

## **Public Spending and the Macroeconomy: Evidence from Developing and Developed Countries**

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### **Abstract**

Using annual data, this paper studies the time series evidence regarding the effectiveness of government spending. Crowding out appears more prevalent in the face of variation in government spending in advanced countries. Private consumption and inflation vary more closely with government spending in developing countries.

*Key words:* fiscal stimulus; crowding out; supply constraints; developing and advanced countries

*JEL classification:* E61; E62; E63; E32; E21

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### **1. Introduction**

In recent years, there has been a lot of discussion about the role of stabilization policies. During a recession, it is possible to stimulate the economy through expansionary fiscal or monetary policies. The increased demand is likely, in turn, to stimulate output growth and price inflation. Conversely, during a boom it is possible to curb excess demand through contractionary fiscal or monetary policies. Demand reduction is likely, in turn, to moderate output growth and price inflation.

The stabilizing function of fiscal policies is dependent on their effects on nominal and real variables. The debate concerning the effectiveness of fiscal policies in stabilizing economic conditions is an old topic. Keynesians have argued for the effectiveness of fiscal policy. The effectiveness of monetary policy is likely to depend on conditions in the credit market and the effect of credit availability on private spending (Tobin, 1947).

The change in government spending guarantees timely changes in aggregate demand. Demand and/or supply conditions may differentiate the expansionary and contractionary effects of fiscal policies. For example, aggregate demand shifts may be different in the face of expansionary and contractionary government spending shocks.

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An increase in government spending increases the demand for goods and total income. Higher spending may prompt the government to issue more bonds. If the public perceives government bonds as wealth, private consumption increases. Alternatively, if consumers are Ricardian, they are likely to discount fully future tax liabilities associated with higher government spending. Moreover, expansionary government spending shocks increase the demand for loanable funds and raise the interest rate, crowding out private spending. The behavior of Ricardian consumers and conditions in the credit market may be different with respect to positive and negative government spending shocks, differentiating the size of the shifts in aggregate demand.

On the supply side, conditions in labor and/or product markets may differentiate the slope of the supply curve in the face of expansionary and contractionary shocks to government spending. If wages and/or prices are more flexible in the upward direction, compared to the downward direction, equal size demand shifts will have asymmetric effects on output and price.

Given theoretical arguments for sources of demand and/or supply asymmetry, previous investigations (Kandil, 2001, 2002a) provided evidence of asymmetry in the effects of government spending shocks, using data for interest rates, output, prices, and wages in the US. The present investigation will shed light on the transmission channel of variation in government spending using data for a sample of developing and advanced countries. The objective is to shed light on the following questions: "How is the fiscal stimulus or withdrawal distributed to components of aggregate demand?" and "Is there evidence of co-movements in components of aggregate demand with respect to variation in government spending?"

The change in government spending follows a stochastic trend that varies with agents' forecasts in steady state. Shocks represent symmetric random fluctuations around agents' forecasts during periods of expansionary and contractionary fiscal stance. The time series evidence will indicate the effects of government spending shifts, anticipated as well as positive and negative shocks, on components of aggregate demand (private consumption, private investment, exports, and imports), as well as on real output growth and price inflation.

Cross-country correlations across the sample of advanced and developing countries will illustrate the allocation of government spending shifts between components of aggregate demand, output growth, and price inflation. These allocations will indicate the degree of price flexibility and the elasticity of aggregate demand with respect to changes in government spending across developing countries, in contrast to advanced countries. Underlying these allocations is the difference in structural and institutional constraints that characterize the demand and supply channels. Cross-country analysis will measure variations in trend and variability of demand components, output growth, and price inflation with the variability of government spending across the samples of developing and advanced countries.

To anticipate the results, the evidence illustrates interesting differences regarding the interaction between government spending and the macroeconomy

across developing and advanced countries. Consistent with liquidity constraints, crowding out appears more prevalent in the face of an increase in government spending in advanced countries. Private consumption varies more closely with government spending in developing countries, increasing inflationary pressures. Concerns about crowding out private activity in advanced countries and fueling inflation in developing countries demand careful management of variation in government spending to reduce uncertainty and limit potential adverse effects on economic growth.

The remainder of the investigation is organized as follows. Section 2 outlines the theoretical underpinnings of demand and supply-side channels that determine the asymmetric effects of fiscal policies. Section 3 presents the time series model. Section 4 analyzes the difference across advanced and developing countries regarding the asymmetric effects of fiscal shocks. Section 5 contrasts the implications of asymmetry across countries. Section 6 concludes.

## 2. The Asymmetric Effects of Government Spending

This section outlines the theoretical arguments regarding determinants of asymmetry in the face of variation in government spending. Traditionally, discretionary fiscal policy aims at determining aggregate demand by varying the level of public spending.

Asymmetry in the face of a change in government spending may be a function of conditions on the demand and/or supply side of the economy (Kandil, 1995, 1996, 1998, and 1999; Karras, 1996a, 1996b; Apergis et al., 2005). To illustrate, consider the following reduced-form equation:

$$Dv_t = \sum_{j=0}^x \beta_{pvj}^s \text{posg}_{t-j} + \sum_{j=0}^x \beta_{nvj}^s \text{negg}_{t-j}, \quad v = y, p, \quad (1)$$

where  $D(\cdot)$  is the first-difference operator, the log of real output is denoted  $y$ , and the log value of the price level is denoted  $p$ . Government spending shocks comprise distributed lags of positive and negative shocks,  $\text{posg}_{t-j}$  and  $\text{negg}_{t-j}$ . The difference between  $\beta_{pvj}^s$  and  $\beta_{nvj}^s$  measures asymmetry in each variable's response to government spending shocks. The  $\beta$  parameters vary in response to two factors: (1) the size of aggregate demand shifts in the face of the policy shock and/or (2) conditions on the supply side that determine capacity constraints and price flexibility in the face of aggregate demand shifts.

### 2.1 Demand-Side Asymmetry

The size of the aggregate demand shift may be different with respect to the expansionary and contractionary shocks to government spending.

The traditional view is that an increase in government spending will stimulate aggregate demand. Two factors determine the size of aggregate demand shifts. First, binding liquidity constraints may differentiate the effects of government spending on

financial markets. An increase in government spending is likely to increase the budget deficit. To finance the increased spending, the government increases borrowing. Given the limited supply of available loanable funds above capacity level, an increase in government spending raises the interest rate, crowding out private spending. This channel moderates the expansionary effects of an increase in government spending on aggregate demand.

As government debt builds up with fiscal expansions, Miller et al. (1990) argue that the monetary risk of default or increasing inflation risk will reinforce crowding out effects through interest rates. Hence, policy credibility is crucial. That is, if the government lacks a track record of fiscal prudence, the interest rate will most likely reflect risk premia. Sizable risk premia represent perhaps the clearest reasons that fiscal multipliers could turn negative. Private spending decreases in the face of a rise in the interest rate induced by sizable risk premia following fiscal expansion.<sup>1</sup> If crowding out is larger in the face of expansionary government spending shocks, a smaller aggregate demand shift will differentiate the effects of expansionary and contractionary shocks on product and labor markets.

