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External and Budget Deficits in Developing Countries

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Abstract:
This paper documents and explains the positive comovement between external and budget deficits for several developing countries. First, the covariance estimated from post-1960 time-series data is numerically positive for each of the 24 countries and statistically significant for almost all cases. This is consistent with previous findings obtained from panel regressions. Second, the empirical covariance is close to that predicted from a tractable small open economy, overlapping generation model with heterogeneous goods. Also, the predicted covariance is induced by shocks which are closely related to internal conditions such as domestic resources and fiscal policies, and to a much lesser extent to external conditions such as the world interest rate, real exchange rate, and terms of trade. This structural analysis explaining the joint behavior of external and budget deficits sharply contrasts with earlier reduced-form studies characterizing the individual behavior of either the external deficit or budget deficit.

Keywords: Covariance decomposition, dynamic responses, internal and external conditions, restricted vector autoregression, small open economy, overlapping generation model with heterogeneous goods.

JEL Classification: E62, F32, F41

1. Introduction

The objectives of this paper are twofold. First, we document the comovement between external and budget deficits for several developing countries. Second, we explain this comovement from a structural model capturing the joint behavior of external and budget deficits.

Earlier studies highlight the existence of a positive comovement for developing countries, as the external balance deteriorates when the budget deficit increases. These analyses mainly rely on panel regressions to extract the comovement that is common across countries. Empirically, the estimated coefficient relating the external deficit to the budget deficit is always statistically positive (e.g. Calderon, Chong, and Zanforlin 2007; Gruber and Kamin 2007; Chinn and Prasad 2003; Calderon, Chong, and Loayza 2002). A similar effect is recovered from the estimated coefficient relating private saving to the budget deficit and the identity stating that the current account corresponds to national saving minus investment (Masson, Bayoumi, and Samiei 1998). The robust comovement between external and budget deficits across developing countries sharply contrasts with the heterogeneous comovement documented for industrial countries (e.g. Boileau and Normandin 2008; Chinn and Prasad 2003).

This paper provides additional evidence of the presence of a positive comovement between external and budget deficits for developing countries. Our analysis relies exclusively on the time-series of external and budget deficits to extract the comovement that is specific to each country. The time-series are annual observations covering the longest period for the post-1960 era for 24 developing countries. Our primary measure of the comovement corresponds to the sample estimate of the covariance between external and budget deficits for each country. The findings reveal that this empirical covariance is numerically positive for all countries and statistically significant for many cases. Similar results are obtained when the comovement is measured by the estimated correlation between external and budget deficits, and the estimated slope coefficient obtained by regressing the external deficit on a constant and the budget deficit.

Also, previous studies rely on reduced forms to explain either the individual behavior of the external deficit or budget deficit, rather than their joint behavior. However, combining the results obtained in these studies suggest that the explanation of the positive comovement between external and budget deficits from the usual internal and external conditions represents a challenging task. For example, an increase of output implies that the external deficit sometimes increases significantly (e.g. Calderon, Chong, and Zanforlin 2007; Calderon, Chong, and Loayza 2002) and sometimes it does not (e.g. Chinn and Prasad 2003), whereas the budget deficit and the governments' borrowing possibilities are not significantly affected (e.g. Combes and Saadi-Sedik 2006; Roubini 1991; Berg and Sachs 1988). An increase of the world interest rate induces the external deficit to significantly decreases (e.g. Calderon, Chong, and Loayza 2002), while the probability of rescheduling the public debt statistically increases such that the budget deficit may increase (e.g. Berg and Sachs 1988). An improvement of the terms of trade implies that the external deficit significantly decreases (e.g. Calderon, Chong, and Zanforlin 2007; Chinn and Prasad 2003; Calderon, Chong, and Loayza 2002), whereas the budget deficit significantly increases (e.g. Combes and Saadi-Sedik 2006). Finally, an improvement of the real exchange rate uniformely leads to a significant decline of the external deficit, but the effect on the budget deficit has not been studied so far.

In contrast to early work, this paper relies on a structural analysis to capture the joint behavior of external and budget deficits. Specifically, we use a tractable small open economy, overlapping generation model with heterogeneous goods to explain the positive comovement between external and budget deficits. The model offers the advantage of involving the external conditions which are often considered for developing countries, such as the world interest rate, real exchange rate, and terms of trade. Also, the model relates the external and budget deficits to the internal conditions associated with domestic resources and fiscal policies, where these policies may reflect, among other things, changes of the government's abilities to collect taxes due to corruption, black markets, or informal markets, for example. Furthermore, the model captures different degrees of imperfectness of intergenerational linkages and financial markets, and as such potential liquidity constraints faced by developing countries.

The parameters of the model are estimated for each country such that the predicted covariance between external and budget deficits is close to its empirical counterpart. The predicted covariance is then decomposed into contributions measuring the portions attributable to shocks associated with each internal and external conditions. The contributions with large positive values provide information on the shocks corresponding to prime determinants of the positive comovement between external and budget deficits.

The results reveal that the contributions are almost always positive, so that most shocks induce a positive relation between external and budget deficits for all countries. Also, the magnitude of the contributions indicate that both internal and external conditions play a role in the determination of the comovement between external and budget deficits. However, the contributions suggest that the shocks associated with internal conditions, and especially domestic resources net of public absorptions, are the most important factors explaining the positive comovement between texternal and budget deficits for most countries. In contrast, the shocks associated with external conditions are dominant for only few countries. Finally, a robustness analysis confirms that these contributions can be viewed as providing a lower bound of the importance of internal conditions in the determination of the positive comovement between external and budget deficits.

The rest of the paper is organized as follows. Section 2 documents the empirical comovement between external and budget deficits for several developing countries. Section 3 presents the model to explain the joint behavior of external and budget deficits. Section 4 elaborates the empirical method to decompose the predicted covariance between external and budget deficits. Section 5 reports the empirical results. Section 6 concludes.

