLICY IN DEVELOPING COUNTRIES:  
TRUTH OR FICTION?

Ethan Ilzetzi  
Carlos A. Vegh

Working Paper 14191  
<http://www.nber.org/papers/w14191>

NATIONAL BUREAU OF ECONOMIC RESEARCH  
1050 Massachusetts Avenue  
Cambridge, MA 02138  
July 2008

We are grateful to Ari Aisen, Ugo Panizza, Roberto Rigobon, Martin Uribe, Guillermo Vuletin and seminar participants at the University of Maryland, Universit? Libre de Bruxelles, and International Economic Association Meetings (Istanbul) for helpful comments and suggestions and to Inci Gumus, James John, Francisco Parodi, and Ioannis Tokatlidis for help in obtaining data. The views expressed herein are those of the author(s) and do not necessarily reflect the views of the National Bureau of Economic Research.

NBER working papers are circulated for discussion and comment purposes. They have not been peer-reviewed or been subject to the review by the NBER Board of Directors that accompanies official NBER publications.

© 2008 by Ethan Ilzetzi and Carlos A. Vegh. All rights reserved. Short sections of text, not to exceed two paragraphs, may be quoted without explicit permission provided that full credit, including © notice, is given to the source.

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

Ethan Ilzetzki and Carlos A. Vegh

NBER Working Paper No. 14191

July 2008

JEL No. E62, F41

## **ABSTRACT**

A large empirical literature has found that fiscal policy in developing countries is procyclical, in contrast to high-income countries where it is countercyclical. The idea that fiscal policy in developing countries is procyclical has all but reached the status of conventional wisdom. This has sparked a growing theoretical literature that attempts to explain such a puzzle. Some authors, however, have suggested that procyclical fiscal policy could be more fiction than truth since, by and large, the current literature has ignored endogeneity problems and may have simply misidentified a standard expansionary effect of fiscal policy. To settle this issue of causality, 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 overwhelming evidence to support the idea that procyclical fiscal policy in developing countries is in fact truth and not fiction. We also find evidence that fiscal policy is expansionary -- a channel disregarded by the existing literature -- lending empirical support to the notion that when "it rains, it pours."

Ethan Ilzetzki  
Square Ambiorix 30  
Boite 63  
Bruxelles 1000  
Belgium  
ilzetzki@econ.umd.edu

Carlos A. Vegh  
Department of Economics  
Tydings Hall, Office 4118G  
University of Maryland  
College Park, MD 20742-7211  
and NBER  
vegh@econ.bsos.umd.edu

## 1. INTRODUCTION

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 appeared to be procyclical. Talvi and Végh (2005) then claimed that, far from being a Latin-American phenomenon, procyclical fiscal policy seemed 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>2</sup>

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 and/or rent-seeking activities: (Tornell and Lane (1998, 1999), Talvi and Végh (2005), Alesina and Tabellini (2005), and Ilzetzki (2007)).

But do we really know what we think we know? Put differently, 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 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, if anything, the structure of shocks in developing and industrial countries is such that it is more likely that reverse causal-

---

<sup>2</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), Sturzenegger and Wernek (2006), Ilzetzki (2007), and Strawczynski and Zeira (2007).

ity 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>3</sup> What if accounting for endogeneity were to 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).<sup>4</sup> 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.

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>5</sup> If procyclical fiscal policy just reflects reverse causality, then clearly this way of thinking would be completely unfounded.

The main purpose of this paper is thus to ask: is fiscal policy really procyclical in developing countries, or does causality run the other way so that previous researchers have just misidentified a standard expansionary (Keynesian or neoclassical) effect of fiscal policy? To tackle this question in depth, we turn to quarterly data (all the 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 put together a database with quarterly data that encompasses 49 (27 developing and 22 industrial) countries 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 a wide array of econometric 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 the evidence. We thus resort to instrumental variables, GMM, simultaneous equations, and time series techniques (Granger causality and impulse responses).<sup>6</sup>

---

<sup>3</sup>We note exceptions like Braun (2001), Lane (2003), Galí and Perotti (2003), and Strawczynski and Zeira (2007).

<sup>4</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.

<sup>5</sup>See Arellano (2006) for the case of Chile and Strawczynski and Zeira (2007) for the case of Israel.

<sup>6</sup>As a reference point – and for the purposes of comparing with the existing literature

In addition to focusing on the issue of causality, our methodology will allow us to identify empirically a critical channel underlying this literature, which has been entirely disregarded so far. Implicit in all the literature is the idea that procyclical fiscal policy is sub-optimal because it would exacerbate the business cycle – what Kaminsky, Reinhart, and Vegh (2004) have dubbed the “when it rains, it pours” phenomenon. Clearly, if changes in fiscal policy did not affect output, then – at least from a purely macro-economic 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 or not.

How do we proceed? After discussing some conceptual and methodological issues in Section 2, Section 3 develops some simple empirical models that illustrate some of the main ideas at stake and formalize the equations that will be estimated in the following sections. Section 4 discusses our datasets and variables of interest. Section 5 sets the 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 6 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 experiment with other instruments). Unlike Jaimovich and Panizza, however, we conclude that a simple two-stage-least-squares approach is *inconclusive* and does not allow us to extract any useful conclusions regarding the existence (or lack thereof) of reverse causality. Section 7 then proceeds to use GMM to estimate the same system. Here we find strong evidence of procyclical fiscal policy in developing countries, while we find that fiscal policy is acyclical in high-income countries. Section 8 estimates a simultaneous 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 9 develops our VAR estimations. For starters, we conduct 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. GMM estimations and (OLS) simultaneous equations estimations, Granger-causality tests, and impulse

---

– we also carry out many of the estimations using an annual dataset.

responses all offer strong support for this proposition.

- The econometric evidence in high-income countries is mixed, and depends on the specification. While our GMM estimations would suggest that fiscal policy is acyclical in high-income countries, our OLS and VAR estimates appear to indicate that fiscal policy is 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 spending in the industrialized world.
- 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>7</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. CONCEPTUAL AND METHODOLOGICAL ISSUES

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

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

Conceptually – and in line with Kaminsky, Reinhart, and Vegh (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 and debt service) 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

---

<sup>7</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).

(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, while not the main focus of this paper, 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, and whenever available (mainly high-income countries and large developing countries; see the data appendix for more details), government consumption was deflated using a deflator specific to government consumption. Elsewhere, we had no choice but to use the CPI index. However, in those countries where several indices were available, all of our results were robust to using either the government

consumption deflator, the GDP deflator, or the CPI index.

## 2.2. Breaking down government spending

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

government spending = government consumption + public investment + transfers + debt service.

With this simple fiscal accounting as background, a couple of points are worth mentioning.<sup>8</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 is not relevant for our purposes – and this seems to be the implicit stand taken by almost all authors in this field. In other words, what matters is the actual response of government consumption to the cycle rather than whether this response comes about as part of some explicit fiscal policy rule (discretionary) or, say, 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).

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, of course, that transfers will be countercyclical (the case, for instance, of 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 in cases in which fiscal policy may not be actively used to smooth the business cycle, it is of course possible that the government may be trying to insure the private sector from business cycle fluctuations. In such a case – and 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.

---

<sup>8</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 the data appendix for details.)



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

As is apparent from the existing literature, the reason why fiscal procyclicality in developing countries constitutes a puzzle in search of an explanation lies in the fact that, from either a Keynesian or neoclassical perspective, theoretical considerations clearly 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 Vegh (2004) have dubbed the “when it rains, it pours” phenomenon).

In a Keynesian world – and due to sticky prices or wages – the economy would 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 (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 be optimally 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 substitutability 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 – and to a first approximation – we will think of optimal government consumption in a neo-classical world as being uncorrelated to 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 neo-classical 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 consumer 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 results could thus be capturing either a Keynesian or neoclassical expansionary output effect of government consumption. In either case, however, this 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 address the question of the expansionary impact of government consumption.

### 3. EMPIRICAL MODELS

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

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

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

$$g_t = \beta y_t + \varepsilon_t, \quad (1)$$

$$y_t = \phi g_t + \mu_t, \quad (2)$$

where  $g_t$  and  $y_t$  are (the cyclical components of) government spending (or consumption) and output;  $\beta$  ( $\beta \gtrless 0$ ) 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, and  $E\mu_t\varepsilon_t = 0$ . Equation (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) allows for an expansionary effect of government consumption on output. The shocks  $\varepsilon_t$  and  $\mu_t$  capture fiscal and output (productivity) shocks, respectively. We assume that  $|\beta\phi| < 1$ .<sup>9</sup>

We can interpret most of the current literature as having estimated some version of equation (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 (1) and (2) to obtain:

$$y_t = \frac{\phi\varepsilon_t + \mu_t}{1 - \phi\beta}, \quad (3)$$

$$g_t = \frac{\beta\mu_t + \varepsilon_t}{1 - \phi\beta}. \quad (4)$$

---

<sup>9</sup>As can be checked, this condition ensures that the ratio  $\sigma_g^2/\sigma_y^2$  is an increasing function of the ratio  $\sigma_\varepsilon^2/\sigma_\mu^2$ .

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

$$Cov(y_t g_t) = \frac{1}{(1 - \phi\beta)^2} (\phi\sigma_\varepsilon^2 + \beta\sigma_\mu^2). \quad (5)$$

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

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

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 be clearly false! In general – and as follows from equation (5) – the sign of the covariance between  $y_t$  and  $g_t$  will depend 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 (3) that

$$\begin{aligned} E(y_t) &= 0, \\ Var(y_t) &= \frac{\sigma_\theta^2}{(1 - \phi\beta)^2}. \end{aligned} \quad (6)$$

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  $Var(y_t)$  is a strictly increasing function of  $\beta$  in the range  $(-1/\phi, 1/\phi)$ , then 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

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

An acyclical policy ( $\beta = 0$ ) would imply that  $Var(y_t) = \sigma_\theta^2$  and any procyclical fiscal policy would imply that  $Var(y_t) > \sigma_\theta^2$ . 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 (i.e., reducing the variability of) 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 (1) cannot be estimated by OLS because the covariance between  $y_t$  and  $\varepsilon_t$  is not zero. Indeed, by substituting (1) into (2), it follows that

$$E(\varepsilon_t y_t) = \frac{\phi}{1 - \phi\beta} \sigma_\varepsilon^2 > 0. \quad (7)$$

We will therefore proceed in the following way. In Section 6, we will estimate equation (1) by instrumental variables. As instruments for output, we will use the weighted growth of countries' trading partners and lagged-GDP growth. In Section 7, we use these same instruments – and, in addition, the real interest rate on U.S. treasury bills – to estimate equations (1) and (2) as a system of simultaneous equations using GMM.<sup>10</sup>

Finally, notice that since the model assumes in equation (1) that government spending (the policy instrument) reacts to *contemporaneous* output, it may be argued that this model would fit better annual rather than quarterly data. (We will estimate the model using data at both frequencies to compare results.) When thinking about quarterly data, the next model looks, in principle, more appropriate.

### 3.2. 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 government spending:

$$g_t = \beta y_{t-1} + \varepsilon_t, \quad (8)$$

$$y_t = \alpha y_{t-1} + \phi g_t + \mu_t, \quad (9)$$

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 (8) into (9), we obtain

$$y_t = (\alpha + \beta\phi)y_{t-1} + \theta_t, \quad (10)$$

where  $\theta_t \equiv \phi\varepsilon_t + \mu_t$ . Assuming that  $|\alpha + \beta\phi| < 1$ , we can express (10) as

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

---

<sup>10</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.

Then,

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

Suppose that the policymaker's objective is to minimize output variability for given values of  $\alpha$  and  $\phi$ .<sup>11</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.

From an econometric point of view, notice that equations (8) and (9) can be estimated by OLS since

$$\begin{aligned} E(\varepsilon_t y_{t-1}) &= 0, \\ E(\mu_t y_{t-1}) &= 0, \\ E(\mu_t g_t) &= 0. \end{aligned}$$

We will estimate this system for quarterly data in Section 7.