In another direction, some economists have questioned the importance of changes in the interest rate in response to government spending. They appeal to the Ricardian equivalence argument to emphasize the effect of government spending on private savings.<sup>2</sup> Given concerns about the budget deficit, agents foresee future tax liabilities in response to higher government spending. Accordingly, private consumption is likely to decrease and savings will increase in response to higher government spending. The reduction in private consumption offsets the positive effect of government spending on aggregate demand and moderates demand expansion. Risk-averse households are likely to assign high probability to future tax liability.<sup>3</sup> If consumers are more Ricardian in the face of expansionary government spending shocks, demand expansion is likely to be smaller, compared to contraction.

## **2.2 Supply-Side Asymmetry**

Conditions on the supply side in the labor and/or product markets may differentiate the slope of the aggregate supply curve in the face of expansionary and contractionary aggregate demand shifts. New Keynesian theoretical models have focused on market imperfections towards an explanation of a kinked-supply curve. The source of asymmetry has varied between sticky-wage and sticky-price explanations of business cycles.

Sticky-wage models have traced sources of cyclical fluctuations to conditions in the labor market (see for instance Gray, 1978). Implicit or explicit labor contracts may offer an explanation of sticky wages. Given nominal wage rigidity, an unanticipated increase in price, e.g., in response to a positive shock to government spending, decreases the real wage and increases the output supplied in the short run. Conditions in the labor market may differentiate, however, upward and downward nominal wage flexibility in the face of expansionary and contractionary demand shocks (see for example Ball et al., 1988). Implicit or explicit contractual wage agreements may establish that nominal wage flexibility is asymmetric.

Asymmetric nominal wage flexibility may be the result of institutional settings which differentiate wage and salary negotiations in the upward and downward directions. During boom periods, cost of living adjustments may be specified to guarantee workers an upward adjustment of wages to keep up with inflation. In contrast, firms may be reluctant to take aggressive measures towards adjusting nominal wages in the downward direction during recessionary periods. This is because the search and training cost of hiring new workers to accommodate a future rise in demand may actually exceed the perceived loss of retaining workers at wages that exceed the marginal physical product of labor during recessionary periods. Alternatively, the asymmetric flexibility of nominal wages maybe an endogenous response to aggregate uncertainty. Models of the variety of Gray (1978) have emphasized the dependency of the degree of indexation on the variability of stochastic disturbances. In a situation where positive and negative shocks are not equally variable, agents' incentives for the optimal degree of indexation would be asymmetric.

In a scenario that assumes more upward flexibility of the nominal wage, positive demand shocks will prompt an instantaneous increase of wages. The upward flexibility of the nominal wage moderates the reduction of the real wage and the increase in output growth in the face of expansionary demand shocks. Consequently, higher demand will be reflected in a higher cost of the output produced and, in turn, higher prices. In contrast, if nominal wages are more downwardly rigid, the countercyclical response (increase) of the real wage exacerbates output contraction and moderates price deflation. Accordingly, asymmetric nominal wage adjustment implies a steeper supply curve in the face of expansionary demand shifts, compared to contractionary shifts.

Sticky-price explanations have isolated output fluctuations in the short run from conditions in the labor market (see for instance Ball and Mankiw, 1994). Menu costs limit the frequency of adjusting prices over time. These are the costs involved in implementing and announcing a price change. Given price rigidity, firms resort to adjusting output in the short run in response to unanticipated demand shifts, e.g., a positive shock to government spending. Conditions in the product market may establish, however, that prices adjust asymmetrically in the face of demand shocks.<sup>4</sup>

Positive trend inflation plays a key role in introducing asymmetries. Inflation causes firms' relative prices to decline automatically between adjustments. This requires greater adjustment of firms' desired price in the face of positive shocks, compared to negative shocks. When a firm wants a lower relative price in the face of negative demand shocks, inflation does much of the work, decreasing the need to pay the menu costs to adjust prices. By contrast, a positive demand shock means that the desired relative price increases while actual price is falling on account of high trend inflation, creating a large gap between desired and actual prices. As a result, positive shocks are more likely to induce a larger price adjustment, compared to negative shocks.

Asymmetric price adjustment implies that shifts in aggregate demand have asymmetric effects on output. Since prices are sticky downward, a fall in aggregate

demand is absorbed in output contraction. Higher upward flexibility of prices moderates the output increase in response to expansionary demand shocks. Accordingly, asymmetric price adjustment implies a steeper supply curve in the face of expansionary demand shifts, compared to contractionary shifts.

The framework of this investigation is an empirical study of the effects of the growth in government spending on demand components, output growth, and price inflation in a sample of developing and advanced countries. The empirical estimation measures the elasticity of specific demand components in the face of government spending shocks. These parameters trace channels of crowding out on the demand side of the economy. The estimation of empirical models that measure the allocation of government spending shifts between real growth and price inflation will measure supply-side constraints. To shed light on differences in the transmission of government spending shifts across advanced and developing countries, cross-country correlation coefficients will measure co-movements on the demand and supply sides across countries of each group.

### **3. Empirical Framework**

The empirical model comprises reduced-form equations explaining components of aggregate demand (private consumption, private investment, exports, and imports) as well as output growth and price inflation. The growth component of the series is the domain of real growth factors that vary with labor, capital and technology. The results indicate that this component is non-stationary.<sup>5</sup> To account for non-stationarity, empirical models are estimated in first-differenced form. Fluctuations in the estimated dependent variables are attributed to a variety of shocks impinging on the economic system.

Assume aggregate demand shocks are distributed symmetrically around an anticipated steady state trend over time. This trend is consistent with capacity utilization in the economy and varies with agents' forecasts of the determinants of aggregate demand in equilibrium. Shocks to aggregate demand develop randomly around the forecasted trend and determine cyclicity in output growth and price inflation.

Aggregate demand varies with the major determinants of domestic and foreign demand. On the domestic front, policy variables include government spending and the money supply. To account for interaction with the rest of the world through the current and capital accounts, the model specification also includes the exchange rate.

Assume shocks to government spending are distributed randomly around a steady state moving trend over time. This trend varies with variables that determine the growth of government spending over time. Fluctuations around this trend are symmetrically distributed.

Fluctuations in the face of government spending shocks are likely to be determined by demand and supply constraints. On the supply side, capacity and institutional constraints determine price flexibility in the face of aggregate demand shifts. On the demand side, structural parameters determine the size of aggregate

demand shifts in the face of government spending shocks.

A positive shock to government spending increases demand and income. Through the multiplier process, the effect is further reinforced on aggregate demand. Nonetheless, the possibility of crowding out may involve an offsetting effect on private spending. Monetary growth may vary to accommodate the growth of government spending and/or stabilize the exchange rate. Hence, both shocks enter the empirical models.