2. Empirical Regularities

This section documents the comovement between external and budget deficits for developing countries. Our sample includes annual observations covering the longest period since the post-1960 era for 12 countries in Africa, 7 countries in the Americas, 4 countries in Asia, and 1 country in Oceania. The selections of the countries, frequency, and time periods are dictated by the availability of the data. In particular, there are several missing values for the budget deficit for many developing countries. The data are fully described in the Data Appendix.

Figure 1 displays the external and budget deficits. The external deficit refers to the negative of the ratio of nominal current account to nominal gross domestic product. The budget deficit corresponds to the ratio of nominal budget deficit to nominal gross domestic product. Visual inspection of the plots suggests the existence of a positive comovement between external and budget balances. For many countries, the external and budget positions seem to move in the same direction for most time periods. In general, these movements translate into both external and budget deficits over prolonged horizons. In some cases, however, these movements lead to external balances alternating between deficits and surpluses over time with persistent budget deficits as for Nigeria, South Africa, and Venezuela.

Table 1 reports statistics summarizing the comovements between external and budget deficits. The first statistic is the empirical covariance between external and budget deficits (multiplied by 10000). Later on, the covariance will prove useful to perform a decomposition allowing the identification of the main explanatory factors of the comovement between external and budget deficits. The second statistic is the correlation between external and budget deficits. Correlations are frequently used in business-cycle studies to document comovements between variables (e.g. Mendoza 1995). The last statistic is the slope coefficient obtained by regressing the external deficit on a constant and the budget deficit. Slope coefficients are often used in reduced-form analyses to assess the relation between external and budget deficits (e.g. Chinn and Prasad 2003). All statistics are computed from the stationary, linearly detrended, external and budget deficits. Similar results are obtained from alternative detrending methods, such as the Hodrick-Prescott filter.

The statistics indicate the existence of a positive comovement between external and budget deficits. For example, the empirical covariance between external and budget deficits is numerically positive for all countries. The covariance averages to 9.559 across all countries; it ranges from a low of 0.061 in Burundi to a high of 45.34 in Togo; and it is larger than 10 for 10 countries, between 5 and 10 for 6 countries, and between 1 and 5 for 5 countries. The covariance is statistically significant at the 1% level for 11 countries, at the 10% level for 6 additional countries, and at the 25% level for 3 more countries.

Also, the correlation between external and budget deficits is numerically positive for all countries. The correlation averages to 0.472 across all countries; it ranges from a low of 0.007 in Burundi to a high of 0.848 in Sri Lanka; and it is larger than 0.75 for 5 countries, between 0.50 and 0.75 for 6 countries, and between 0.25 and 0.50 for 7 countries. The correlation is statistically significant at the 1% level for 15 countries, at the 10% level for 4 additional countries, and at the 25% level for 2 more countries.

Finally, the slope coefficient relating the external deficit to the budget deficit is numerically positive for all countries. The slope coefficient averages to 0.724 across all countries; it ranges from a low of 0.007 in Burundi to a high of 1.876 in Venezuela; it is larger than 1.00 for 4 countries, between 0.75 and 1.00 for 7 countries, and between 0.25 and 0.75 for 9 countries. The slope coefficient is statistically significant at the 1% level for 12 countries, at the 10% level for 4 additional countries, and at the 25% level for 5 more countries.

Overall, the statistics reveal the existence of a positive comovement between external and budget deficits for many developing countries. This robust result is consistent with previous findings, where the estimated coefficient relating the external deficit to the budget deficit is statistically positive for panels of developing countries (e.g. Calderon, Chong, and Zanforlin 2007; Gruber and Kamin 2007; Chinn and Prasad 2003; Calderon, Chong, and

Loayza 2002). However, this sharply contrasts with the heterogeneous results documented for industrial countries. For example, the covariance between external and budget deficits is numerically positive for only half of the OECD countries, and the estimated coefficient relating the external deficit to the budget deficit is no longer significant for panels of industrial countries (e.g. Boileau and Normandin 2008; Chinn and Prasad 2003).

3. The Economic Environment

This section presents the economic environment explaining the joint behavior of external and budget deficits. This environment relies on a structural small open economy, overlapping generation model with heterogeneous goods. The model involves the usual external conditions related to the world interest rate, real exchange rate, and terms of trade, as well as internal conditions such as domestic resources and fiscal policies reflecting changes of taxes or changes of the government's abilities to collect taxes. The model also captures different degrees of imperfectness of intergenerational linkages and of financial markets.

In the model, each domestic consumer born at time s sloves in period t the following problem:

$$\max E_t \sum_{j=0}^{\infty} \beta^j (1-\rho)^j \frac{C_{s,t+j}^{1-\gamma}}{1-\gamma}, \tag{1.1}$$

$$\text{s.t.} \quad C_{s,t} = \left[\omega^{\frac{1}{\xi}} (C_{s,t}^T)^{\frac{\xi-1}{\xi}} + (1-\omega)^{\frac{1}{\xi}} (C_{s,t}^N)^{\frac{\xi-1}{\xi}}\right]^{\frac{\xi}{\xi-1}}, \tag{1.2}$$

$$C_{s,t}^T = \left[\varpi^{\frac{1}{\zeta}} (C_{s,t}^H)^{\frac{\zeta-1}{\zeta}} + (1-\varpi)^{\frac{1}{\zeta}} (C_{s,t}^F)^{\frac{\zeta-1}{\zeta}}\right]^{\frac{\zeta}{\zeta-1}}, \tag{1.3}$$

$$(1-\rho)(B_{s,t+1} + F_{s,t+1}) = (1+r_t)(B_{s,t} + F_{s,t}) + Y_{s,t} - T_{s,t} - P_t C_{s,t}. \tag{1.4}$$

Equation (1.1) specifies the utility function in terms of private consumption of a composite good. Equation (1.2) defines this consumption in terms of tradable and non-tradable goods. Equation (1.3) expresses tradable consumption in terms of home and foreign tradable goods. Equation (1.4) depicts the intertemporal budget constraint of the consumer.