### 3.3. 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:

$$g_t = \beta E[y_t | \Omega_t] + \varepsilon_t, \tag{11}$$

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 (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 (9), it follows that

$$E[y_t | \Omega_t] = \alpha y_{t-1} + \phi g_t. \tag{12}$$

---

<sup>11</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.

Substituting (12) into (11),

$$g_t = \frac{\alpha\beta}{1 - \beta\phi}y_{t-1} + \frac{\varepsilon_t}{1 - \beta\phi}. \quad (13)$$

The equations to be estimated would then be (9) and (13). While these equations are econometrically the same as those to be estimated for Model 2 – given by (8) and (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 (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 cyclicity 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 (13) into (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,

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

It is easy to check that  $Var(y_t)$  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  $\phi\beta \rightarrow -1$ .

### 3.4. 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 Ilzetzki (2007)), 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

$$S_t \equiv \eta y_t - g_t, \quad (14)$$

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

$$g_t = \bar{g} + \beta S_t + \varepsilon_t, \quad (15)$$

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 (14) into (15), we obtain:

$$g_t = \frac{\bar{g}}{1 + \beta} + \frac{\beta \eta}{1 + \beta} y_t + \frac{\varepsilon_t}{1 + \beta}. \quad (16)$$

The second equation in this model would remain unchanged (relative to Model 1) and remain given by equation (2).

The system to be estimated (given by equations (2) and (16)) would be the same as in Model 1 but, of course, the interpretation of the coefficient on  $y$  in equation (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>12</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>13</sup>

### 3.5. Model 5: A simple VAR

#### 3.5.1. 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 8 we estimate the following system:

$$AY_t = \sum_{k=1}^j C_k Y_{t-k} + Bu_t, \quad (17)$$

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 the variables on their current observation. The matrix  $B$  is diagonal, so

<sup>12</sup>See, for example, Ilzetzki (2007) 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>13</sup>Notice, of course, that the question of what would the optimal value of  $\beta$  be does not apply since, by construction,  $\beta$ , is capturing some pre-existing political distortion.

that the vector  $u_t$  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 (17). To see this, let  $j = 1$  and  $A$  and  $C_1$  be given by

$$\begin{aligned} A &= \begin{pmatrix} 1 & 0 \\ a_{21} & 1 \end{pmatrix}, \\ C_1 &= \begin{pmatrix} 0 & \beta \\ 0 & \alpha \end{pmatrix}, \end{aligned}$$

with  $a_{21} = -\phi$ . Then, the system (17) is identical to the one given by (8) and (9). Following Blanchard and Perotti (2002), the assumption that in the matrix  $A$ ,  $a_{12} = 0$  (reflecting the assumption that  $y_t$  does not affect  $g_t$ ) is common in the VAR estimates of the effectiveness of fiscal policy.

### 3.5.2. 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>14</sup>

The impulse response of  $g$  to an output shock,  $\mu$ , after one quarter is defined as  $\partial g_{t+1}/\partial \mu_t$ . Leading (8) and then substituting (9) into (8), we obtain:

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

Hence:

$$\frac{\partial g_{t+1}}{\partial \mu_t} = \beta. \quad (18)$$

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 (9) into (8) to obtain:

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

Hence:

$$\frac{\partial g_{t+2}}{\partial \mu_t} = \alpha\beta + \beta^2\phi. \quad (19)$$

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

---

<sup>14</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.



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 (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 (19).<sup>15</sup>

### 3.5.3. Interpretation

As equation (1) makes clear, when we perform IV/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, IV/GMM estimations are able to address the issue of causality but not of forecastability since, 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.

---

<sup>15</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.

#### 4. THE DATA

In order to carefully explore the question of fiscal cyclicity, we employ a data set of quarterly frequency, including government spending, business cycle, and control variables. A detailed description of the data appears in Appendix 1. 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>16</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 studied, 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 a balanced panel including the quarters 1996Q1 to 2006Q3 is used. The main data source is the IMF's International Financial Statistics (IFS) database; we used 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. 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. The main results will be for the behavior of real general government consumption. For comparison, we will occasionally report results using central government real total spending as the fiscal measure. Estimations are less precise when using government spending since fewer countries report this measure on a quarterly basis.<sup>17</sup> Also, the overlap between quarterly measures of total spending of the central government and GDP include very short time series for a number of countries.

There is a trade-off in the choice of the government spending measure. While the use of a general government measure is more inclusive, including 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

---

<sup>16</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.

<sup>17</sup>In fact, the problem is more acute for high-income countries than for developing countries, as many European Union countries stopped reporting this measure on a quarterly basis in the mid-1990s.

categories, such as government investment and transfers, but also interest payments, which makes this measure more noisy. Much of the literature on the cyclical 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)).

#### 4.1. 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>18</sup> This interest rate is weighted for each country based on its degree of financial openness. We scale the interest rate using the measure of Chinn and Ito (2007), rescaled to range between 0 and 1 and averaged over the relevant sample for each country (giving one index of financial openness per country). As in Jaimovich and Panizza (2007), we also use an instrument representing real external shocks, using an index of the real GDP growth of each country's trading partners. The construction of this variable is discussed in Appendix 1.

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.

#### 4.2. 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)

---

<sup>18</sup>We use an adaptive-expectations measure of real interest rates. Results are identical with an ex-post measure of real interest rates.

is larger. We sacrificed consistency of data sources between the quarterly and annual samples for the sake of a larger sample size.

## 5. STYLIZED FACTS

Table 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. Appendix Table A1 repeats the OLS regression for government spending, using industrial production as a proxy for output. This increases our sample size. The estimated parameters are virtually unchanged, but we can reject at the 99 percent confidence level that the cyclicity of government spending in the two income groups is the same.

Table 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). There is no statistically significant difference between the other measures in high-income and developing countries.

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 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 (i.e., 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.

## 6. A TWO-STAGE-LEAST-SQUARES 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 a two-stage-least-squares (2SLS) regression. 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. 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 the latter is instrumented for using the contemporaneous value and three lags of the weighted GDP growth of each country's trading partners. In effect, we are estimating  $\beta$  in equation (1), using 2SLS to correct for the potential bias suggested by (7).

Jaimovich and Panizza (2007) argue that this instrument is valid. Trading partners' growth measure 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. This latter critique may be valid for the larger economies in the sample, so that our results for high-income countries should be taken with a grain of salt.

The results are summarized in Table 3. The OLS regressions, shown in the first row of the table, repeat the second row of Table 1. Real government consumption is procyclical in both income groups, but far more so in developing countries. The second row reports the results of the 2SLS regression. Standard errors are in parenthesis and F-statistics for the first stage regressions are in brackets. While the point estimate for the cyclicity of government consumption in developing countries is similar to that of the OLS regression, the results are inconclusive. Like in Jaimovich and Panizza (2007), the standard errors of the 2SLS estimates are large and the 2SLS estimate is not statistically distinguishable from the OLS estimate. We cannot reject that government consumption is highly procyclical, acyclical, or even countercyclical in developing countries. In contrast to Jaimovich and Panizza (2007), we cannot reject that the instrument we are using is a weak instrument, based on the test proposed by Stock and Yogo (2002).

For sake of comparison, we recreate Jaimovich and Panizza's (2007) result in Table A2, using annual data. Table A3 reports results of regressions using quarterly data, with total central government spending as the fiscal variable, which provides the quarterly-frequency analog of Jaimovich and Panizza's (2007) annual regressions. In both cases, the estimates are too imprecise to make robust inferences about the cyclicity of fiscal policy.

Jaimovich and Panizza (2007) put forth these inconclusive estimates as evidence that previous estimates of the cyclicity of fiscal policy are driven by reverse causality. In contrast, we view these inconclusive results more literally. As we will see in the following sections, using quarterly data

and different choices of instruments and estimation strategies yields more precise estimates, allowing us to make more accurate inferences regarding the cyclical nature of fiscal policy.

In order to compare Jaimovich and Panizza’s (2007) results with some of the other results obtained in the literature, we report in Table A4 an estimation using an alternative instrument. We use GDP growth in year  $t-1$  as an instrument for growth in year  $t$ . This estimation strategy has been used in this context by Braun (2001), Galí and Perotti (2003), and Lane (2003). With this 2SLS strategy, our finding of procyclical government spending in developing countries and acyclical spending in high-income countries are robust to an instrumental-variables estimation. Similar results obtain when lagged GDP growth and the weighted GDP growth of each country’s trading partners are both used as instruments. It should be noted, however, that the strong serial correlation of GDP may make lagged-GDP an imperfect instrument, as GDP at time  $t-1$  may still be correlated with the error term at time  $t$ .

In summary, the results using instrumental variables regressions give mixed results, either providing support for the notion that fiscal policy is procyclical in developing countries or inconclusive results. The following section attempts to provide more robust evidence.

## 7. GMM

We now propose an alternative estimation strategy, which uses a GMM estimator. To formalize our estimation strategy, consider the estimation of equation (1) using panel data:

$$g_{i,t} = \alpha_1 + \beta y_{i,t} + \varepsilon_{1i,t}, \quad (20)$$

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 (20) using OLS regressions and find that government consumption is procyclical in developing countries. However, as (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 the previous section, in Braun (2001), Lane (2003), Galí and Perotti (2003), and Jaimovich and Panizza (2007).

We propose two improvements on the methodology of the previous section. First, we include an additional instrumental variable. Since the 2SLS estimate of the previous section was inefficient, in the sense that it provided estimates with very large standard errors, efficiency may be improved by including an additional valid instrument. The instrument we propose is the

real interest rate on six-month U.S. Treasury bills, weighted by a country-specific measure of financial openness. We use this as a measure of global liquidity conditions. A natural criticism of this instrument is that it might be endogenous in the case of the United States. To address this concern, all regressions reported in this section exclude the U.S. Results are virtually unchanged when the U.S. is included, or when all G7 countries are excluded.

A second improvement concerns the choice of estimator. It is well known that a 2SLS estimator is not the most efficient estimator in the class of IV estimators. Specifically, 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 GMM estimates in quarterly frequency are summarized in Table 4, with the OLS estimates presented for comparison. Table 4 shows estimates for the cyclicity of government consumption –  $\beta$  in the discussion above. In developing countries, government consumption is procyclical, with a similar point estimate as in the OLS regression. We can reject with 95 percent confidence that government consumption is acyclical or countercyclical. We can also reject with 95 percent confidence that the estimates for high-income and developing countries are the same. From the results for high-income countries, we conclude that the 95 percent confidence interval is  $[0.13, -0.35]$ , indicating that government consumption is either countercyclical or mildly procyclical.

Both changes with respect to the specification of the previous section are important in improving the efficiency of our estimates. Appendix Table A5 shows 2SLS estimates using the same two instruments. While the results are similar, the estimates are less precise, and we can reject only at the 90 percent confidence level that government consumption is acyclical in developing countries.

In Table A6, we repeat the same exercise using the annual sample. In this case, the standard errors remain very large, making it difficult to draw inferences on the cyclicity of government consumption in developing countries. On the other hand, these estimates do provide some evidence that government consumption may be countercyclical at annual frequencies in high income countries.

## 8. SIMULTANEOUS EQUATIONS – OLS

In Section 3, we proposed two models of the simultaneous interactions between government consumption and output. In the previous two sections,

we estimated the first model (Model 1), which 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 estimate Model 2. 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 (8) and (9), using OLS with fixed effects. As indicated in section 3, and unlike Model 1, OLS is not a biased estimator of Model 2.

The results are summarized in Table 5. Government consumption shows a highly-statistically-significant procyclical reaction (with a one-quarter lag) to output. There is also evidence that, in developing countries, government consumption has an expansionary effect on output.

## 9. A VAR APPROACH

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

$$AY_{i,t} = \sum_{k=1}^j C_k Y_{i,t-k} + Bu_{i,t}, \quad (21)$$

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 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,  $Y$ , 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 (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>

### 9.1. Granger causality

We begin our time series analysis by conducting a Granger causality test of the two variables of interest. Table 6 reports these results. The top panel presents results 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 high income 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.