Underlying the model specification is the assumption that cyclical fluctuations in the output supplied is attributed to changes in the output price around its anticipated value, i.e., output price surprises. These surprises are attributed to demand shocks that include shocks to government spending, the money supply, and the exchange rate. These are the major determinants of domestic and external demand in theory (for a detailed theoretical illustration, see Kandil and Mirzaie, 2002). In addition, fluctuations in the exchange rate may also determine the output supplied. Given the dependency of developing countries on imported goods, a depreciation of the exchange rate increases the cost of imported goods. Hence, the output supplied decreases. Accordingly, the empirical model is specified as follows:

$$\begin{aligned}
 Dy_t = & \beta_{0y} + \beta_{1y}E_{t-1}Dg_t + \beta_{2y}E_{t-1}Dm_t + \beta_{3y}E_{t-1}Dh_t \\
 & + \beta_{4yp}posg_t + \beta_{4yn}negg_t + \beta_{5yp}posm_t + \beta_{5yn}negm_t \\
 & + \beta_{6yp}posh_t + \beta_{6yn}negh_t + \eta_{yt}
 \end{aligned} \tag{2}$$

$$\begin{aligned}
 Dp_t = & \beta_{0p} + \beta_{1p}E_{t-1}Dg_t + \beta_{2p}E_{t-1}Dm_t + \beta_{3p}E_{t-1}Dh_t \\
 & + \beta_{4pp}posg_t + \beta_{4pn}negg_t + \beta_{5pp}posm_t + \beta_{5pn}negm_t \\
 & + \beta_{6pp}posh_t + \beta_{6pn}negh_t + \eta_{pt}
 \end{aligned} \tag{3}$$

where real output growth is denoted  $Dy_t$ , price inflation is denoted  $Dp_t$ , and  $E(\cdot)$  is the expected value of a variable at time  $t$  based on information available to agents at time  $t-1$ . By construction, anticipated changes of variables on the right-hand side of the empirical models are a function of lagged variables in the economic system, which capture persistence in adjustments over time. Having accounted for this persistence, only contemporaneous shocks appear in the model.

The exchange rate measures the real price of the domestic currency relative to a weighted average of currencies for major trading partners. An increase indicates currency appreciation. Anticipated appreciation of the exchange rate is denoted  $EDh_t$ , where  $EDg_t$  and  $EDm_t$  denote anticipated growth of government spending and the money supply. Positive shocks to the exchange rate,  $posh_t$ , are unexpected appreciation of the domestic currency. Similarly,  $negh_t$  approximates unexpected depreciation of the domestic currency. Expansionary and contractionary shocks to government spending are approximated by  $posg_t$  and  $negg_t$ . Similarly, expansionary and contractionary shocks to the money supply are represented by  $posm_t$  and  $negm_t$ , while  $\eta_{yt}$ , and  $\eta_{pt}$  are random unexplained residuals with zero mean and constant variance.

To measure fluctuations on the demand side in response to government

spending, the empirical models in (2) and (3) are replicated to estimate growth in private consumption,  $Dcon_t$ , the growth in private investment,  $Dinv_t$ , the growth in exports,  $Dexp_t$ , and the growth in imports,  $Dimp_t$ . Adjustment in demand components will determine the transmission channels of government spending shifts to output growth and price inflation.

Anticipated appreciation of the domestic currency decreases the demand for exports and increases demand for imports. Through this channel, real output growth and price inflation decrease. Also on the demand side, unanticipated appreciation of the domestic currency may decrease money demand, as agents seek to capitalize on higher than expected currency value. Lower demand for money increases velocity and hence domestic demand, mitigating the negative effects on real output growth and price inflation. On the supply side, unanticipated currency appreciation decreases the cost of imports and the output produced, increasing output growth and decreasing price inflation. The opposite holds in the face of negative shocks to the exchange rate, i.e., unanticipated currency depreciation. Structural parameters determine the net effects of currency fluctuations on output and price.

Expansionary government spending shocks are expected to increase demand and income. The resulting increase in money demand raises the interest rate with crowding out effects on aggregate demand. If the net result is positive on aggregate demand, expansionary government spending shocks increase price inflation and output growth. Through the income channel, government spending shocks are likely to have a positive effect on consumption growth. The effects on investment spending will depend on the relative effects of government spending on income and the interest rate. If the income channel dominates, investment demand increases in response to higher government spending. Imports increase on account of higher domestic demand. The net effect on exports is likely to depend, however, on the relative strengths of income and crowding out channels following an increase in government spending.

Expansionary monetary shocks increase liquidity and, in turn, available credit. Subsequently, aggregate demand increases with positive effects on output growth and price inflation. The effectiveness of monetary policy may be hampered, however, by accompanying domestic and external effects. If monetary growth accommodates an increase in government spending, inflationary expectation increases. Higher inflationary expectations may prompt agents to decrease the demand for domestic currency, creating additional inflationary pressure. As confidence is eroded in the ability of monetary policy to stimulate growth, capital outflow may further counter the effectiveness of monetary policy. The combined effects of the various channels will determine the allocation of monetary growth between output growth and price inflation. Moreover, the effects of monetary growth on specific demand components (private consumption, private investment, exports, and imports) will be dependent on the relative effects on real growth and price inflation.

The difference between the effects of positive and negative shocks on economic variables measures asymmetry. If the difference is positive, the variability



of government spending shocks has, on average, a positive net effect on variables' growth.

#### 4. Time Series Evidence

The data under investigation are annual for a sample of 18 developing and 25 advanced countries. Developing countries are selected based on data availability with an objective to have a diverse sample based on income and geographical location. Countries in the advanced group are based on the IMF classification in the World Economic Outlook (WEO) data base. The sample period for investigation covers 1976–2006. Appendix B outlines variables' description and data sources.

Table 1A summarizes the mean and variance of selected time series statistics within countries: growth of government spending, real growth, price inflation, consumption growth, investment growth, import growth, and export growth. In general, developing countries are characterized by higher average growth and higher variability of government spending, compared to advanced countries. While indicators of real growth are not pronouncedly different between the two groups, other indicators (price inflation, consumption growth, investment growth, export growth, and import growth) are pronouncedly higher in developing countries, compared to advanced countries.

The empirical models (2) and (3) are estimated jointly with the equations that determine agents' forecasts of variables that enter the empirical model (see Appendix A for details). Detailed results for real output growth, price inflation, and components of aggregate demand are available upon request.