All the variables are measured in terms of home tradable goods. Specifically, $C_{s,t}$ is an index of private consumption, $C^N_{s,t}$ is the consumption of non-tradable goods, $C^T_{s,t}$ is the consumption of tradable goods, $C^F_{s,t}$ is the consumption of foreign tradable goods, and $C^H_{s,t}$ is the consumption of home tradable goods. P_t, P^N_t, P^T_t, P^F_t, and P^H_t are the corresponding price indices, with the normalization $P^H_t = 1$. $B_{s,t}$ is the purchase of one-period bonds issued by the domestic government, $F_{s,t}$ is the purchase of one-period bonds issued by the foreign government, r_t is the world interest rate on one-period bonds, $T_{s,t}$ is lump-sum taxes, and $Y_{s,t} = Y^H_{s,t} + P^N_t Y^N_{s,t}$ is the value of output, where $Y^H_{s,t}$ and $Y^N_{s,t}$ are resources of home tradable and non-tradable goods. The term E_t represents the expectation operator conditional on information available in period t.

Also, the parameter β corresponds to the discount factor, γ is the reciprocal of the elasticity of intertemporal substitution of consumption, ξ is the elasticity of substitution between tradable and non-tradable goods, ζ is the elasticity of substitution between home and foreign tradable goods, ω is the weight of tradable goods in total consumption, and ϖ is the weight of home tradable goods in total tradable consumption. The parameter ρ is the probability of being dead next period, or equivalently, the death and birth rates when the population is constant (e.g. Blanchard 1985). Consequently, $\rho = 0$ indicates that the domestic economy is described by an infinitely-lived representative consumer model, so that agents fully smooth their consumption. Conversely, $\rho = 1$ implies that the domestic environment is represented by a sequence of static economies in which each cohort is fully replaced in the subsequent period by a different cohort, such that agents consume only their current income. The parameter ρ may be related to the imperfectness of intergenerational linkages. In this context, a large value of ρ indicates that consumers are not altruistic, so that agents prefer a consumption profile which is not fully smoothed. Alternatively, ρ may be related to the degree of imperfectness of financial markets. In this case, a large value of ρ indicates that consumers experience difficulties in selling or buying bonds, so that agents are unable to fully smooth consumption through time.

The domestic public sector is described as:

$$(B_{t+1} + B^*_{t+1}) = (1 + r_t)(B_t + B^*_t) + P_t G_t - T_t, \tag{2.1}$$

$$= (B_t + B^*_t) + D_t. \tag{2.2}$$

Equations (2.1) and (2.2) correspond to the intertemporal budget constraint of the government. The variables without the subscript s refer to aggregate variables. In particular, B^*_t is the aggregate foreign purchases of one-period domestic bonds, G_t is the public consumption of goods, and D_t is the budget deficit including the service of the debt.

The external deficit of the domestic economy is measured as the negative of the current account. The current account is:

$$Z_t = (F_{t+1} - F_t) - (B^*_{t+1} - B^*_t). \tag{3}$$

Equation (3) defines the current account as the change of net foreign asset positions.

The model (1)–(3) is solved from an analytical approximation. This approximation is fully described in a technical appendix available from the authors. In brief, the individual consumption function is derived, first, from the Euler equation associated with (1.1) and (1.4) and the distributional assumption of log normality (e.g. Campbell and Mankiw 1989), and, second, from the expected integrated budget constraint associated with (1.4) which is linearized around the means (e.g. Campbell and Deaton 1989). Then, the aggregate consumption function is derived from the individual consumption function and the assumptions that all consumers alive in a given time period face identical taxes and have the same tradable and non-tradable outputs (e.g. Gali 1991). The current account function is derived from the definition (3), the aggregate budget constraints associated with (1.4) and (2.1), and the aggregate consumption function. To highlight the relation between external and budget deficits, the current account function is rewritten by substituting aggregate taxes from the expected integrated budget constraint associated with (2.1) and (2.2), which is linearized around the means (e.g. Normandin 1999). Finally, the consumer price indices associated with (1.2) and (1.3) are log-linearized around the means of exchange rate and terms of trade. The exchange rate is defined as $q_t = (P_t^N / P_t^T)$. The terms of trade correspond to $\tau_t = (P_t^H / P_t^F)$.

The analytical approximation yields the following first-order vector autoregression (VAR):

$$\mathbf{x}_{1,t} = \mathbf{\Theta}_{11}\mathbf{x}_{1,t-1} + \mathbf{\Theta}_{12}\mathbf{x}_{2,t}, \tag{4}$$

or more explicitly,

$$\begin{pmatrix} \mathbf{p}_{t+1} \\ z_t \end{pmatrix} = \begin{pmatrix} \mathbf{\Theta}_{pp} & \mathbf{0} \\ \mathbf{\Theta}_{zp} & 0 \end{pmatrix} \begin{pmatrix} \mathbf{p}_t \\ z_{t-1} \end{pmatrix} + \begin{pmatrix} \mathbf{\Theta}_{pf} & \mathbf{\Theta}_{pa} \\ \mathbf{\Theta}_{zf} & 1 \end{pmatrix} \begin{pmatrix} \mathbf{f}_t \\ a_t \end{pmatrix},$$

with

$$a_t = \mathbf{\Theta}_{af} E_t \sum_{j=1}^{\infty} \lambda^j \mathbf{f}_{t+j}. \tag{5}$$

The process (4) corresponds to the rules for the predetermined and nonpredetermined variables. Equation (5) represents the purely forward-looking component of the rules.

All the variables are demeaned. The predetermined variables are $\mathbf{p}_t = (\,(f_t - b_t^*) \quad (b_t + b_t^*)\,)'$, where $(f_t - b_t^*) = (F_t - B_t^*)/Y_{t-1}$ and $(b_t + b_t^*) = (B_t + B_t^*)/Y_{t-1}$. The nonpredetermined variable is $z_t = Z_t/Y_t$. The forcing variables are $\mathbf{f_t} = (\,r_t \quad \Delta\log\tau_t \quad \Delta\log q_t \quad \Delta\log Y_t \quad \log g_t \quad d_t\,)'$, where Δ is the first difference operator, $g_t = P_t G_t / Y_t$, and $d_t = D_t / Y_t$. The forcing variables include the typical exogenous stochastic variables for small open economies. These variables reveal information on external conditions related to interest rate (r_t), terms of trade ($\Delta\log\tau_t$), and exchange rate

($\Delta \log q_t$), as well as on internal conditions related to domestic resources ($\Delta \log Y_t$), net of public absorptions ($\log g_t$), and fiscal policies (d_t). Specifically, the budget deficit provides information on taxes, since government expenditures and debt service are given (that is, g_t and r_t are exogenous, and $(b_t + b_t^*)$ is predetermined). Also, the variables z_t and d_t are consistent with the measures used to document the empirical positive comovement between external and budget deficits (see Section 2). For convenience, a_t is termed the adjusted current account.