### 9.2. Impulse responses

The system described by (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>

---

<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.

<sup>20</sup>Notice that this identifying assumption is not necessarily inconsistent with the GMM results of Table 4 since in that case the contemporaneous impact of output on government spending captures both anticipated and unanticipated changes in output whereas in the

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 1-2. Dotted lines reflect two-standard-deviation bands. Figures 1 and 2 present the responses of GDP and government consumption, respectively, to a 10 percent impulse to the two variables. In Figure 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 shows that a 10 percent shock 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.

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. It is nevertheless interesting to observe in Figures A1-A4 that the result regarding the procyclicality of government consumption in developing countries carries over to total government expenditure. This result holds regardless of whether government spending (Figures A1-A2) or GDP (Figures A3-A4) is ordered first.

Figures A5 and A6 show impulse responses of GDP and government consumption, respectively, in a VAR regression when the additional variables are included. The results obtained before are robust to these additional variables. Government consumption shows a sizable procyclical response to GDP and to trading partners' GDP and a negative response to increases in global borrowing rates.

Figures 3 and 4 repeat the exercise for high-income countries. Figure 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

---

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).

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 and Simonelli (2007), figure 1-A for example).<sup>21</sup> Thus government consumption shows a procyclical response with long delays.

Figures A7-A10 present the results of a VAR regression 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* to output shocks.

Finally, figures A11 and A12 show the results for high-income countries of regressions with additional control variables. The results of figures 3 and 4 remain unchanged.

## 10. CONCLUSIONS

This paper 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., 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 relation from output to government consumption. Our analysis thus leaves no doubt that fiscal policy is indeed procyclical in developing countries. Interestingly enough – and contrary to the typical finding in the literature – we also find substantial evidence of procyclicality in high-income countries.

Moreover, 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.

---

<sup>21</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.

## REFERENCES

- Agenor, Piere-Richard, C. John McDermott, and Eswar S. Prasad (2000). "Macroeconomic Fluctuations in Developing Countries: Some Stylized Facts." *World Bank Economic Review* 14: 251-285.
- Alesina, Alberto, Felipe Campante, and Guido Tabellini (2008). "Why is Fiscal Policy Often Procyclical?" *Journal of the European Economic Association*, forthcoming.
- Arellano, Manuel and Stephen Bond (1991). "Some Tests of Specification for Panel Data and an Application to Employment Equations." *Review of Economic Studies* 58: 277-297.
- Arellano, Jose Pablo (2006). "Del Deficit al Superavit Fiscal: Razones para una Transformacion Estructural en Chile." *Estudios Publicos* 101: 165-186.
- Barro, Robert (1979). "On the Determination of Public Debt." *Journal of Political Economy* 87: 940-971.
- Baxter, Marianne, and Robert G. King (1993). "Fiscal Policy in General Equilibrium." *American Economic Review* 83: 315-334.
- Blanchard, Olivier, and Roberto Perotti (2002). "An Empirical Characterization of the Dynamic Effects of Changes in Government Spending and Taxes on Output." *Quarterly Journal of Economics* 117: 1329-1368.
- Blinder, Alan (2004). "The Case Against the Case Against Discretionary Fiscal Policy." CEPS Working Paper No. 100.
- Braun, Miguel (2001). "Why Is Fiscal Policy Procyclical in Developing Countries?" mimeo, Harvard University.
- Caballero, Ricardo J., and Arvind Krishnamurthy (2004). "Fiscal Policy and Financial Depth." NBER Working Paper No. 10532.
- Chinn, Menzie and Hiro Ito (2007), "A New Measure of Financial Openness." *Journal of Comparative Policy Analysis*. Forthcoming.
- Fatas, Antonio, and Ilian Mihov (2006). "Fiscal Policy and Business Cycles: An Empirical Investigation." Mimeo (INSEAD).
- Galí, Jordi and Roberto Perotti (2003). "Fiscal Policy and Monetary Integration in Europe," *Economic Policy* 18: 533-572.
- Judson, Ruth and Ann L. Owen (1999). "Estimating Dynamic Panel Data Models: A Guide for Macroeconomists." *Economics Letters* 68:9-15.

- Gavin, Michael and Roberto Perotti (1997). "Fiscal Policy in Latin America." *NBER Macroeconomics Annual*.
- Guerson, Alejandro (2003). "On the Optimality of Procyclical Fiscal Policy when Governments are not Credible." (Ph.D. dissertation, George Washington University).
- Ilzetzki, Ethan (2007). "Rent-Seeking Distortions and Fiscal Procyclicality." Mimeo (University of Maryland).
- Jaimovich, Dany, and Ugo Panizza (2007). "Procyclicality or Reverse Causality?" *RES Working Papers* 1029. Inter-American Development Bank, Research Department.
- Judson, Ruth A. and Ann L. Owen (1999). "Estimating Dynamic Panel Data Models: A Guide for Macroeconomists." *Economics Letters* 65: 9-15
- Kaminsky, Graciela, Carmen Reinhart and Carlos A. Vegh (2004). "When It Rains It Pours: Procyclical Capital Flows and Macroeconomic Policies." in *NBER Macroeconomics Annual*, edited by Mark Gertler and Kenneth Rogoff, Cambridge, MA: MIT Press.
- Lane, Philip (2003). "The Cyclical Behavior of Fiscal Policy: Evidence from the OECD." *Journal of Public Economics* 87: 2661-2675.
- Mailhos, Jorge A., and Sebastian Sosa (2000). "On the Procyclicality of Fiscal Policy: the Case of Uruguay." Mimeo (CERES, Montevideo, Uruguay).
- Manasse, Paolo (2006). "Procyclical Fiscal Policy: Shocks, Rules, and Institutions – A view from MARS." IMF Working Paper No. 06/27.
- McCallum, Bennett T. (1999). "Analysis of the Monetary Transmission Mechanism: Methodological Issues," NBER Working Paper No. 7395.
- Mendoza, Enrique G. (1995). "The Terms of Trade, the Real Exchange Rate, and Economic Fluctuations." *International Economic Review* 36: 101-137.
- Mendoza, Enrique G, and Marcelo Oviedo (2006). "Fiscal Policy and Macroeconomic Uncertainty in Developing Countries: The Tale of the Tormented Insurer." Mimeo (University of Maryland and Iowa State University).
- Monacelli, Tommaso and Roberto Perotti (2007). "Fiscal Policy, the Trade Balance, and the Real Exchange Rate: Implications for International Risk Sharing," Mimeo (Universita Bocconi).

- Newey, Whitney and Kenneth West (1987). "A Simple Positive Semi-Definite, Heteroscedasticity and Autocorrelation Consistent Covariance Matrix." *Econometrica*, 55, p. 777-787.
- Nickell, Stephen J. (1981). "Biases in Dynamic Models with Fixed Effects," *Econometrica* 49: 1417-1426.
- Perotti, Roberto (2004). "Estimating the Effects of Fiscal Policy in OECD Countries." Working Paper 274 IGER, Bocconi University.
- Ravn, Morten O. and Saverio Simonelli (2007). "Labor Market Dynamics and the Business Cycle: Structural Evidence for the United States." CSEF Working Paper No. 182.
- Ravn, Morten O., Stephanie Schmitt-Grohe and Martin Uribe (2007), "Explaining the Effects of Government Spending Shocks on Consumption and the Real Exchange Rate." NBER Working Paper no. 13328.
- Riascos, Alvaro and Carlos A. Végh (2003). "Procyclical Government Spending in Developing Countries: The Role of Capital Market Imperfections." Mimeo (UCLA and Banco Republica, Colombia).
- Rigobon, Roberto (2004). Comments on "When It Rains It Pours: Procyclical Capital Flows and Macroeconomic Policies." in *NBER Macroeconomics Annual*, edited by Mark Gertler and Kenneth Rogoff, Cambridge, MA: MIT Press.
- Sanchez de Cima, Manuel (2003). "The Political Economy of Pro-Cyclical Fiscal Policy in Mexico, 1970-1988." Working Paper (CIS, University of Southern California).
- Sims, Christopher A. (1992). "Interpreting the Macroeconomic Time Series Facts : The Effects of Monetary Policy." *European Economic Review* 36: 975-1000.
- Susuki, Yui (2006). "Fate for Procyclical Fiscal Policy in Emerging Economies: Role and Function of Sovereign Borrowing with Default Option." Mimeo (University of Michigan).
- Stock, James H., and Motohiro Yogo (2002). "Testing for Weak Instruments in Linear IV Regression." *NBER Technical Working Papers* 0284.
- Strawczynski, Michel and Joseph Zeira (2007). "Cyclicality of Fiscal Policy in Israel." Discussion Paper No. 2007.04 (Bank of Israel).
- Sturzenegger, Federico, and Rogerio Werneck (2006). "Fiscal Federalism and Procyclical Spending: The Cases of Argentina and Brazil." Mimeo (Universidad Di Tella and PUC).

Talvi, Ernesto, and Carlos A. Végh (2005). “Tax Base Variability and Pro-cyclical Fiscal Policy in Developing Countries.” *Journal of Development Economics* 78: 156-190.

Tornell, Aaron, and Philip Lane (1998). “Are windfalls a curse? A non-representative agent model of the current account.” *Journal of International Economics* 44: 83-112.

Tornell, Aaron and Philip Lane (1999). “The Voracity Effect.” *American Economic Review* 89: 22-46.

## 11. 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 A7. Developing countries are in italics.

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 is 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. We then weigh this measure on a country-by-country basis using the Chinn and Ito (2007) measure of financial openness, scaled to range between zero and one.

#### **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 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 ***<br>(0.13)   | -0.05<br>(0.37)       |
| Government Consumption | 0.48 ***<br>(0.06)   | 0.11 ***<br>(0.03)    |
| n (Spend.)             | 1286                 | 852                   |
| n (Consum.)            | 1598                 | 1946                  |

Standard Errors in parenthesis

\* - Significant at 90%

\*\* - Significant at 95%

\*\*\* - Significant at 99%

**Table 2: Cyclicalities 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 ***<br>(0.05)   | 0.08<br>(0.11)        |
| Government Consumption       | 0.31 ***<br>(0.14)   | 0.51 ***<br>(0.07)    |
| Government Capital Formation | 1.31 ***<br>(0.14)   | 1.22 ***<br>(0.37)    |
| Interest Payments            | -0.07<br>(0.28)      | -0.09<br>(0.30)       |
| n (Expend.)                  | 3139                 | 754                   |
| n (Consum.)                  | 2945                 | 789                   |
| n (Interest)                 | 1178                 | 509                   |

Cluster-Robust Standard Errors in parenthesis

\* - Significant at 90%

\*\* - Significant at 95%

\*\*\* - Significant at 99%

### Table 3: OLS and IV Estimates

Dependent Variable: Change in Real Government Consumption

Instrumented Variable: Change in Real GDP

Instruments: 4 lags of Weighted GDP Growth of Trading Partners

|     | Developing Countries     | High-Income Countries      |
|-----|--------------------------|----------------------------|
| OLS | 0.48 ***<br>(0.06)       | 0.11 ***<br>(0.03)         |
| IV  | 0.39<br>(0.31)<br>[4.36] | -0.13<br>(0.15)<br>[10.06] |
| n   | 1290                     | 1570                       |

Standard Errors in parenthesis, F-statistics of first stage regressions in square brackets

The critical value for the Stock and Yogo (2002) test for weak instruments is an F-statistic of 11.59

\* - Significant at 90%

\*\* - Significant at 95%

\*\*\* - Significant at 99%

**Table 4: GMM Estimates**

Dependent Variable--Change in Log Real Government Consumption

Instrumented Variable: Change in Real GDP

Instruments: 4 lags of Weighted GDP Growth of Trading Partners and  
of the Real Interest Rate on 6-month U.S. Treasuries

|     | Developing Countries        | High-Income Countries     |
|-----|-----------------------------|---------------------------|
| OLS | 0.51 ***<br>(0.07)          | 0.17 ***<br>(0.04)        |
| GMM | 0.61 **<br>(0.24)<br>[5.36] | -0.11<br>(0.12)<br>[9.48] |
| n   | 1290                        | 1570                      |