Table 1A. Summary Statistics across Countries

Variable	Statistic	Advanced Countries		Developing Countries	
		Mean	SD	Mean	SD
<b>Predictor</b>					
Growth of government spending	Mean	0.11	0.06	0.26	0.24
	Variance	0.11	0.06	0.29	0.31
<b>Response</b>					
Real growth	Mean	0.04	0.02	0.04	0.01
	Variance	0.03	0.02	0.05	0.03
Price inflation	Mean	0.08	0.07	0.18	0.14
	Variance	0.06	0.08	0.29	0.37
Consumption growth	Mean	0.11	0.06	0.26	0.23
	Variance	0.07	0.08	0.26	0.35
Investment growth	Mean	0.11	0.06	0.26	0.19
	Variance	0.12	0.07	0.39	0.39
Export growth	Mean	0.12	0.05	0.27	0.20
	Variance	0.10	0.07	0.38	0.42
Import growth	Mean	0.11	0.06	0.27	0.20
	Variance	0.12	0.08	0.36	0.40

Table 1B summarizes means and variances of the variables' responses to anticipated shifts in government spending, positive shocks, and negative shocks across the samples of developing and advanced countries. To save space, only parameters that measure the effects of government spending are shown.

**Table 1B. Responses to Government Spending Shifts in Developing and Advanced Countries**

Country group	Government spending shifts	<u>Real growth</u>		<u>Price inflation</u>		<u>Cons. growth</u>	
		Mean	SD	Mean	SD	Mean	SD
Developing	Anticipated	0.02	0.23	0.36	0.37	0.32	0.42
Advanced	Anticipated	-0.11	0.30	0.37	0.31	0.25	0.34
Developing	Positive Shocks	-0.01	0.31	0.31	0.83	0.47	0.94
Advanced	Positive Shocks	-0.16	1.02	0.17	0.56	0.23	0.47
Developing	Negative Shocks	-0.05	0.21	0.10	0.64	0.01	0.60
Advanced	Negative Shocks	0.07	0.63	0.14	0.48	0.17	0.43
Country group	Government spending shifts	<u>Investment growth</u>		<u>Import growth</u>		<u>Export growth</u>	
		Mean	SD	Mean	SD	Mean	SD
Developing	Anticipated	0.38	1.15	0.22	0.91	0.26	0.66
Advanced	Anticipated	-0.16	2.28	-0.09	1.30	0.18	1.06
Developing	Positive Shocks	0.27	1.82	0.17	0.89	-0.21	1.19
Advanced	Positive Shocks	0.09	2.80	-0.10	1.13	-0.10	0.93
Developing	Negative Shocks	0.37	1.28	0.29	1.19	0.39	8.60
Advanced	Negative Shocks	0.13	1.86	0.31	1.30	0.13	0.85

Notes: Means are average time series responses across the group of countries to government spending shifts, and SDs are standard deviations across time series estimates.

#### 4.1 Output Growth

In general, anticipated growth of government spending has significant negative effects on real growth in a number of advanced countries. Anticipated increase in government spending captures anticipation in response to lagged economic conditions that determine agents' forecasts. The negative response of real growth indicates failure of the fiscal stimulus to revive growth in a timely span. Growth does not respond positively to anticipated growth in government spending within a year, indicating ineffectiveness of the fiscal stimulus in steady state. Anticipated increase in government spending triggers anticipation of tighter constraints on credit availability and a higher cost of borrowing, with potential adverse effects on growth.

The negative significant effects of expansionary government spending shocks on real growth remain prevalent across advanced countries, providing further support to the adverse effect of higher government spending on economic activity across advanced countries. Consistently, the reduction in government spending eases binding constraints on credit availability, stimulating real growth, as evident by the negative significant response to contractionary shocks.

Across developing countries, the evidence provides less support for the crowding out channel of an increase in government spending. The negative significant response of real growth to anticipated growth and expansionary shocks to

government spending appear less prevalent across developing countries, compared to advanced countries. In general, contractionary government spending shocks appear insignificant on real growth, except for a few significant negative responses, indicating moderate increase in real growth despite fiscal contraction.

The evidence across developing and advanced countries highlights a few differences. Consistent with near full utilization of available resources, financing constraints are more binding in advanced countries. In contrast, excess liquidity and idle resources in many developing countries avail financing for an increase in government spending, while limiting the crowding out effect on private spending. A few specifics in developing countries are relevant in this context: the underdevelopment of the financial system, inefficient intermediation, high saving rates, high risk of lending to the private sector, and limited lending opportunities in highly undiversified economies.

#### **4.2 Price Inflation**

In contrast to the limited effect of anticipated government spending on real growth across advanced countries, the effects on price are more pervasive in support of long-lasting significant inflationary effects. The inflationary effect of expansionary shocks to government spending appears less evident. The deflationary effect of contractionary government spending shocks appears, in general, limited.

Across developing countries, the inflationary effects of anticipated government spending shifts are generally larger, relative to their real effects on growth. The inflationary effect of expansionary government spending shocks is even more pervasive, compared to that of anticipated shifts. Downward rigidity of price inflation is more prevalent, however, across developing countries, compared to advanced countries.

Clearly, the evidence spells out rigidity to adjust prices downward despite high trend inflation in many developing countries. In Table 1A, the mean and variance of price inflation are much higher across developing countries, compared to advanced countries. Across developing countries, average trend inflation over time ranges from a low of 5% in Saudi Arabia to a high of 56% in Argentina. In contrast, across advanced countries, the average inflation over time ranges from a low of 2.3% in Germany to a high of 34% in Israel. As noted in Section 2, both sticky-wage and sticky-price models predict less downward flexibility of wages and/or prices in the face of higher trend inflation. Agents are more reluctant to adjust wages and/or prices downward in anticipation of higher price inflation.

#### **4.3 Private Consumption Growth**

Across advanced countries, anticipated growth of government spending is an important determinant of private consumption, as evident by the significant positive response. Accordingly, anticipated growth of government spending determines planned income and the steady growth of private consumption. There is also evidence of cyclicity in private consumption growth with respect to expansionary shocks to government spending. The reduction in private consumption with respect

to random contraction in government spending is less pervasive. Nonetheless, the evidence indicates flexibility to adjust consumption downward during cyclical downturns in a few countries.

Across many developing countries, government spending is likely to play a larger role in providing employment and supporting growth, compared to advanced countries. In support of this role is the positive and significant response of private consumption to anticipated growth in government spending in many countries. The cyclical increase in private consumption with respect to expansionary shocks to government spending, although less pervasive, is robust, signifying the role of government spending in supporting private income. In contrast, the response of private consumption to contractionary government spending shocks appears less pervasive, indicating acyclical response, in general.

The evidence highlights some difference regarding the role of government spending in stimulating consumption growth across developing and advanced countries. Planned consumption, in many advanced and developing countries, is tied to anticipated growth in government spending, reflecting movement in permanent income and rational expectations. Cyclicalities spells out, however, a bigger role of government spending in developing countries in stabilizing economic conditions and weathering the adverse effects of exogenous shocks.