Table 2 relates the coefficients of the rules to the structural parameters and the means of the variables. These coefficients reveal that the rules are static when the probability of death is unity ($\rho = 1$, so that $\lambda = 0$). In this case, the current account is exclusively affected by contemporaneous output and budget deficit (see the nonzero elements of $\mathbf{\Theta}_{zf}$). First, the current account improves following an increase of ouput, through a positive wealth effect. Second, the current account deteriorates following an increase of budget deficit, since it reflects a tax-cut which leads to an increase of consumption (including that of foreign tradable goods). This translates into a positive relation between external and budget deficits. As explained above, this relation can be due to non-altruistic behavior associated with imperfect intergenerational linkages or to liquidity constraints related to imperfect financial markets.

In contrast, the rules are dynamic when the probability of death is smaller than one ($0 \leq \rho < 1$, so that $0 < \lambda < 1$). In this case, the current account is affected by all expected future forcing variables (see the elements of $\mathbf{\Theta}_{af}$). First, the current account deteriorates in response to an expected increase of output and an expected decrease of government expenditures, since this expected increase of resources, net of public absorption, induces an increase of current consumption (including that of foreign tradable goods). Second, when the elasticity of intertemporal substitution of consumption exceeds one, then the current account may deteriorate in response to an expected decrease of interest rate, an expected appreciation of exchange rate, and an expected deterioration of terms of trade, through the intertemporal substitution effects associated with an increase of price of future consumption relative to current consumption, an increase of price of future non-tradable goods relative to future tradable goods, and an increase of price of future foreign tradable goods relative to future home tradable goods. Finally, a positive probability of death implies that the current account deteriorates in response to an expected increase of the budget deficit, whereas a zero probability of death implies that the current account is unaffected because the contemporaneous consumption is unaltered while private saving increases to reimburse the budget deficit induced by a tax-cut. Hence, a zero probability of death implies that there is no relation between external and budget deficits.

The analytical approximation is completed by constructing the expectations of future forcing variables in (5) from a first-order unrestricted VAR process involving all forcing variables and the adjusted current account (e.g. Boileau and Normandin 2002). This yields the restricted VAR process:

$$\mathbf{x}_{2,t} = \mathbf{\Theta}_{22}\mathbf{x}_{2,t-1} + \mathbf{\Theta}_{2u}\mathbf{u}_t. \tag{6}$$

Here $\mathbf{x}_{2,t} = (\begin{array}{cc} \mathbf{f}_t' & a_t \end{array})'$, whereas $\mathbf{u}_t$ and $\mathbf{\Theta}_{2u}\mathbf{u}_t$ contain the innovations of the unrestricted and restricted VARs. Also, $\mathbf{\Phi}_{22}$ and $\mathbf{\Theta}_{22} = \mathbf{\Theta}_{2u}\mathbf{\Phi}_{22}\mathbf{\Theta}_{2u}^{-1}$ include the feedback coefficients of the unrestricted and restricted VARs, where $\mathbf{\Theta}_{2u} = (\begin{array}{cccc} \mathbf{e}_1' & \dots & \mathbf{e}_6' & \mathbf{\Upsilon} \end{array})'$, $\mathbf{e}_k$ contains the value one for the kth element and zero elsewhere, $\mathbf{\Upsilon} = \mathbf{\Theta}_{af}\mathbf{\Phi}_{22}\lambda\left[\mathbf{I} - \mathbf{\Phi}_{22}\lambda\right]^{-1}$, and $\mathbf{I}$ is the identity matrix. Some of the feedback coefficients reflect the dynamic interactions between the contemporaneous budget deficit and the expected forcing variables related to future internal and external conditions. This response of the budget deficit and the response of the current account (discussed above) to expected movements of future forcing variables may induce a positive relation between external and budget deficits.

Finally, the VARs (4) and (6) are stacked to form the following first-order representation:

$$\mathbf{x}_t = \mathbf{\Theta}_x\mathbf{x}_{t-1} + \mathbf{\Theta}_u\mathbf{u}_t, \tag{7}$$

or

$$\begin{pmatrix} \mathbf{x}_{1,t} \\ \mathbf{x}_{2,t} \end{pmatrix} = \begin{pmatrix} \mathbf{\Theta}_{11} & \mathbf{\Theta}_{12}\mathbf{\Theta}_{22} \\ \mathbf{0} & \mathbf{\Theta}_{22} \end{pmatrix} \begin{pmatrix} \mathbf{x}_{1,t-1} \\ \mathbf{x}_{2,t-1} \end{pmatrix} + \begin{pmatrix} \mathbf{\Theta}_{12}\mathbf{\Theta}_{2u} \\ \mathbf{\Theta}_{2u} \end{pmatrix} \mathbf{u}_t.$$

This representation will prove useful to isolate the key factors inducing a positive relation between external and budget deficits.

4. Empirical Method

This section elaborates the empirical method designed to estimate the parameters of system (7) and to identify the main determinants of the positive comovement between external and budget deficits. Ideally, the empirical method should jointly estimate all the parameters of system (7). In practice, however, this exercise is difficult to perform given the large number of parameters to estimate relative to the number of observations. Specifically, there is a total of 64 parameters which include (i) the means μ_y, μ_q, μ_τ, μ_r, μ_g, μ_d, $\mu_{(f-b^*)}$, u_c, and u_t associated with the variables $\Delta \log Y_t$, $\log q_t$, $\log \tau_t$, r_t, $\log g_t$, d_t, $(f_t - b_t^*)$, $\log c_t = \log(P_t C_t / Y_t)$, and $\log t_t = \log(T_t / Y_t)$, (ii) the feedback coefficients incorporated in $\mathbf{\Phi_{22}}$ for the unrestricted version of the VAR (6), and (iii) the structural coefficients ρ, γ, ξ, ζ, ω, and ϖ involved in the agent's problem (1). In contrast, the samples for our different countries include between 24 and 44 annual observations per variable.