Standard Errors in parenthesis, F-statistics of first stage regressions in square brackets

The critical value for the Stock and Yogo (2002) test for weak instruments is an F-statistic of 11.59

Standard Errors in parenthesis

\* - Significant at 90%

\*\* - Significant at 95%

\*\*\* - Significant at 99%

**Table 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 ***<br>(0.03)   | 0.53 ***<br>(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 ***<br>(.01)    | 0.01<br>(0.01)        |
| GDP(-1)                | 0.87 ***<br>(0.01)   | 0.93 ***<br>(0.01)    |

Standard Errors in parenthesis

\* - Significant at 90%

\*\* - Significant at 95%

\*\*\* - Significant at 99%

**Table 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<br>Consumption | 6.96<br>(0.14)     | 5.26 *<br>(0.72)   |
| Real GDP                       | 35.1 ***<br>(0.00) | 34.2 ***<br>(0.00) |
| n                              | 1517               | 1297               |

\* Null rejected with 90% confidence

\*\* Null rejected with 95% confidence

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

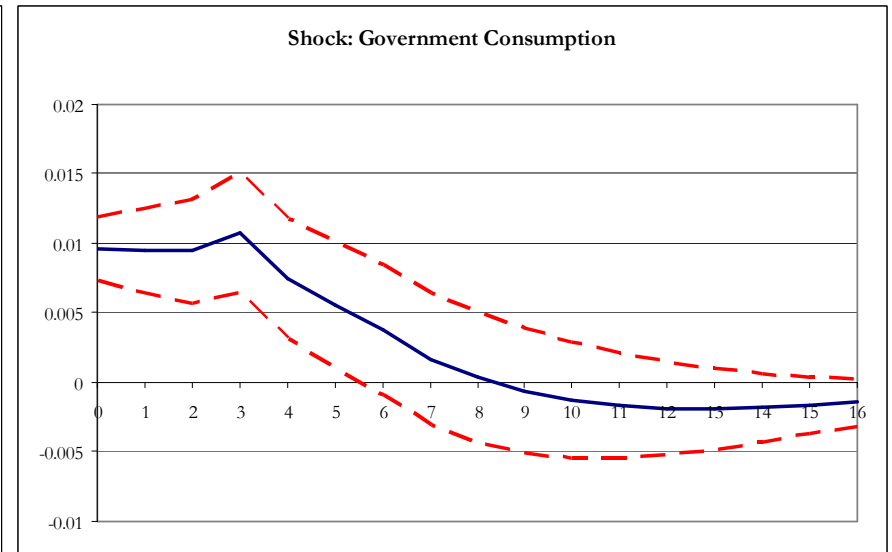
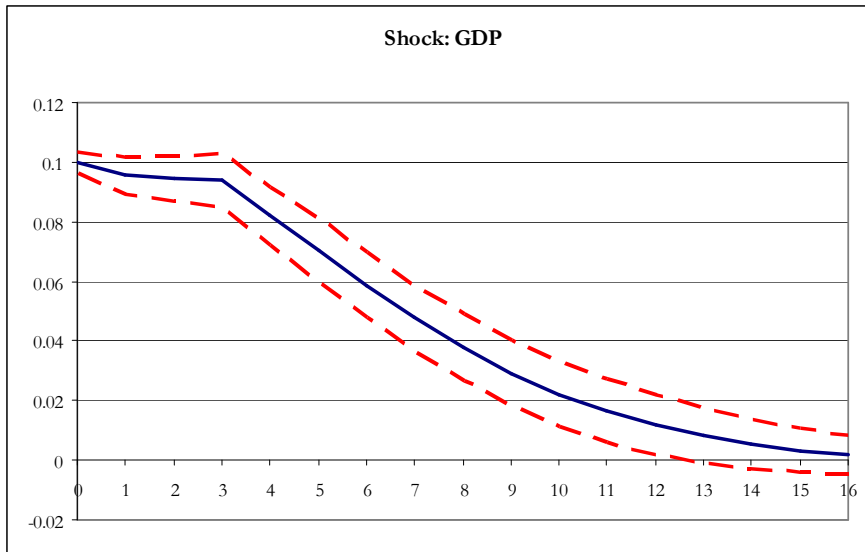
| <b>High-Income Countries</b>   |                    |                    |
|--------------------------------|--------------------|--------------------|
| Excluded Variable              | Bivariate          | Full               |
| Real Government<br>Consumption | 12.6<br>(0.13)     | 20.5 ***<br>(0.00)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

\* Null rejected with 90% confidence

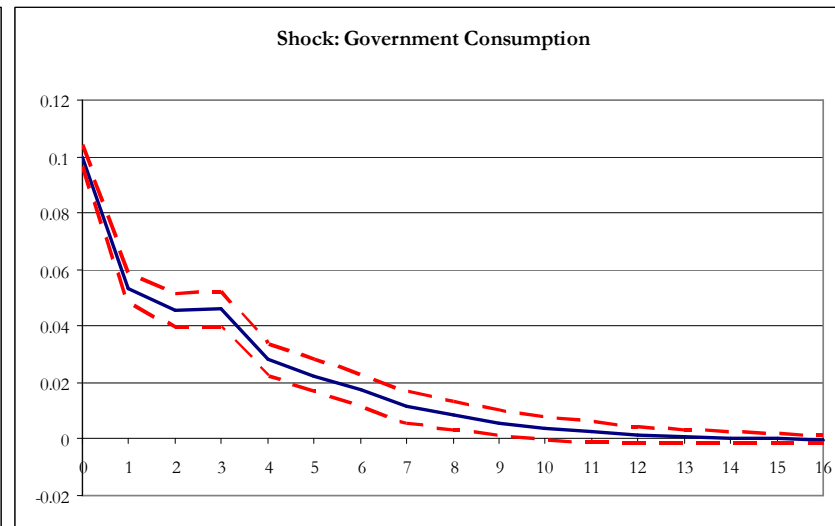
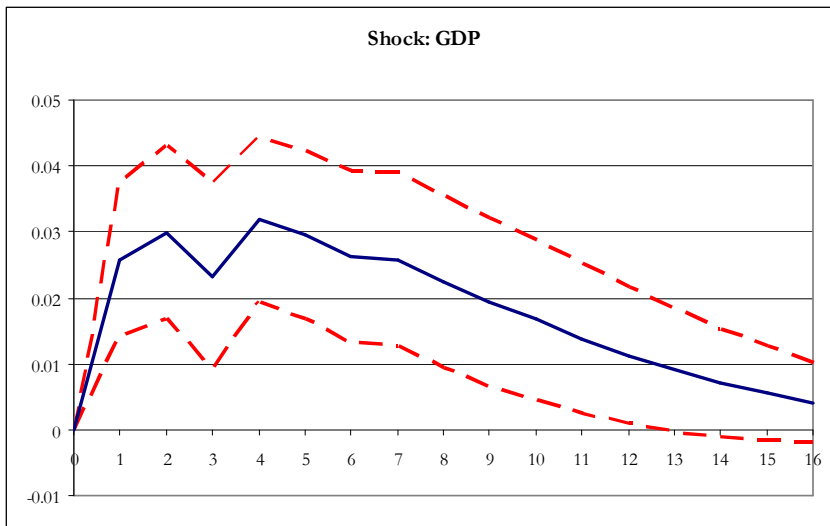
\*\* Null rejected with 95% confidence

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

**Figure 1**  
**Developing Countries**  
**Bivariate Regression with Government Consumption**  
**Response of Real GDP to Shocks**

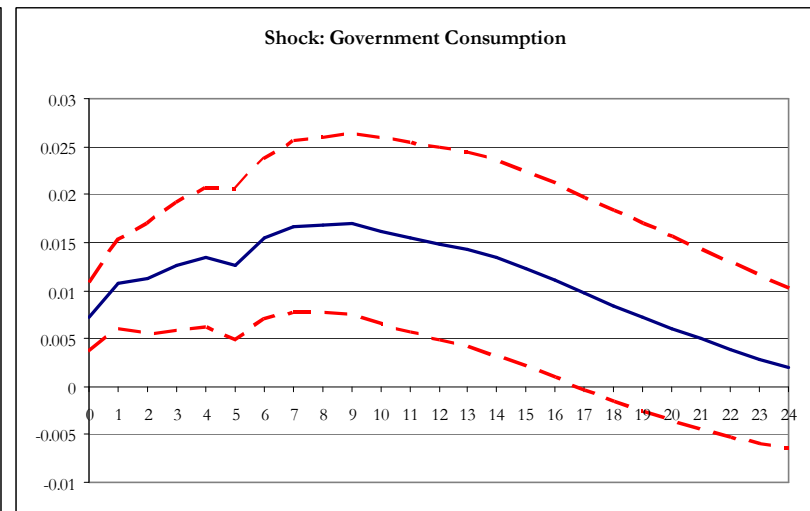
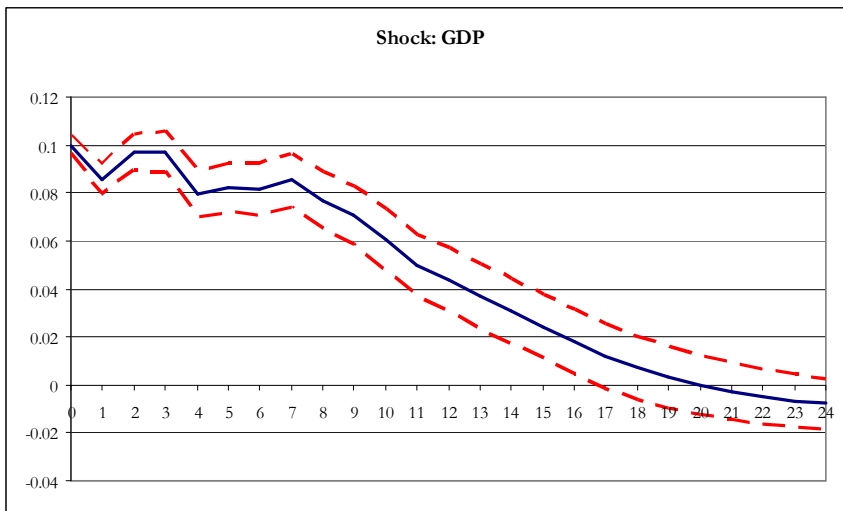


**Figure 2**  
**Developing Countries**  
**Bivariate Regression with Government Consumption**  
**Response of Real Government Consumption to Shocks**