#### **4.4 Investment Growth**

Across advanced countries, the response of private investment to anticipated shifts in government spending provides further evidence in support of crowding out. This is evident by the significant negative response of private investment growth to anticipated growth of government spending, in general. Significant responses of private investment to expansionary shocks are mixed, combining both negative responses in support of crowding out and positive responses in support of the fiscal stimulus. Similarly, contractionary shocks have mixed significant effects on private investment growth. Negative effects indicate an increase, while positive effects indicate a reduction in private investment growth in the face of contractionary government spending shocks.

Across developing countries, the evidence highlights limited crowding out effects, compared to advanced countries. The significant response of private investment growth to fluctuations in government spending, both anticipated as well as expansionary and contractionary shocks, is primarily positive. Accordingly, the growth of government spending provides a necessary stimulus to spur growth of private investment, in general, across countries.

As many advanced countries employ existing resources near full utilization, an increase (decrease) in government spending increases (relaxes) constraints on available financing, limiting (availing) resources to finance private activity. In contrast, private investment decisions are mostly dependent on economic conditions in developing countries, and government spending provides the necessary stimulus to mobilize private resources.

#### 4.5 Import Growth

Across advanced countries, the crowding out channel remains prevalent in the response of imports to anticipated growth of government spending. The evidence differentiates, however, the effects of anticipated and unanticipated increase in government spending on imports. Limited significant effects on import growth signify the role of contractionary government spending shocks in slowing down economic activity and import growth.

Across developing countries, import growth is evident to respond significantly to anticipated growth in government spending in many countries. In contrast, the transitory effects of expansionary shocks to government spending appear rather limited on import growth. The contractionary effect of a slowdown in government spending is generally more prevalent across developing countries.

Overall, the evidence does not highlight pronounced differences between the effects of government spending on import growth in developing and advanced countries.

#### 4.6 Export Growth

Across advanced countries, the growth of government spending is an important determinant of fluctuations in exports. Anticipated growth in government spending contributes to a surge in export growth in several countries. The impact of cyclical fluctuations in government spending appears less pronounced on export growth across countries. The evidence supports, however, contraction in export growth in response to a slowdown in government spending.

Across developing countries, the evidence indicates a relatively more important role for the fiscal stimulus to revive export growth, compared to advanced countries. Variation in export growth with expansionary government spending shocks appears less prevalent, compared to planned adjustment with respect to anticipated shifts. Exports, in developing countries, are mostly raw materials and agricultural products that vary more closely with anticipated development in external demand, compared to domestic conditions. Nonetheless, a slowdown in government spending may shrink export growth in developing countries.

### 5. Cross-Section Analysis

To shed additional light on the differences between variables' adjustments to government spending shifts in developing and advanced countries, the paper turns to an analysis of the time series evidence in three different directions.

1. Cross-country correlations measure co-movements in the variables' responses to each component of government spending shifts—anticipated growth, expansionary shocks and contractionary shocks—across the samples of advanced and developing countries. Tables 2A, 3A, and 4A summarize correlations between the responses of dependent variables to shifts in

government spending across advanced countries. Tables 2B, 3B, and 4B summarize correlations across developing countries.

2. Cross-country regressions measure the impact of variability in government spending on the trends of real output growth, price inflation, and the averages of the growth in private consumption, private investment, exports, and imports. Results are summarized in Tables 5A and 5B.
3. Cross-country regressions measure the impact of variability in government spending on the variability of real output growth, price inflation, and growth in private consumption, private investment, exports, and imports. Results are summarized in Tables 6A and 6B.

The results will contrast the evidence across developing and advanced countries.

### 5.1 Co-Movements in Response to Anticipated Shifts in Government Spending

Based on statistical significance of correlation coefficients, the following patterns emerge. Across developing countries (Table 2A), anticipated growth in government spending stimulates output (income) growth, which correlates with an increase in private spending on consumption and investment as well as a surge in import demand. The increase in private consumption is a major source of inflation. Correlation coefficients indicate larger contribution of investment demand, compared to consumption demand, to import growth.

Across advanced countries (Table 2B), similar patterns emerge. In particular, real growth in the face of anticipated government spending correlates with growth in private investment and imports. As anticipated growth of government spending crowds out private investment, it correlates with a reduction in output and import growth. The increase in consumption is particularly inflationary, as evident by the significant positive correlation coefficient.

**Table 2A. Correlation Matrix across Advanced Countries with Respect to Anticipated Government Spending Shifts**

	<i>Dy</i>	<i>Dp</i>	<i>Dcon</i>	<i>Dinv</i>	<i>Dexp</i>	<i>Dimp</i>
<i>Dp</i>	-0.21 (0.30)					
<i>Dcon</i>	0.41* (0.034)	0.38* (0.048)				
<i>Dinv</i>	0.49* (0.0099)	-0.11 (0.58)	0.54* (0.0034)			
<i>Dexp</i>	0.28 (0.16)	0.15 (0.46)	0.45* (0.02)	0.43* (0.025)		
<i>Dimp</i>	0.58* (0.0017)	0.037 (0.86)	0.68* (0.0001)	0.78* (0.0001)	0.68* (0.0001)	
<i>Dtbal</i>	0.044 (0.83)	0.23 (0.26)	0.18 (0.38)	-0.00017 (0.99)	0.14 (0.48)	0.066 (0.74)

To summarize, major differences regarding variables' comovements in the face

of anticipated increase in government spending across developing and advanced countries are as follows: (1) co-movement in output growth and price inflation is negative across advanced countries, in support of the crowding out effect of government spending, (2) the inflationary effect of an increase in consumption is much more pronounced across developing countries, and (3) the increase in exports is an integral component across advanced countries.

**Table 2B. Correlation Matrix across Developing Countries with Respect to Anticipated Government Spending Shifts**

	<i>Dy</i>	<i>Dp</i>	<i>Dcon</i>	<i>Dinv</i>	<i>Dexp</i>	<i>Dimp</i>
<i>Dp</i>	0.13 (0.59)					
<i>Dcon</i>	0.50* (0.033)	0.76* (0.0002)				
<i>Dinv</i>	0.85* (0.0001)	0.29 (0.24)	0.46* (0.058)			
<i>Dexp</i>	-0.064 (0.80)	0.25 (0.32)	0.18 (0.47)	0.14 (0.59)		
<i>Dimp</i>	0.70* (0.0012)	0.23 (0.35)	0.57* (0.014)	0.82* (0.0001)	0.38 (0.12)	
<i>Dtbal</i>	-0.04 (0.88)	0.48* (0.051)	0.36 (0.16)	-0.12 (0.64)	-0.16 (0.54)	-0.18 (0.48)

Notes: *Dy* is real output growth, *Dp* is price inflation, *Dcon* is growth of private consumption, *Dinv* is growth of private investment, *Dexp* is growth of exports, *Dimp* is growth of imports, *Dtbal* is change in trade balance. P-values are in parentheses. \* and \*\* denote significance at 10% and 5% levels.