To circumvent this problem, we apply the following multi-step estimation procedure. The first step evaluates the means from the sample estimates. The second step determines the feedback coefficients from the OLS estimates. To do so, the variables involved in the unrestricted version of (6) are obtained by using the actual data for forcing variables, current account, and predetermined variables; by constructing the adjusted current account as $a_t = z_t - \mathbf{\Theta}_{zp}\mathbf{p}_t - \mathbf{\Theta}_{zf}\mathbf{f}_t$ (see the last equation of (4)); and by fixing the means to their estimates and the structural parameter ρ to a given value (see Table 2).

The third step computes the structural parameters from the GMM estimates. These estimates are obtained by setting the covariance between external and budget deficits, *cov*, to its empirical counterpart (reported in Table 1), by fixing the means and the feedback coefficients to their estimates and by exploting the following moment conditions:

$$E\left[(cov + z_t d_t)\mathbf{x}'_{2,t-1}\right] = 0, \tag{8}$$

where $\mathbf{x}_{2,t-1}$ is the vector of instruments, while z_t and d_t are substituted by the values predicted by system (7)

$$z_t = \mathbf{e}'_3\mathbf{x}_t = \mathbf{e}'_3\big(\mathbf{\Theta}_x\mathbf{x}_{t-1} + \Theta_u\mathbf{u}_t\big), \tag{9.1}$$

$$d_t = \mathbf{e}'_9\mathbf{x}_t = \mathbf{e}'_9\big(\mathbf{\Theta}_x\mathbf{x}_{t-1} + \Theta_u\mathbf{u}_t\big). \tag{9.2}$$

To gain intuition, note that the GMM estimates select values for the structural parameters involved in the nonlinear regression $cov = -z_t d_t + \epsilon_t$ such that the error term ϵ_t is orthogonal to lagged information, where z_t and d_t are given by (9). Taking expectations implies that $E(cov) = -E(z_t d_t) + E(\epsilon_t)$ or $cov = -\sigma_{zd}$ provided that the error term is centered on zero, so that the estimated structural parameters ensure that the predicted covariance between external and budget deficit, $-\sigma_{zd}$, is close to its empirical counterpart, *cov*. In practice, the GMM estimates are obtained for the structural parameters ρ and γ and for the composite parameters $\epsilon_q = 1 + \left(\frac{1-\omega}{\omega}\right)e^{(1-\xi)\mu_q}$ and $\epsilon_\tau = 1 + \left(\frac{1-\varpi}{\varpi}\right)e^{(1-\zeta)\mu_\tau}$, given that the structural parameters ω, ϖ, ξ, and ζ are not individually identified.

The last step of the estimation procedure consists in repeating the second and third steps. More explicitly, the estimate of ρ obtained in the third step is used in the second step to reestimate the feedback coefficients $\mathbf{\Phi}_{22}$. These new estimates of $\mathbf{\Phi}_{22}$ are then used in the third step to update the estimate of ρ. These iterations are done until the estimates of the structural parameter ρ and those in $\mathbf{\Phi}_{22}$ converge to fix points.

The empirical procedure then uses the estimates of parameters to evaluate and decompose the predicted covariance between external and budget deficits. Specifically, the predicted covariances between variables governed by system (7) are given by:

$$\boldsymbol{\Sigma} = \sum_{j=0}^{\infty} \boldsymbol{\Theta}_x^j \boldsymbol{\Theta}_u \boldsymbol{\Omega} \boldsymbol{\Theta}_u' \boldsymbol{\Theta}_x^{j\,\prime}, \tag{10.1}$$

$$= \sum_{j=0}^{\infty} \boldsymbol{\Psi}_j \boldsymbol{\Psi}_j'. \tag{10.2}$$

Here, $\boldsymbol{\Sigma} = E[\mathbf{x}_t \mathbf{x}_t']$ is the predicted covariance matrix, $\boldsymbol{\Omega} = E[\mathbf{u}_t \mathbf{u}_t'] = \boldsymbol{\Lambda}\boldsymbol{\Lambda}'$ is the covariance matrix of innovations, $\boldsymbol{\Psi}_j = \boldsymbol{\Theta}_x^j \boldsymbol{\Theta}_u \boldsymbol{\Lambda}$ is the matrix summarizing the dynamic responses of various variables j periods after each orthogonal shock, and $\boldsymbol{\Lambda}$ is a lower triangular matrix transforming the innovations into orthogonal shocks. In practice, $\boldsymbol{\Lambda}$ is obtained from a Choleski factorization for the ordering $\mathbf{x}_{2,t} = \begin{pmatrix} \mathbf{f}_t' & a_t \end{pmatrix}'$ and $\mathbf{f_t} = \begin{pmatrix} r_t & \Delta \log \tau_t & \Delta \log q_t & \Delta \log Y_t & \log g_t & d_t \end{pmatrix}'$. This ordering ensures that the shocks related to internal conditions capture the portion that is orthogonal to external conditions. Also, the shock related to $\log g_t$ corresponds to a shock on the level of government expenditures, rather than on government expenditures to output ratio, given that it captures the portion that is orthogonal to output. Likewise, the shock related to d_t is a shock on taxes, since it measures the portion that is orthogonal to output, government expenditures, and interest rates. Finally, the shock affecting a_t captures any other shocks than those already associated with $\mathbf{f}_t$, because it is the portion that is orthogonal to forcing variables.