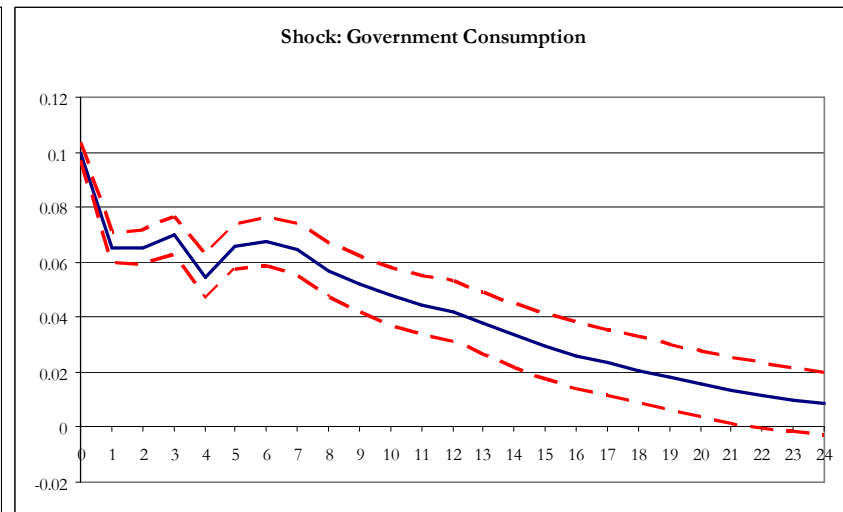
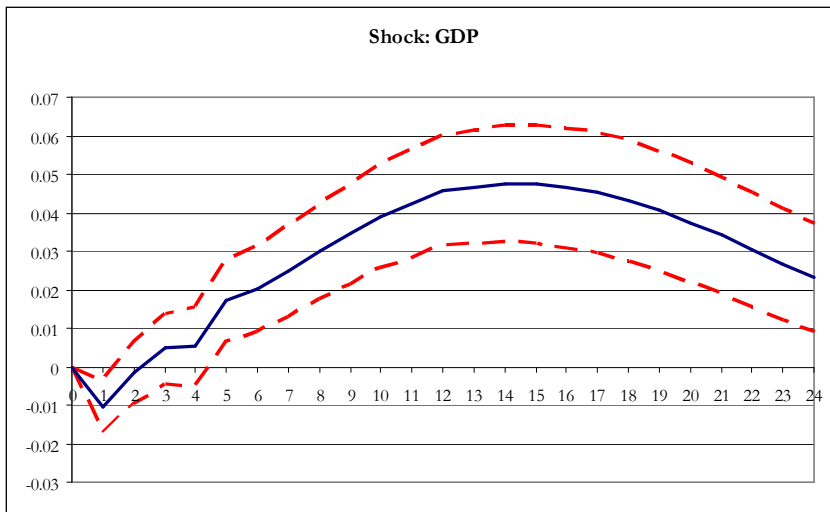




**Figure 3**  
**High-Income Countries**  
**Bivariate Regression**  
**Response of Real GDP to Shocks**



**Figure 4**  
**High-Income Countries**  
**Bivariate Regression**  
**Response of Real Government Consumption to Shocks**



**Table A1: OLS Estimates**

Dependent Variable: Change in Real Government Spending

Independent Variable: Change in Industrial Production

|         | Developing Countries | High-Income Countries |
|---------|----------------------|-----------------------|
| OLS     | 0.45 ***<br>(0.08)   | 0.05<br>(0.13)        |
| n (OLS) | 1163                 | 1514                  |

Standard Errors in parenthesis

\* - Significant at 90%

\*\* - Significant at 95%

\*\*\* - Significant at 99%

**Table A2: OLS and IV Estimates--Annual Data**  
 Dependent Variable: Change in Real Government Spending

Instrumented Variable: Change in Real GDP

Instrument: Weighted GDP Growth of Trading Partners

|                                | Developing Countries | High-Income Countries |
|--------------------------------|----------------------|-----------------------|
| OLS                            | 0.93 ***<br>(0.05)   | 0.08<br>(0.11)        |
| IV                             | -0.56<br>(0.75)      | -0.74<br>(0.80)       |
| n                              | 1874                 | 623                   |
| F-stat in first stage<br>of IV | 2.87                 | 11.83                 |

Standard Errors in parenthesis

\* - Significant at 90%

\*\* - Significant at 95%

\*\*\* - Significant at 99%

**Table A3: OLS and IV Estimates**

Dependent Variable: Change in Real Government Spending

Instrumented Variable: Change in Real GDP

Instruments: 4 lags of Weighted GDP Growth of Trading Partners

|                             | Developing Countries | High-Income Countries |
|-----------------------------|----------------------|-----------------------|
| OLS                         | 0.34 ***<br>(0.09)   | -0.33<br>(0.575)      |
| IV                          | -0.76<br>(0.60)      | -0.97<br>(1.66)       |
| n                           | 1049                 | 695                   |
| F-stat in first stage of IV | 4.36                 | 8.63                  |

Standard Errors in parenthesis

\* - Significant at 90%

\*\* - Significant at 95%

\*\*\* - Significant at 99%

**Table A4: OLS and IV Estimates--Annual Data**  
 Dependent Variable: Change in Real Government Spending

Instrumented Variable: Change in Real GDP

Instrument: Lagged real GDP growth

|                                | Developing Countries | High-Income Countries |
|--------------------------------|----------------------|-----------------------|
| OLS                            | 0.93 ***<br>(0.05)   | 0.08<br>(0.11)        |
| IV                             | 1.03 **<br>(0.47)    | 0.23<br>(0.19)        |
| n (OLS)                        | 3139                 | 754                   |
| n (IV)                         | 3114                 | 752                   |
| F-stat in first stage<br>of IV | 179.4                | 163.69                |

Standard Errors in parenthesis

\* - Significant at 90%

\*\* - Significant at 95%

\*\*\* - Significant at 99%

**Table A5: 2SLS Estimates with Both Instruments**  
 Dependent Variable: Change in Real Government Consumption  
 Instrumented Variable: Change in Real GDP

Instruments: 4 lags of Weighted GDP Growth of Trading Partners, of  
 the Real Interest Rates on 6-month U.S. Treasuries.

|          | Developing Countries | High-Income Countries |
|----------|----------------------|-----------------------|
|          | 0.51 *               | -0.05                 |
|          | (0.28)               | (0.46)                |
|          | [5.36]               | [9.48]                |
| <b>n</b> | 1598                 | 1562                  |

Standard Errors in parenthesis, F-statistics of first stage regressions in square brackets

The critical value for the Stock and Yogo (2002) test for weak instruments is an F-statistic of 11.59

Standard Errors in parenthesis

\* - Significant at 90%

\*\* - Significant at 95%

\*\*\* - Significant at 99%

**Table A6: GMM Estimates--Annual Data**

Dependent Variable--Change in Log Real Government Consumption

Instrumented Variable: Change in Real GDP

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

|     | Developing Countries | High-Income Countries |
|-----|----------------------|-----------------------|
| OLS | 0.34 ***<br>(0.10)   | 0.63 ***<br>(0.08)    |
| GMM | -1.71<br>(1.35)      | -1.09 **<br>(0.36)    |
| n   | 1866                 | 600                   |

Standard Errors in parenthesis

\* - Significant at 90%

\*\* - Significant at 95%

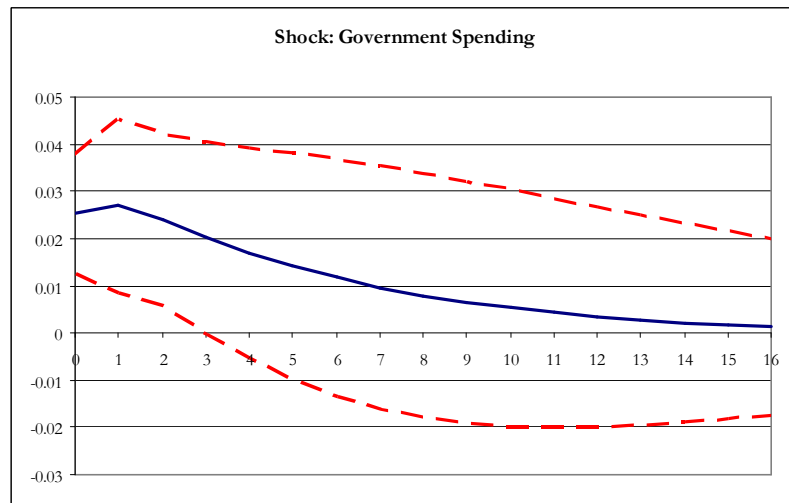
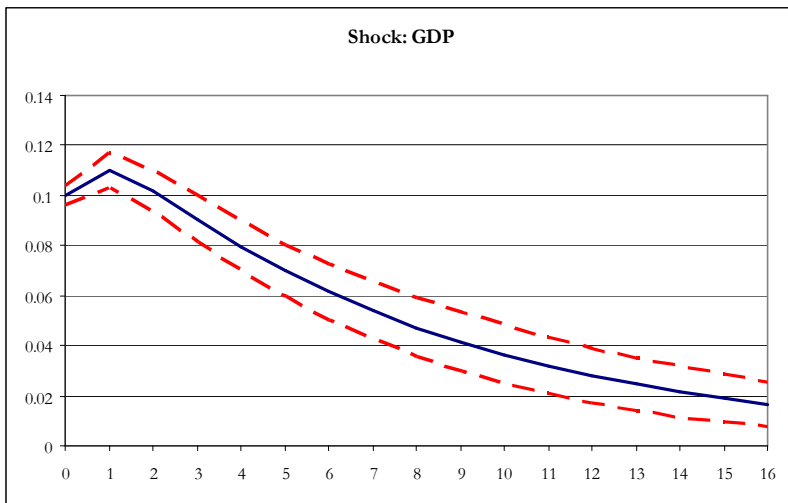
\*\*\* - Significant at 99%



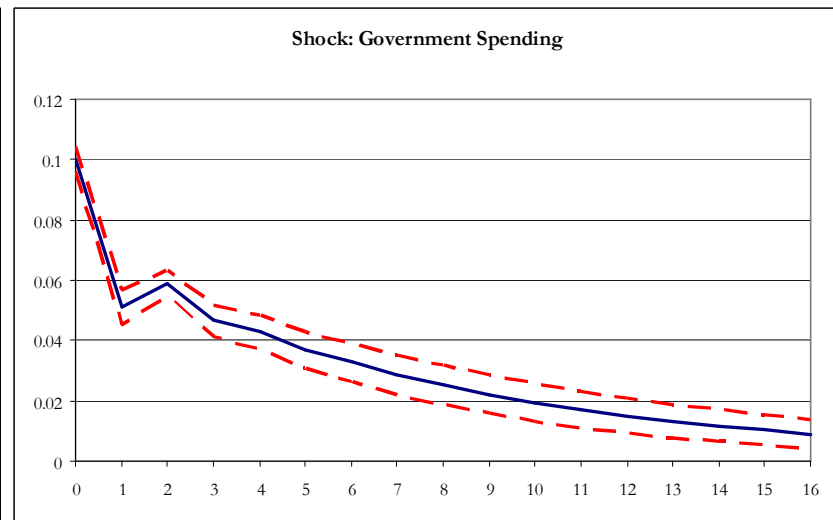
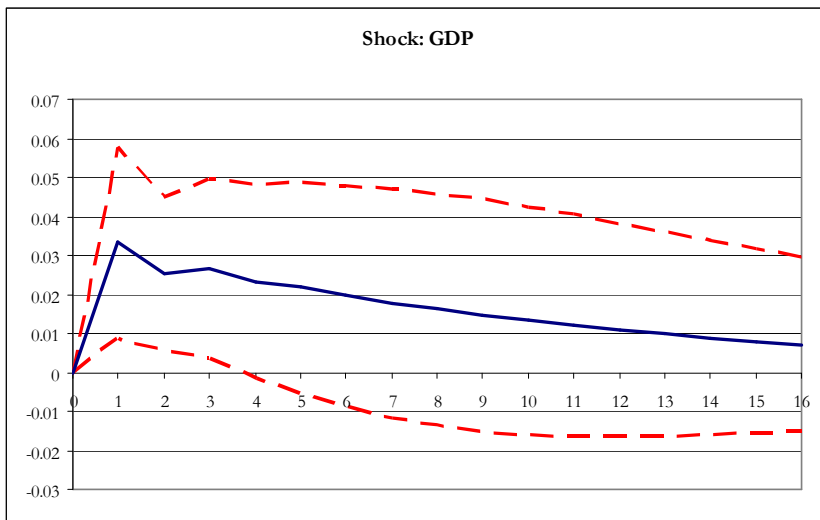
**Table A7: Length of Time Series by Country**  
For Real GDP and Government Consumption Series