## 5.2 Co-Movements in Response to Expansionary Shocks to Government Spending

Fluctuations in response to government spending shocks provide similar, although somewhat different, patterns of correlation. Across developing countries (Table 3A), expansionary shocks to government spending stimulate growth, which appears to be correlated with an increase in investment and import growth. An increase in private consumption correlates with a large inflationary effect. The growth of investment appears to be correlated with higher imports.

Across advanced countries (Table 3B), an increase in import growth correlates with an increase in consumption and investment growth. Unique, however, for advanced countries is the effect of the increase in imports in stimulating export growth.

To summarize, major differences regarding variables' co-movements in the face of expansionary shocks to government spending across developing and advanced countries are as follows: (1) the inflationary effect of an increase in consumption growth is much more pronounced across developing countries and (2) higher growth generates larger increase in imports across developing countries. Higher imports correlate with export growth across advanced countries.

**Table 3A. Correlation Matrix across Advanced Countries with Respect to Positive Government Spending Shocks**

	<i>Dy</i>	<i>Dp</i>	<i>Dcon</i>	<i>Dinv</i>	<i>Dexp</i>	<i>Dimp</i>
<i>Dp</i>	-0.36** (0.062)					
<i>Dcon</i>	0.30 (0.13)	-0.17 (0.39)				
<i>Dinv</i>	0.27 (0.17)	-0.33** (0.096)	0.74* (0.0001)			
<i>Dexp</i>	-0.025 (0.90)	0.37* (0.058)	0.022 (0.92)	-0.065 (0.75)		
<i>Dimp</i>	0.20 (0.32)	-0.009 (0.96)	0.54* (0.0034)	0.60* (0.001)	0.49* (0.01)	
<i>Dtbal</i>	-0.052 (0.80)	0.11 (0.59)	0.12 (0.54)	-0.07 (0.73)	0.27 (0.17)	-0.031 (0.88)

**Table 3B. Correlation Matrix across Developing Countries with Respect to Positive Government Spending Shocks**

	<i>Dy</i>	<i>Dp</i>	<i>Dcon</i>	<i>Dinv</i>	<i>Dexp</i>	<i>Dimp</i>
<i>Dp</i>	-0.29 (0.23)					
<i>Dcon</i>	-0.04 (0.88)	0.92* (0.0001)				
<i>Dinv</i>	0.80* (0.0001)	-0.16 (0.53)	-0.05 (0.84)			
<i>Dexp</i>	-0.22 (0.38)	0.21 (0.41)	0.054 (0.83)	-0.14 (0.58)		
<i>Dimp</i>	0.69* (0.0016)	-0.046 (0.85)	0.094 (0.71)	-0.78* (0.0001)	0.22 (0.38)	
<i>Dtbal</i>	-0.19 (0.46)	-0.079 (0.76)	-0.19 (0.46)	-0.24 (0.35)	0.043 (0.87)	-0.36 (0.16)

Notes: Notes: *Dy* is real output growth, *Dp* is price inflation, *Dcon* is growth of private consumption, *Dinv* is growth of private investment, *Dexp* is growth of exports, *Dimp* is growth of imports, *Dtbal* is change in trade balance. P-values are in parentheses. \* and \*\* denote significance at 10% and 5% levels.

### 5.3 Co-Movement in Response to Contractionary Shocks to Government Spending

Across developing countries (Table 4A), the correlation between price inflation and private consumption growth remains robust. Both are negatively correlated with output growth, implying downward price rigidity during a slowdown. Similarly, export growth correlates negatively with real output growth, implying greater dependence of export growth on external demand.

Across advanced countries (Table 4B), deflation correlates, on average, with an



increase in real growth. As government spending decreases, more resources are available in support of private sector activity and real growth. Investment growth correlates with consumption growth, and both are highly correlated with import growth. Fluctuations in exports vary significantly with movements in other demand components.

To summarize, major differences regarding variables' co-movements in the face of contractionary shocks to government spending across developing and advanced countries are as follows: (1) the reduction in consumption correlates with price deflation across developing countries and (2) output growth is increasing, despite contractionary shocks, and correlates with an increase in spending on consumption and investment across advanced countries.

**Table 4A. Correlation Matrix across Advanced Countries with Respect to Negative Government Spending Shocks**

	<i>Dy</i>	<i>Dp</i>	<i>Dcon</i>	<i>Dinv</i>	<i>Dexp</i>	<i>Dimp</i>
<i>Dp</i>	-0.27 (0.17)					
<i>Dcon</i>	0.36** (0.067)	0.21 (0.29)				
<i>Dinv</i>	0.32 (0.11)	-0.10 (0.61)	0.70* (0.0001)			
<i>Dexp</i>	0.11 (0.57)	0.029 (0.89)	0.31 (0.11)	0.059 (0.77)		
<i>Dimp</i>	0.28 (0.15)	-0.092 (0.65)	0.66* (0.0002)	0.45* (0.018)	0.77* (0.0001)	
<i>Dtbal</i>	-0.17 (0.42)	-0.041 (0.84)	-0.27 (0.18)	-0.13 (0.53)	-0.28 (0.17)	-0.31 (0.12)

**Table 4B. Correlation Matrix across Developing Countries with Respect to Positive Government Spending Shocks**

	<i>Dy</i>	<i>Dp</i>	<i>Dcon</i>	<i>Dinv</i>	<i>Dexp</i>	<i>Dimp</i>
<i>Dp</i>	-0.45* (0.056)					
<i>Dcon</i>	-0.42** (0.084)	0.83* (0.0001)				
<i>Dinv</i>	0.27 (0.28)	-0.036 (0.89)	-0.16 (0.53)			
<i>Dexp</i>	-0.41** (0.09)	0.62* (0.007)	0.67* (0.0026)	-0.16 (0.52)		
<i>Dimp</i>	0.054 (0.83)	0.25 (0.32)	0.32 (0.20)	0.60* (0.0086)	0.48* (0.046)	
<i>Dtbal</i>	0.11 (0.67)	0.17 (0.52)	0.19 (0.48)	-0.15 (0.58)	0.14 (0.59)	0.004 (0.99)

Notes: Notes: *Dy* is real output growth, *Dp* is price inflation, *Dcon* is growth of private consumption, *Dinv* is growth of private investment, *Dexp* is growth of exports, *Dimp* is growth of imports, *Dtbal* is change in trade balance. P-values are in parentheses. \* and \*\* denote significance at 10% and 5% levels.

#### 5.4 Differences in Trends with Government Spending Variability

Cross-country regressions estimate the effects of the variability of government spending on variables' trends. Table 5A summarizes the effects of the variability of government spending on trend variables across advanced countries. Table 5B presents the results across developing countries. The standard deviation of shocks to growth in government spending measures variability.

Variability is the result of positive and negative shocks that are assumed to follow a symmetric distribution. Symmetric effects of random shocks will produce neutral results that cancel out without affecting economic trends. In contrast, larger effects of positive shocks, relative to negative shocks, would result in a positive net contribution, increasing trends over time.