From expression (10), the predicted covariance between external and budget deficits is decomposed as follows:

$$-\sigma_{zd} = \psi_r + \psi_\tau + \psi_q + \psi_y + \psi_g + \psi_d + \psi_a. \tag{11}$$

The component $\psi_r = \sum_{j=0}^{\infty} \left(-\mathbf{e}_3' \boldsymbol{\Psi}_j \mathbf{e}_4\right)\left(\mathbf{e}_9' \boldsymbol{\Psi}_j \mathbf{e}_4\right)$ is the portion of the predicted covariance between external and budget deficits which is attributable to the interest rate shock. In practice, this portion is computed by evaluating the sum over 100 years. Also, the portion involves the dynamic responses of the external deficit [i.e. $\left(-\mathbf{e}_3'\mathbf{\Psi}_j\mathbf{e}_4\right)$] and of the budget deficit [i.e. $\left(\mathbf{e}_9'\mathbf{\Psi}_j\mathbf{e}_4\right)$] to an interest rate shock. The other terms in (11) are defined in an analogous way. The components ψ_τ, ψ_q, ψ_y, ψ_g, ψ_d, and ψ_a measure the contributions to the predicted covariance of the terms of trade shock, exchange rate shock, output shock, government expenditures shock, tax shock, and other shocks. The component with the largest positive value provides information on the shock corresponding to the prime determinant of the positive comovement between external and budget deficits.

5. Results

This section applies the empirical method just described for 12 of our 24 initial countries. The selection of the countries relies on the availability of the data required for the estimation exercise. In particular, the series on public debt are often missing. The data are fully described in the Data Appendix.

The estimates of all parameters are available upon request. For briefness, Table 3 reports only the estimates of the structural and composite parameters. The estimates systematically display the expected signs and the appropriate magnitudes, but are often imprecise since the number of estimated parameters is large relative to the sample size. Specifically, the estimates indicate that the probability of death, ρ, is always between zero and one. Also, the probability of death averages to 0.318 across all countries; and it ranges from a low of 0.001 in Mauritius, Morocco, South Africa, and Tunisia to a high of 0.948 in Sierra Leone. As explained above, large values of ρ may reflect non-altruistic behavior associated with imperfect intergenerational linkages or liquidity constraints related to imperfect financial markets. Interestingly, previous findings detect strong liquidity constraints for many developing countries (e.g. Haque and Montiel 1989). Among the countries which are common to our sample, severe liquidity constraints are documented for India, Malaysia, and Nigeria, whereas no liquidity constraint is detected for Morocco. Our estimates accord with these results, that is, the estimates of the probability of death are substantially larger for India, Malaysia, and Nigeria than that for Morocco.

The estimates imply that the elasticity of intertemporal substitution of consumption, $(1/\gamma)$, is always positive. Also, the elasticity averages to 0.719 across all countries; and it ranges from a low of 0.139 in South Africa to a high of 4.016 in Tunisia. Interestingly, these estimates are consistent with previous findings, where the estimates of the elasticity are smaller than unity for almost all selected developing countries (e.g. Ogaki, Ostry, and Reinhart 1996; Ostry and Reinhart 1992; Giovannini 1985).

As expected, the estimates reveal that the composite parameter, ϵ_q, is always larger than one. Also, the elasticity of substitution between tradable and non-tradable goods, ξ, is systematically positive — where this elasticity is recovered from the definition $\epsilon_q = 1 + \left(\frac{1-\omega}{\omega}\right)e^{(1-\xi)\mu_q}$, given values of the weight ω, and the estimated values of the mean μ_q. The elasticity uniformely declines as the weight of tradable goods in total consumption, ω, increases. For example, fixing the weight to $\omega = 0.3$ implies that the elasticity averages to 4.589; and it ranges from a low of 1.911 in Sierra Leone to a high of 8.113 in Sri Lanka. In contrast, setting $\omega = 0.7$ implies that the elasticity averages to 1.935; and it ranges from a low of 0.114 in Sierra Leone to a high of 4.899 in Sri Lanka.

Likewise, the estimates indicate that the composite parameter, ϵ_τ, is always larger than one. Also, the elasticity of substitution between home and foreign tradable goods, ζ, is almost always positive — where this elasticity is obtained from $\epsilon_\tau = 1 + \left(\frac{1-\varpi}{\varpi}\right)e^{(1-\zeta)\mu_\tau}$, given values of the weight ϖ, and the estimated values of the mean μ_τ. The elasticity decreases as the weight of home tradable goods in total tradable consumption, ϖ, increases. In particular, fixing the weight to $\varpi = 0.3$ implies that the elasticity averages to 4.411; and it ranges from a low of 2.731 in Tunisia to a high of 8.446 in Sierra Leone. However, setting $\varpi = 0.7$ implies that the elasticity averages to 1.336; and it ranges from a low of -0.575 in Sri Lanka to a high of 4.440 in Sierra Leone. Overall, the values for the weights, ω and ϖ, and the elasticities of substitution, ξ and ζ, are consistent with previous findings, where the estimates of the weight are around 0.5 and the estimates of the elastiticity of substitution between imported and non-tradable goods is about 1.3 across selected developing countries (e.g. Ostry and Reinhart 1992). In these studies, however, the tradable goods are usually not decomposed into imported and non-imported goods.

For completeness, Table 3 also presents the overidentification restriction tests. The statistics, J, reveal that the restrictions associated with the moment conditions (8) are never rejected at the 1% level, are refuted at the 5% level for only 3 countries, and at the 10% level for 2 additional countries.

Figure 2 displays the transitory dynamic responses of external and budget deficits following, one standard deviation, shocks. These responses are obtained from our benchmark ordering: $\mathbf{x}_{2,t} = (\,\mathbf{f}_t' \quad a_t\,)'$ and $\mathbf{f_t} = (\,r_t \quad \Delta\log\tau_t \quad \Delta\log q_t \quad \Delta\log Y_t \quad \log g_t \quad d_t\,)'$. In brief, a positive shock to interest rate leads to positive responses of external and budget deficits over most horizons, except for Costa Rica, Malaysia, Mauritius, and Pakistan. A positive shock to terms of trade usually produces negative responses of external and budget deficits, except for India, Pakistan, Sierra Leone, Sri Lanka, and South Africa. A positive shock to exchange rate generally implies positive responses of external and budget deficits, except for Malaysia, Mauritius, and Pakistan. A positive shock to output frequently leads to negative responses of external and budget deficits, except for Honduras, Pakistan, Sri Lanka, and Tunisia. A positive shock to government expenditures almost always yields positive responses of external and budget deficits, except for Nigeria and Sri Lanka. Finally, a positive shock to budget deficit due to a tax cut yields positive responses of external and budget deficits over most horizons, except for Nigeria and Sri Lanka.