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

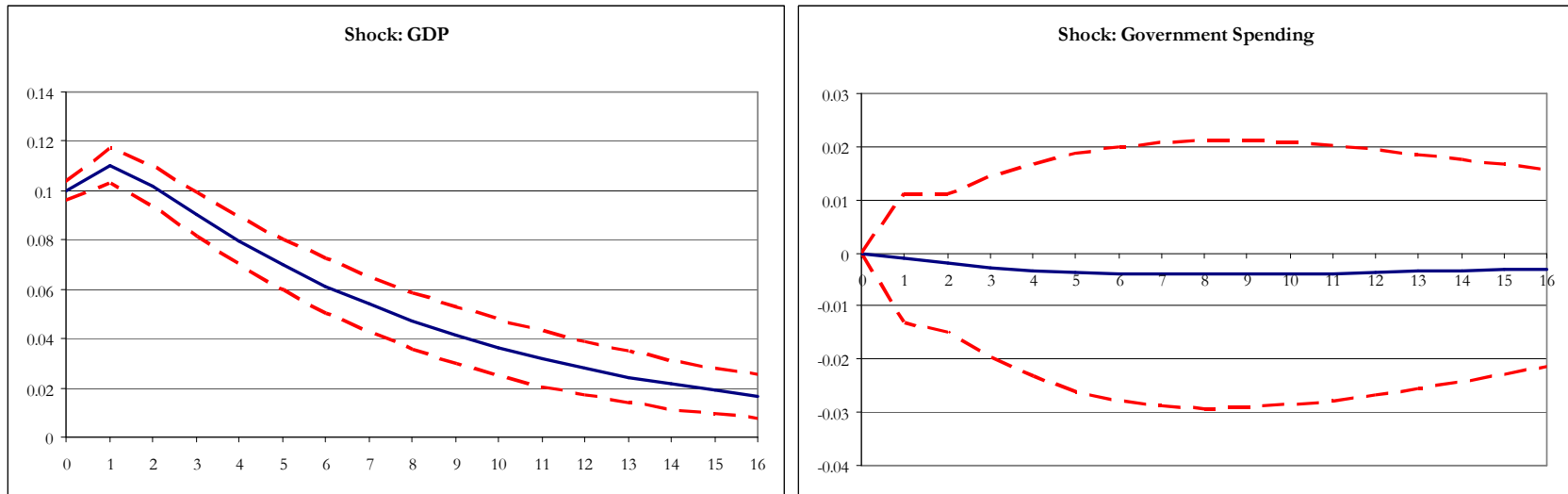
**Figure A1**  
**Developing Countries**  
**Bivariate Regression with Government Spending**  
**Response of Real GDP to Shocks**  
**Government Spending Ordered First**



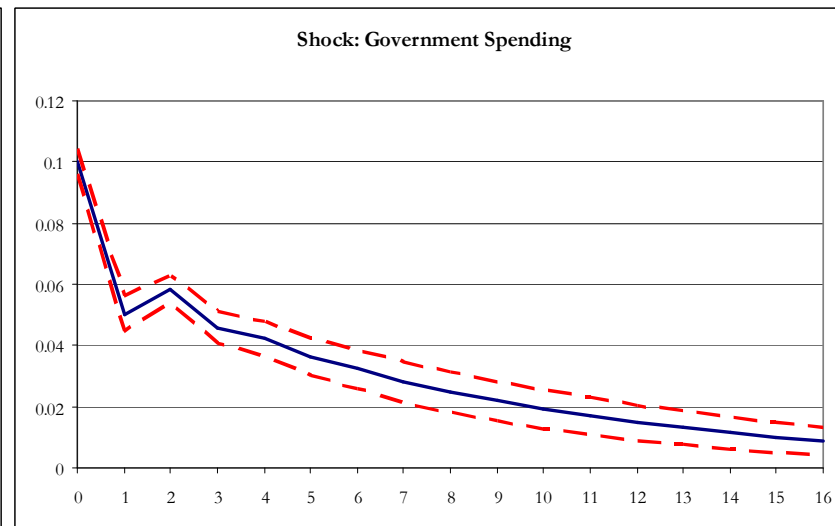
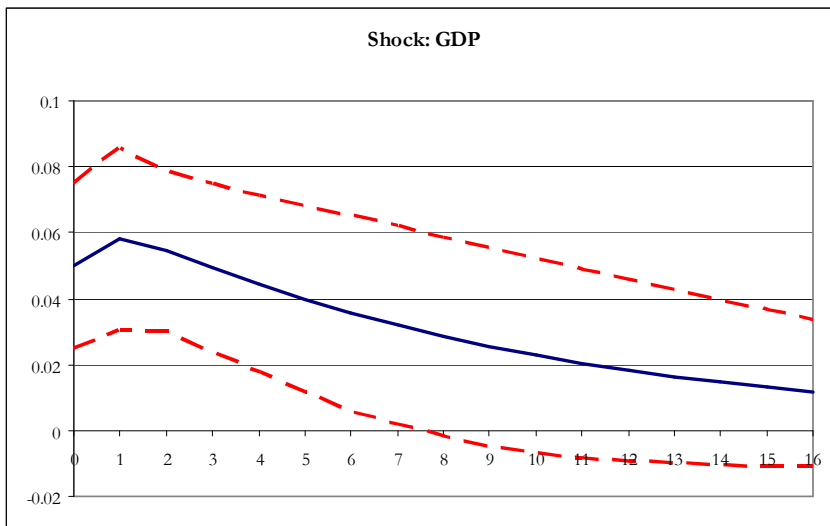
**Figure A2**  
**Developing Countries**  
**Bivariate Regression with Government Spending**  
**Response of Real Government Spending to Shocks**  
**Government Spending Ordered First**



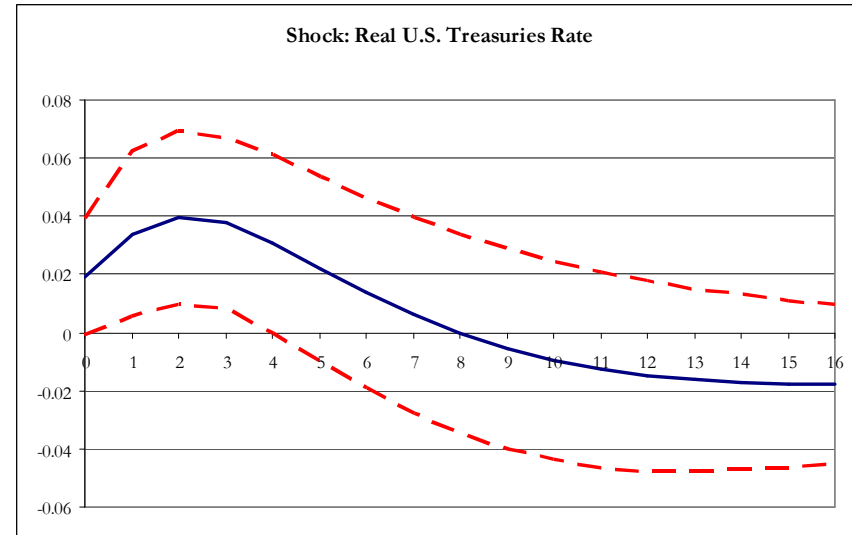
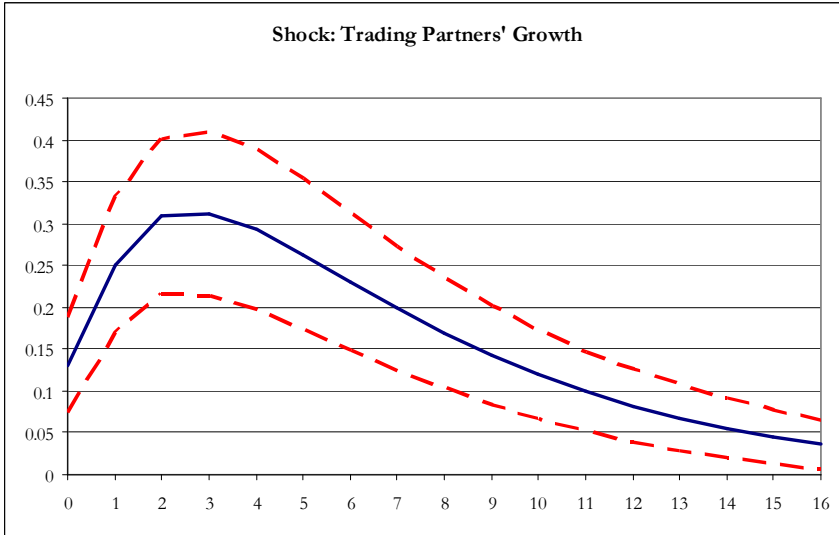
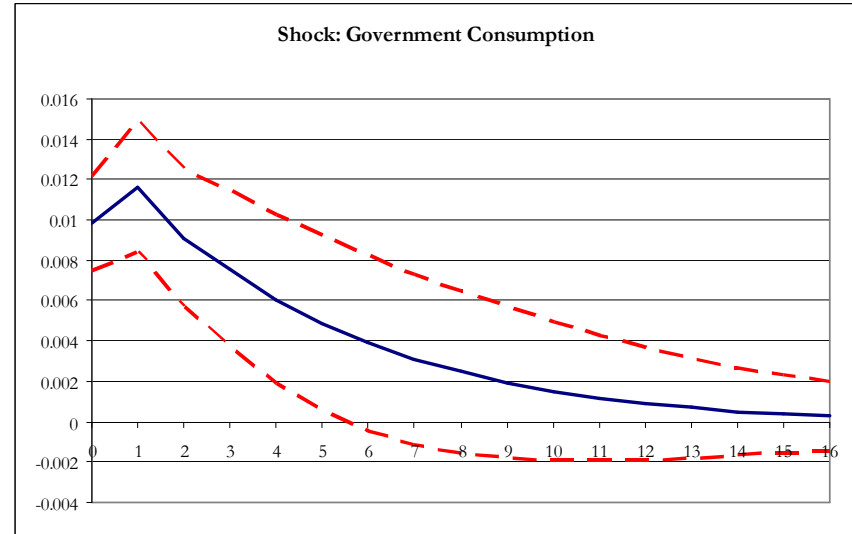
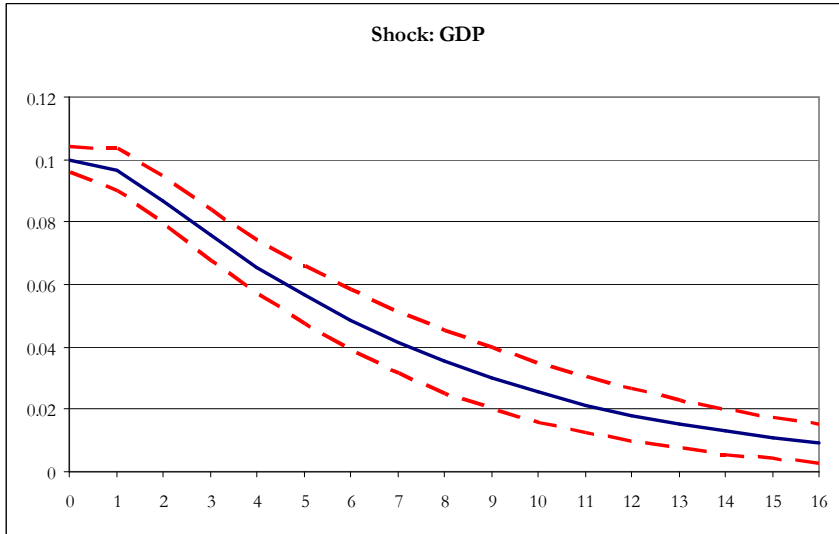
**Figure A3**  
**Developing Countries**  
**Bivariate Regression with Government Spending**  
**Response of Real GDP to Shocks**  
**Real GDP Ordered First**