There are two scenarios where the effect of expansionary shocks to government spending could exceed that of negative shocks. First, the stimulus effect of expansionary shocks may dominate the contractionary effect of the fiscal withdrawal on income and related economic activity. Second, crowding out may be larger in the face of negative shocks, compared to positive shocks. That is, the increase in private investment with respect to contractionary government spending shocks dominates the reduction in the face of expansionary shocks.

**Table 5A. The Impact of Government Spending Variability on Trends across Advanced Countries**

Response	Predictor		$R^2$
	Constant	Variability of government spending	
Average real growth	0.027* (4.90)	0.11* (2.57)	0.20
Average price inflation	-0.025 (-1.39)	0.95* (6.51)	0.61
Average private consumption growth	-0.006 (-0.77)	1.013* (17.54)	0.92
Average private investment growth	-0.0063 (-0.93)	0.97* (17.90)	0.92
Average export growth	0.041* (4.23)	0.69* (8.87)	0.74
Average import growth	0.007 (0.83)	0.96* (14.03)	0.88

The evidence indicates that the effects of positive shocks dominate that of negative shocks, resulting in a positive net contribution of variability to economic trends. Across advanced countries, higher variability of government spending increases trends of all variables: real growth, price inflation, private consumption growth, private investment growth, export growth, and import growth.

Across developing countries, the positive effects of the variability of government spending on trends remain robust with one exception. Higher variability of government spending has a negative although statistically insignificant effect on

trend real output growth. While the time series evidence spells out limited crowding out effects, the contractionary effect of spending shocks exceeds the expansionary effect on real growth. The difference may be attributed to constraints and structural bottlenecks in developing countries that limit output expansion in the face of expansionary government spending shocks. In light of these constraints, the variability of government spending fails to induce significant expansion and the contractionary effect appears more dominant across developing countries.

**Table 5B. The Impact of Government Spending Variability on Trends across Developing Countries**

Response	Predictor		$R^2$
	Constant	Variability of government spending	
Average real growth	0.043* (11.87)	-0.013 (-1.55)	0.12
Average price inflation	0.077* (3.12)	0.36* (6.09)	0.67
Average private consumption growth	0.063* (2.70)	0.69* (13.34)	0.89
Average private investment growth	0.096* (3.84)	0.57* (9.59)	0.84
Average export growth	0.098* (4.01)	0.59* (10.18)	0.85
Average import growth	0.094* (3.43)	0.59* (9.10)	0.82

Notes: Monetary variability is the standard deviation of growth in the money supply. t-statistics are in parentheses. \* and \*\* denote significance at the 10% and 5% levels.

### 5.5 Differences in Variability with Government Spending

Table 6A summarizes the effects of the variability of government spending on the variability of economic variables across advanced countries. Table 6B presents the results across developing countries.

Across advanced countries, the variability of government spending increases the variability of all variables under consideration. Across developing countries, in contrast, the variability of government spending significantly increases the variability of all variables, except for real growth. The difference further reinforces limitation to expand output growth in the face of expansionary shocks to government spending in several developing countries. In light of this structural limitation, the effect of the fiscal stimulus on output growth is limited, mitigating output variability in response to government spending variability.

Two interesting results emerge. First, government spending plays a leading role in determining economic conditions in advanced countries. The variability of government spending increases trend real growth over time, while contributing to more variability in the economic system. Minimizing the variability of government spending may be beneficial to sustain growth and reduce cyclical variability. Second, variability of government spending is detrimental to growth in developing countries

in two directions. It fuels price inflation and entrenched expectations, without increasing trend real growth. Moreover, excessive variability of government spending increases aggregate uncertainty.

**Table 6A. The Impact of Government Spending Variability on Economic Variability across Advanced Countries**

Response	Predictor		$R^2$
	Constant	Variability of government spending	
Variability of real growth	0.022* (3.21)	0.093** (1.73)	0.10
Variability of price inflation	-0.067* (-4.44)	1.15* (9.52)	0.78
Variability of private consumption growth	-0.053* (-3.37)	1.11* (8.79)	0.75
Variability of private investment growth	0.021 (1.55)	0.93* (8.47)	0.73
Variability of export growth	-0.013 (-1.07)	1.021* (10.34)	0.80
Variability of import growth	0.021 (0.95)	0.91* (5.12)	0.50

**Table 6B. The Impact of Government Spending Variability on Economic Variability across Advanced Countries**

Response	Predictor		$R^2$
	Constant	Variability of government spending	
Variability of real growth	0.043* (5.65)	0.021 (1.19)	0.073
Variability of price inflation	-0.039 (-1.01)	1.12 (12.23)	0.89
Variability of private consumption growth	-0.058* (-2.46)	1.10* (19.43)	0.95
Variability of private investment growth	0.044 (1.05)	1.18* (11.83)	0.89
Variability of export growth	0.0078 (0.23)	1.29* (16.15)	0.94
Variability of import growth	-0.0023 (-0.07)	1.24* (15.66)	0.93

Notes: Variability is the standard deviation of growth in the relevant variable. t-statistics are in parentheses. \* and \*\* denote statistical significance at the 10% and 5% levels.

To enhance the effectiveness of government spending, priorities should aim at relaxing structural bottlenecks that hinder growth in developing countries or crowd out private resources in advanced countries. Concurrently, discretionary fiscal spending should refrain from pro-cyclicality that exacerbates the variability of

economic variables, increasing aggregate uncertainty and fueling inflationary expectations.

## **6. Summary and Conclusion**

Amidst recent evidence of a global slowdown and constraints on monetary policy, the importance of the fiscal stimulus has once again taken center stage as an important policy instrument that aims at reviving economic conditions. Indeed, the fiscal stimulus has traditionally played an important role to stimulate economic conditions, as the scope for monetary policy has been exhausted.

The debate surrounding the fiscal stimulus has often focused on the timing of its introduction, its size, and the right policy mix. To gauge the strategy, a careful analysis of the track record is necessary. Structural constraints may differentiate the effects of the shifts in government spending across economies and between developing and advanced countries. To detect the difference, this paper estimates empirical models to trace the difference in the transmission mechanism of government spending shifts across the economies of representative countries in each group. Of particular interest is to study the effects of fluctuations in the growth of government spending on real growth, price inflation, and the growth of demand components: private consumption, private investment, exports, and imports.

The growth of government spending is decomposed into anticipated shifts, positive shocks, and negative shocks. Anticipated shifts capture long-lasting effects of the variability of government spending on economic variables while the effects of positive and negative shocks may exhibit asymmetry. Given evidence of asymmetry, the variability of government spending will differentiate trend economic variables across countries. The investigation traces the difference between developing and advanced countries and draws policy implications.

The time series evidence highlights a few interesting aspects that differentiate the evidence across developing and advanced countries. The evidence of crowding out appears to be stronger across advanced countries, compared to developing countries. The difference reflects capacity constraints that shrink available resources to finance private sector activity as the increase in government spending absorbs a larger share of available financing in advanced countries. In contrast, excess liquidity in developing countries avails resources to finance an increase in government spending, without shrinking private activity. Accordingly, the fiscal multiplier on real growth appears, generally larger, across developing countries, compared to advanced countries.