Importantly, these dynamic responses provide some intuition behind the predicted relation between external and budget deficits. For example, the various shocks produce responses of external and budget deficits which are almost always of the same sign. This suggests that most shocks induce a positive relation between external and budget deficits. In turn, these relations translate into a positive predicted comovement between external and budget deficits, as observed in the data. This sharply contrasts with the results obtained from reduced-form analyses, suggesting that the explanation of the empirical positive covariance between external and budget deficits from the usual external and internal conditions represents a challenging task (e.g. Calderon, Chong, and Zanforlin 2007; Combes and Saadi-Sedik 2006; Chinn and Prasad 2003; Calderon, Chong, and Loayza 2002; Roubini 1991; Berg and Sachs 1988).

Also, the various shocks yield responses of external and budget deficits which generally exhibit a modest persistence. That is, most shocks affect the external and budget deficits for a horizon of about 5 years, except for India, Pakistan, and Sri Lanka. This suggests that the different shocks lead to a positive comovement between external and budget deficits mainly through their short-run effects.

Moreover, the various shocks induce responses of external and budget deficits which display different magnitudes. For example, a government expenditures shock leads to pronounced responses of external and budget deficits for many countries. These responses are clearly the largest (in absolute values) for Costa Rica, Honduras, and Pakistan. In additions, these responses seem quite large for Mauritius, Morocco, Sierra Leone, and Tunisia. Also, an output shock induces large responses of external and budget deficits for Nigeria and Sri Lanka. Given the measures involved in our covariance decomposition, these results suggest that shocks to internal conditions represent the prime determinants of the positive comovements between external and budget deficits for most countries. In contrast, a terms of trade shock yields the largest responses of external and budget deficits for Malaysia, while an interest rate shock produces the largest responses for India and South Africa. These findings suggest that shocks to external conditions constitute the main explanation of the positive comovements between external and budget deficits for only few countries.

Table 4 confronts the empirical and predicted covariances between external and budget deficits. These statistics display similar numerical values for almost all countries. Also, the empirical and predicted covariances are statistically identical at all conventional levels for every country, except Tunisia.

Table 4 further reports the estimates of the contribution of each shock to the predicted covariance between external and budget deficits. Again, these estimates are computed for our benchmark ordering: $\mathbf{x}_{2,t} = (\,\mathbf{f}_t' \quad a_t\,)'$ and $\mathbf{f_t} = (r_t \quad \Delta\log\tau_t \quad \Delta\log q_t \quad \Delta\log Y_t \quad \log g_t \quad d_t)'$. The estimates are always numerically positive, except those associated with the portions attributable to the shocks of exchange rate, tax cut, and other factors (summarized by the adjusted current account) for Nigeria, and interest rate for Mauritius. The positive contributions of most shocks reflect the notion that the responses of external and budget deficits are frequently of the same sign. Also, these positive contributions reveal that most shocks induce a positive relation between external and budget deficits, translating into a positive predicted comovement between the two deficits.

The contributions also display different sizes across the various shocks. In general, the magnitude of the contributions indicate that both internal and external conditions play a role in the determination of the comovement between external and budget deficits. However, the contributions related to the government expenditures shock represent the largest numerical values for 7 out of 12 countries, namely Costa Rica, Honduras, Mauritius, Morocco, Pakistan, Sierra Leone, and Tunisia. Also, the portions attributable to the output shock are the most important component for 2 countries, that is, Nigeria and Sri Lanka. But the contributions of the budget deficit shock associated with a tax change never display the largest numerical values. So far, these results reveal that the shocks associated with internal conditions, and especially the domestic resources net of public absorptions, are the most important factors explaining the positive comovement between external and budget deficits for most countries. These findings confirm the intuition deduced from the dynamic responses.

In contrast, the contributions related to the interest rate shock reach the largest numerical values for only 2 countries, namely India and South Africa. Also, the portions attributable to the terms of trade shock are the most important component for only 1 country, that is, Malaysia. In addition, the contributions of the exchange rate shock never exhibit the largest numerical values. In sum, these findings indicate that the shocks associated with external conditions play a major role in the determination of the positive comovement between external and budget deficits for only few countries.

Note that many estimates of the contributions are precisely estimated. Importantly, selecting the contributions with the largest positive, statistically significant (rather than numerical), values leads to similar results as above. The only differences are the following: the contribution of the shock to output (rather than government expenditures) becomes the most important for Morocco, the portion attributable to the shock to budget deficit induced by a tax change (rather than interest rate) is the most crucial for South Africa, while the contribution of the shock to terms of trade (rather than government expenditures) is the most dominant for Tunisia. Overall, the findings confirm that the shocks associated with internal conditions still constitute the prime determinants of the positive relation between external and budget deficits for most countries, whereas the shocks related to external conditions remain key factors for few countries.

To check the robustness of the results, Table 5 presents the contributions obtained from the following ordering: $\mathbf{x}_{2,t} = (\,\mathbf{f}_t' \quad a_t\,)'$ and $\mathbf{f_t} = (\Delta \log Y_t \;\; \log g_t \;\; d_t \;\; r_t \;\; \Delta \log \tau_t \;\; \Delta \log q_t)'$. This alternative ordering places the variables related to internal conditions before those associated with external conditions, unlike the benchmark ordering. Accordingly, the alternative ordering assumes that the internal conditions are more predetermined than the external ones. Importantly, this case may be relevant for many developing economies which heavily rely on natural resources. This is because the endowment of these resources is crucially affected by exogenous, and possibly highly predetermined, factors. Examples of such factors are weather conditions affecting crops for agricultural economies (i.e. Costa Rica), geological conditions affecting the mining industry (i.e. South Africa), and reserves of oil affecting the petrolium industry (i.e. Nigeria). All these exogenous factors are captured by shocks to domestic resources, net of public absorption, in our alternative ordering.