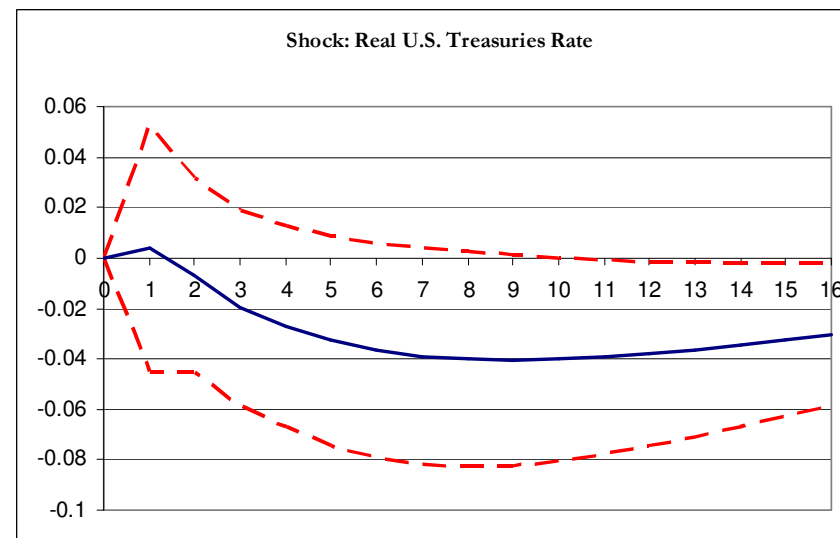
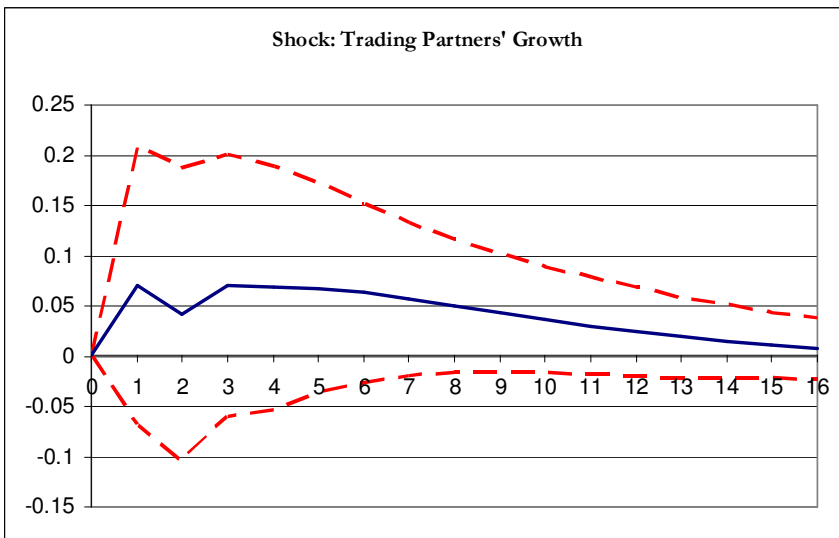
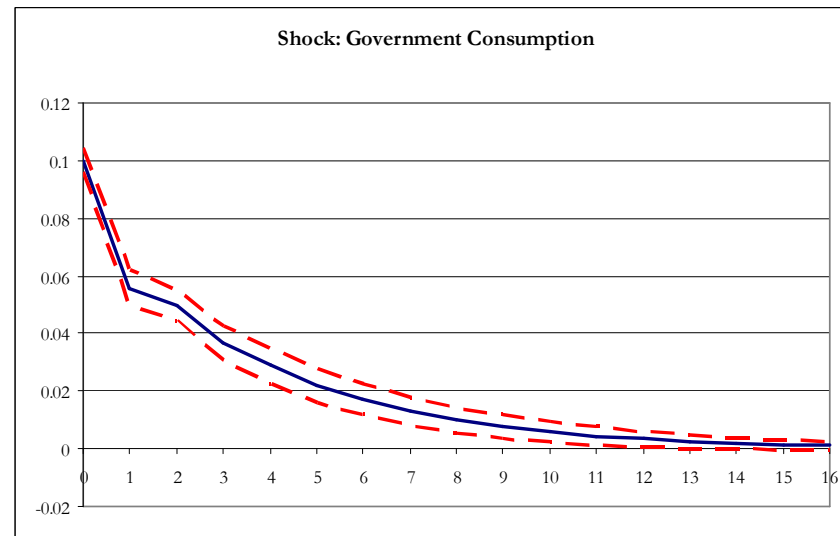
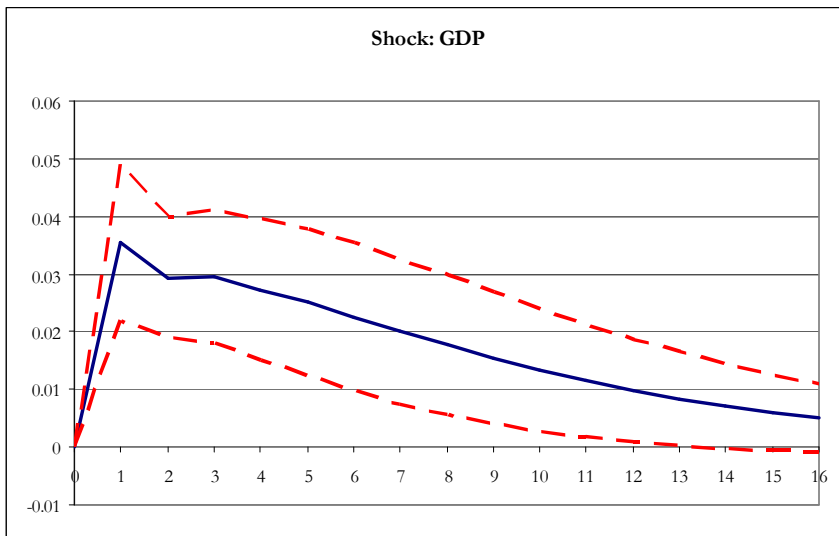
**Figure A4**  
**Developing Countries**  
**Bivariate Regression with Government Spending**  
**Response of Real Government Spending to Shocks**  
**Real GDP Ordered First**



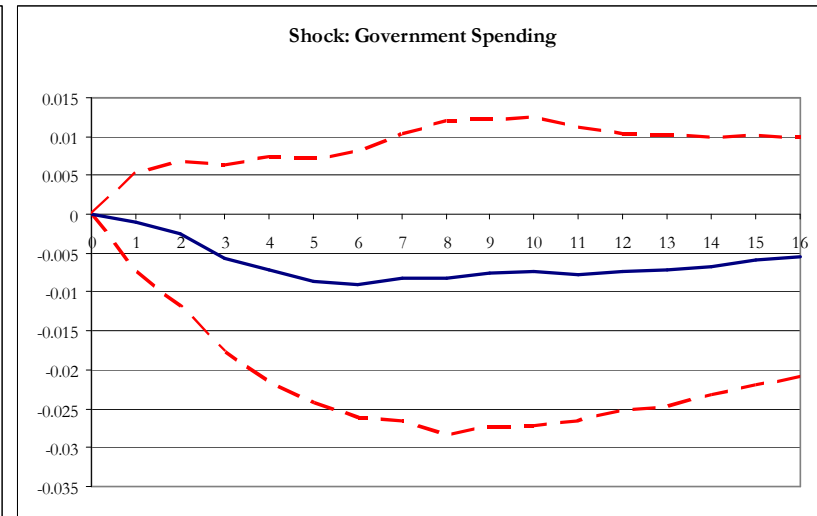
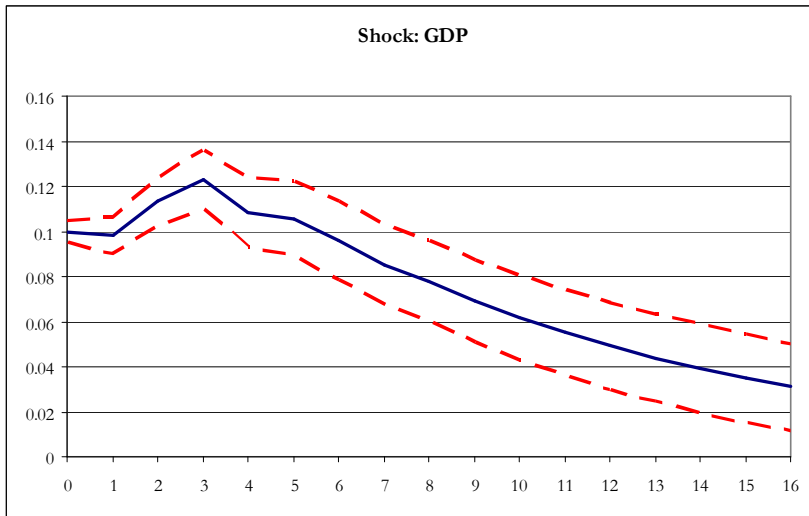
**Figure A5**  
**Developing Countries**  
**Full Specification**  
**Response of Real GDP to Shocks**



**Figure A6**  
**Developing Countries**  
**Full Specification**  
**Response of Real Government Consumption to Shocks**

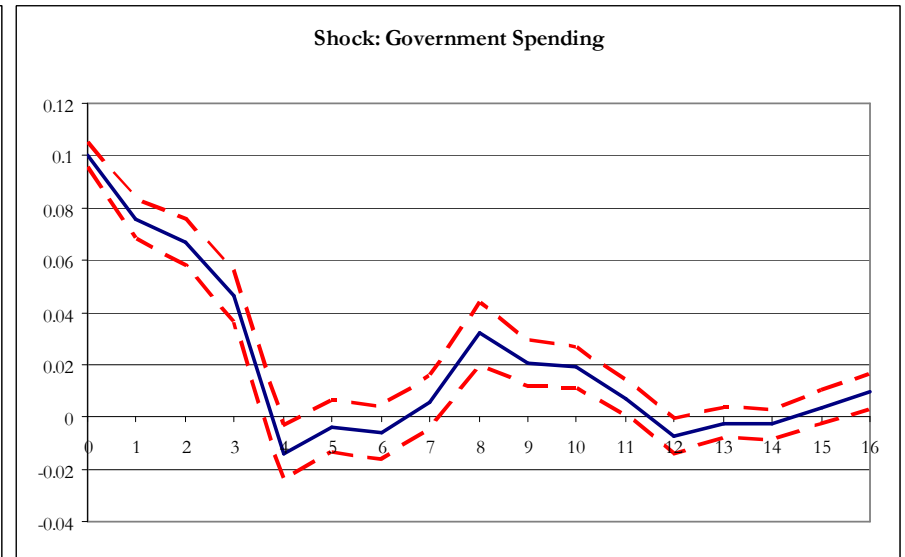
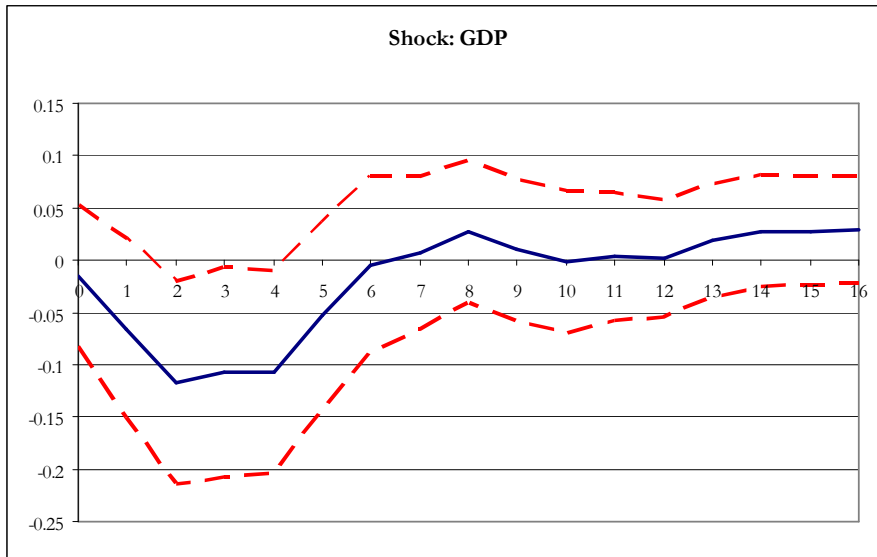


**Figure A7**  
**High-Income Countries**  
**Bivariate Regression with Government Spending**  
**Response of Real GDP to Shocks**  
**Government Spending Ordered First**