The dependence of private consumption on government spending is more pervasive across developing countries, compared to advanced countries. The pervasive evidence reflects the dominant role of government in providing employment and supporting private consumption in developing countries.

The time series evidence of the response of private investment to government spending provides further illustration of crowding out in advanced countries. In contrast, the role of government spending in stimulating economic activity and

private investment is evident by the more pervasive significant evidence in developing countries.

Government spending plays a relatively more important factor in stimulating export growth in advanced countries, compared to developing countries. The evidence highlights constraints on competitiveness across developing countries. Accordingly, higher government spending may not generate a pickup in export growth in light of constraints on external demand. In contrast, government spending could direct resources to capitalize on opportunities and increase export potential in advanced countries.

The evidence draws closer similarity between developing and advanced countries in the response of import growth to government spending shifts. Across both groups, anticipated growth in government spending stimulates a long-lasting increase in imports, in expectation of stronger demand and economic activity.

Cross-country analysis further highlights a few differences in co-movements in variables' adjustments to government spending shifts across developing and advanced countries. The inflationary effect of an increase in consumption is much more pronounced across developing countries. The pervasive effect of higher government spending on consumption is a major determinant of inflation in developing countries. In contrast, the increase in exports is an integral component of adjustment to anticipated government spending shifts in advanced countries.

Across advanced countries, the variability of government spending is an important determinant of economic conditions, at the risk of crowding out private resources. Across developing countries, variability of government spending could be detrimental to growth. It fuels inflation and entrenched expectations, without increasing trend real growth.

Minimizing the variability of government spending may be beneficial to sustain growth and reduce cyclical variability. To maximize the effectiveness of fiscal policy, priorities should aim at relaxing structural bottlenecks that hinder growth in developing countries or crowd out private resources in advanced countries. Discretionary fiscal spending should refrain from pro-cyclicality that exacerbates economic variability and aggregate uncertainty.

#### **Appendix A: Econometric Methodology**

The surprise terms that enter models (1) and (2) are unobservable, necessitating the construction of empirical proxies before estimation can take place. Thus, the empirical models include equations that describe the process generating the change in government spending, the money supply, and the exchange rate. The predictive values of these equations are the proxies for agents' expectations of the change in these variables.

Obtaining the proxy for agents' forecasts follows the results of the endogeneity test suggested by Engle (1982). Given evidence of endogeneity, variables in the forecast equations are based on the results of a formal causality test. Hence, agents' forecasts are approximated using two lags of the change in the short-term interest

rate and two lags of the change in the log value of real output, the price level, government spending, the money supply, the exchange rate, and the energy price.

Surprises that enter the empirical models are then formed by subtracting agents' forecasts from the actual growth in each variable. The positive and negative components of shocks are defined for joint estimation, following the suggestions of Cover (1992), as follows:

$$\begin{aligned} negs_t &= -\frac{1}{2}\{abs(Dss_t) - Dss_t\}, \\ poss_t &= \frac{1}{2}\{abs(Dss_t) + Dss_t\}, \quad s = g, m, h, \end{aligned}$$

where  $Dgs_t$ ,  $Dms_t$ , and  $Dhs_t$  are the shocks to the change in government spending, the money supply, and the exchange rate. The terms  $negs_t$  and  $poss_t$  are the negative and positive components of each shock.

To obtain efficient estimates and ensure correct inferences (i.e., to obtain consistent variance estimates), the empirical models in (1) through (2) are estimated jointly with the equations that determine proxy variables following the suggestions in Pagan (1984, 1986) using 3SLS. The instruments list for estimation includes two lags of the change in the interest rate and two lags of the change in the log value of real output, the price level, government spending, the money supply, the exchange rate, and the oil price. This paper's evidence is robust with respect to variations in the instruments list or the lag length.

The results of Engle's (1982) test for serial correlation in simultaneous-equation models are consistent with the presence of first-order autoregressive errors in some models. To correct for serial correlation, it is assumed that the error term follows an AR(1) process. To filter out serial correlation, the estimated model is transformed through the filter  $1 - \rho L$ , where  $\rho$  is the estimate of the serial correlation parameter and  $L$  is the lag operator, such that  $LX_t = X_{t-1}$ . The estimated residuals from the transformed models have zero mean and are serially independent.

### Appendix B: Data Sources

All annual series are from *World Economic Outlook* (WEO), *Information Notice System* (INS), or *International Financial Statistics* (IFS), available on tape from the International Monetary Fund.

1. Real output: Gross domestic product, constant prices,  $W914NGDP_R$ , WEO.
2. Aggregate demand: Gross domestic product, current prices,  $W914NGDP$ , WEO.
3. Price: Gross domestic product deflator,  $W914NGDP_D$ , WEO.
4. Government spending: Public consumption expenditure, current prices,  $W914NCG$ , WEO, or government consumption,  $61291F.ZF...$ , IFTSTSUB.
5. Exchange rate: real effective exchange rate, INS.

6. Monetary base: Reserve money, *W914FMB*, WEO.
7. Consumption: Private consumption expenditure, current prices, *W311NFIP*, WEO.
8. Investment: Gross private fixed capital formation, current prices, *W311NFIP*, WEO.
9. Imports: Imports of goods and services, current prices, *W213NM*, WEO.
10. Exports: Exports of goods and services, current prices, *W513NX*, WEO.
11. Money: the sum of currency outside banks and private sector demand deposits, *91434..ZF...*, IFTSTSUB.
12. Interest Rate: measures of short-term interest rate. Deposit rate, *21360L..ZF...*, IFTSTSUB. Lending rate, *21360P..ZF...*, IFTSTSUB.

### Notes

1. This explanation was advocated in view of the evidence of expansionary fiscal contractions, see for instance Giavazzi and Pagano (1990) and Alesina and Perotti (1995). For evidence of asymmetry in interest-rate adjustment to government spending shocks, see Kandil (2001).
2. See for instance Barro (1989): "The substitution of a budget deficit for current taxes has no impact on the aggregate demand for goods. In this sense, budget deficit and taxation have equivalent effects on the economy—hence the term 'Ricardian equivalence theorem.'" For a coherent theoretical illustration of the equivalence theorem, see Barro (1974).
3. See for example Kandil (2002b).
4. The results, following the suggestions of Nelson and Plosser (1982), verify the empirical validity of non-stationarity. Based on tabulation provided by Dickey and Fuller (1981), the dependent variables in the empirical model are non-stationary in level and stationary in first-difference.
5. The other determinant of fiscal policy (taxes) is endogenous to economic conditions and less subject to discretionary shocks. Terms of trade shocks and developments in the current account balance are endogenous to the change in the real effective exchange rate, which is included in the empirical model.

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