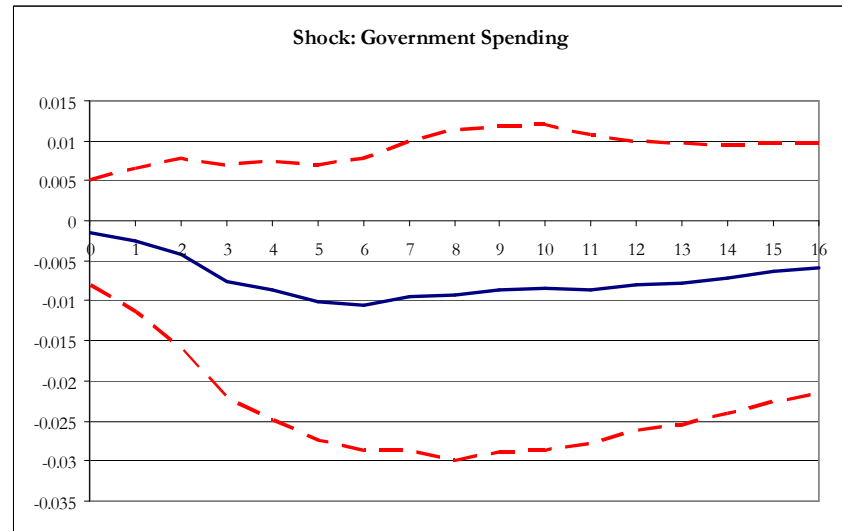
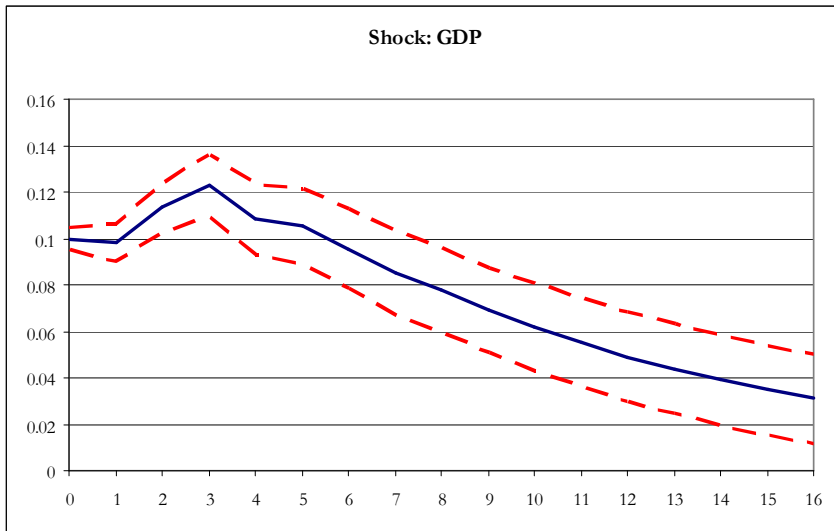




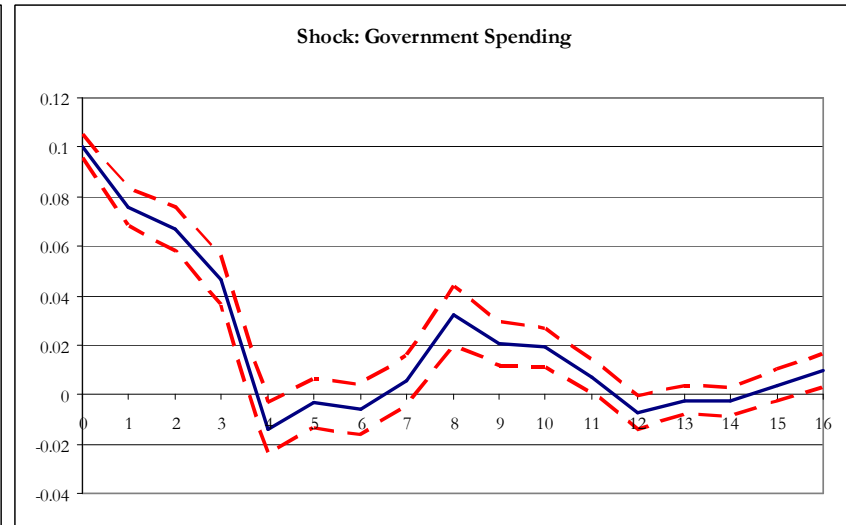
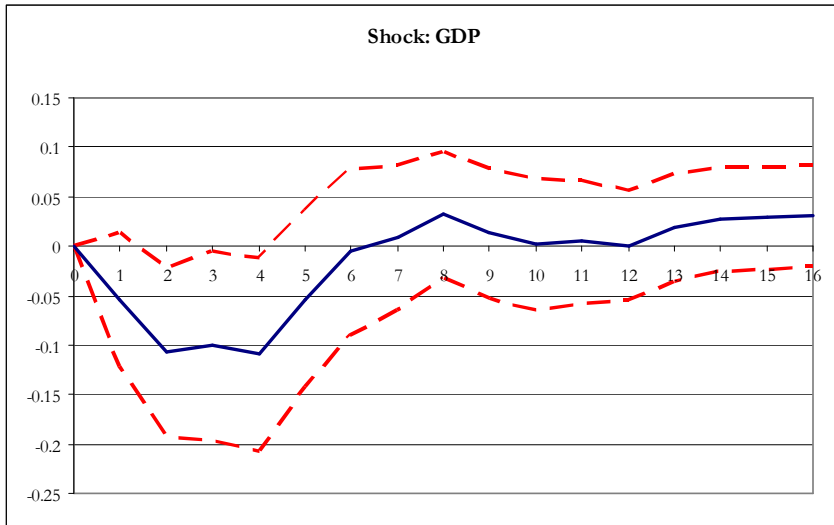
**Figure A8**  
**High-Income Countries**  
**Bivariate Regression with Government Spending**  
**Response of Real Government Spending to Shocks**  
**Government Spending Ordered First**



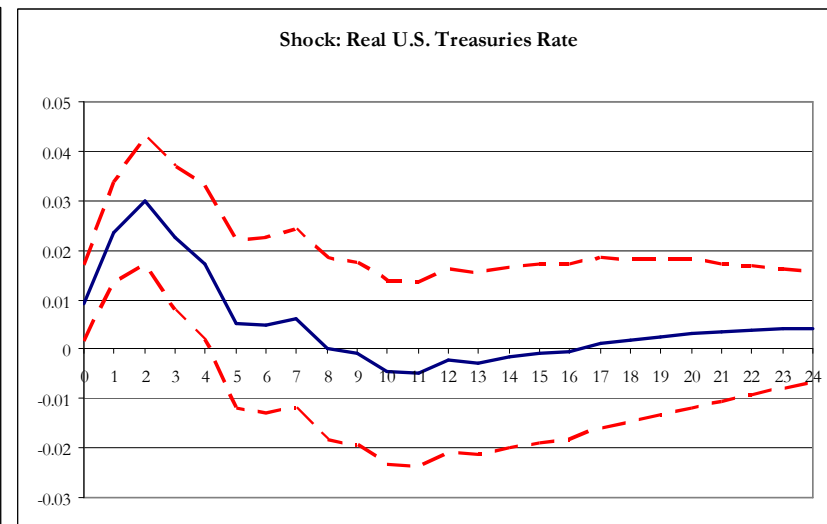
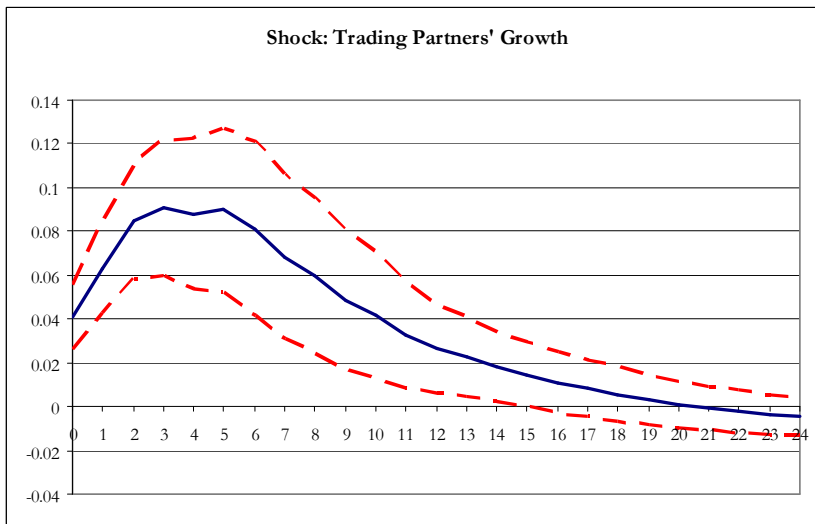
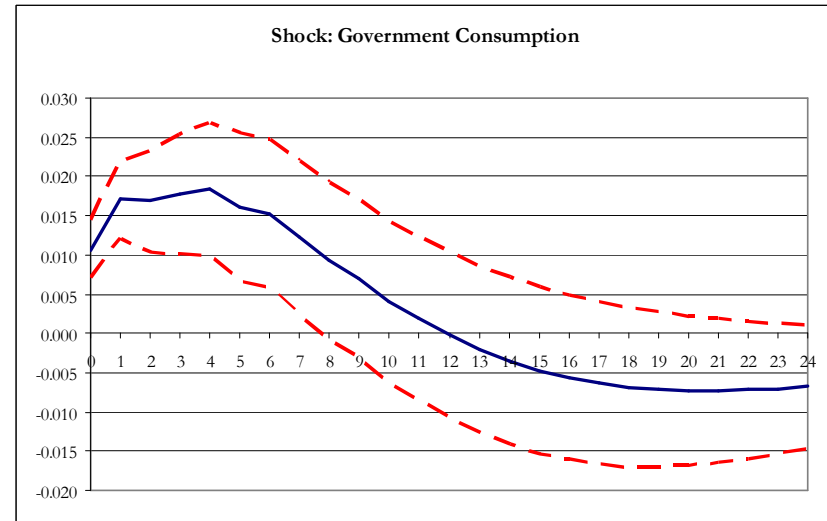
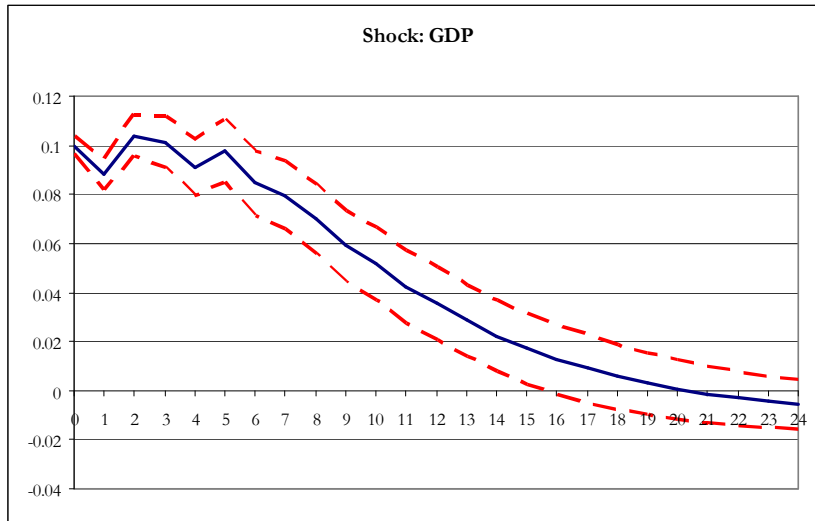
**Figure A9**  
**High-Income Countries**  
**Bivariate Regression with Government Spending**  
**Response of Real GDP to Shocks**  
**Real GDP Ordered First**



**Figure A10**  
**High-Income Countries**  
**Bivariate Regression with Government Spending**  
**Response of Real Government Spending to Shocks**  
**Real GDP Ordered First**



**Figure A11**  
**High-Income Countries**  
**Full Specification**  
**Response of Real GDP to Shocks**



**Figure A12**  
**High-Income Countries**  
**Full Specification**  
**Response of Real Government Consumption to Shocks**