For the alternative ordering, the contributions related to the government expenditures shock now represent the largest numerical values for 9 out of 12 countries, namely Costa Rica, Honduras, India, Mauritius, Morocco, Pakistan, Sierra Leone, Sri Lanka, and Tunisia. Also, the portions attributable to the output shock are still the most important component for 2 countries, that is, Nigeria and Sri Lanka. Finally, the contribution of the budget deficit shock associated with a tax change becomes the largest numerical value for South Africa. Consequently, these results indicate that the shocks associated with internal conditions are now the most important factors explaining the positive relation between external and budget deficits for all countries. Interestingly, these contributions reinforce the conclusion reached from the benchmark ordering. Moreover, the results suggest that the contributions obtained from the benchmark ordering can be viewed as providing a lower bound of the importance of internal conditions in the determination of the positive comovement between external and budget deficits.

6. Conclusion

This paper documented and explained the positive relation between external and budget deficits for several developing countries. First, we provide evidence of the existence of a positive comovement between external and budget deficits. This is consistent with previous findings obtained from panel regressions. However, our analysis relies on time-series of external and budget deficits to extract the comovement that is specific to each country. The estimated covariance between external and budget deficits is numerically positive for all countries and statistically significant for many cases. Similar results are found from the estimated correlation between external and budget deficits, and the estimated slope coefficient obtained by regressing the external deficit on a constant and the budget deficit.

Second, we explain the joint behavior of external and budget deficits from a tractable small open economy, overlapping generation model with heterogeneous goods. This sharply contrasts with earlier reduced-form studies characterizing the individual behavior of either the external deficit or budget deficit. Our model offers the advantage of relating external and budget deficits to the external and internal conditions usually considered for developing economies. The model further captures different degrees of imperfectness of intergenerational linkages and of financial markets, and as such potential liquidity constraints faced by developing countries.

Empirically, the model is estimated for each country such that the predicted covariance between external and budget deficits is close to its empirical counterpart. The predicted covariance is then decomposed into contributions measuring the portions attributable to shocks associated with each internal and external conditions. The size of the contributions indicate that the shocks associated with internal conditions, and especially the domestic resources net of public absorptions, are the most important factors explaining the positive comovement between external and budget deficits for most countries. In contrast, the contributions of the shocks associated with external conditions are dominant for only few countries.

Data Appendix

This appendix describes the data which are mainly collected from the International Financial Statistics (IFS), released by the International Monetary Fund. The annual data cover the longest period since the post-1960 era for our selected developing economies. The selections of the countries, frequency, and time periods are dictated by the availability of the data, and in particular of budget deficit and public debt. Table 1 lists the countries and time periods for which external and budget deficits are available. Table 3 lists the countries for which all variables required for the estimation exercise are available.

The variables which are central to our analysis are external and budget deficits. The external deficit refers to the negative of the nominal current account in U.S. dollars (source: IFS) converted in domestic currencies from the appropriate nominal exchange rate (source: IFS), divided by the nominal gross domestic product in domestic currencies (source: IFS). The budget deficit is the nominal budget deficit in local currencies (source: IFS), normalized by the nominal gross domestic product.

The predetermined variables are the public debt and net foreign assets. The public debt is measured from the nominal foreign and domestic public debts of central governments net of guaranteed loans in domestic currencies (source: IFS), divided by the nominal gross domestic product. The net foreign assets correspond to the nominal net foreign assets in U.S. dollars (source: Lane and Milesi-Ferretti 2006) expressed in domestic currencies, normalized by the nominal gross domestic product. Exceptionally, for Sierra Leone the nominal net foreign assets in U.S. dollars is taken from the World Development Indicators (WDI) published by the World Bank.

The forcing variables are the world interest rate, terms of trade, exchange rate, output, and government expenditures. The world interest rate is proxied by the nominal yield on three-month US treasury bills (source: IFS) minus the expected inflation, constructed as the one-step-ahead forecasts of an ARMA(1,1) process for the annual growth rate of the consumer price index (source: IFS) (e.g. Fry 1986; Uribe and Yue 2006). The terms of trade are measured from the ratio of export prices to import prices (source: WDI). The exchange rate corresponds to the real effective exchange rate (source: IFS). Exceptionally, for Honduras, Mauritius, and Sri Lanka the real effectice exchange rate is taken from Cashin, Cespedes, and Sahay (2004), while for India the real effective exchange rate is published by the Reserve Bank of India. Output is obtained from the nominal gross domestic product, divided by the consumer price index. The government expenditures are computed as the nominal government expenditures of services, consumption goods, and investment goods in domestic currencies (source: IFS), normalized by the nominal gross domestic product.

The additional variables required for the estimation purpose are taxes and private consumption. Taxes correspond to the ratio of the nominal tax revenues in domestic currencies (source: IFS) to the nominal gross domestic product. Private consumption is obtained from the nominal households expenditures of services, nondurable goods, and durable goods in domestic currencies (source: IFS), normalized by the nominal gross domestic product.

All the variables are linear detrended to ensure stationarity. Similar results are obtained from alternative detrending methods, such as the Hodrick-Prescott filter.

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Table 1. Empirical Regularities: Statistics

Country	*cov*	*corr*	*coeff*	Country	*cov*	*corr*	*coeff*
Burundi	0.061	0.007	0.007	Pakistan	10.57	0.804	0.728
[1985–2003]	(0.968)	(0.968)	(0.978)	[1976–2003]	(0.005)	(0.000)	(0.000)
Colombia	0.885	0.202	0.448	Papua New Guinea	7.169	0.392	1.538
[1968–2003]	(0.269)	(0.262)	(0.237)	[1976–2001]	(0.092)	(0.038)	(0.048)
Costa Rica	7.871	0.624	1.548	Paraguay	1.832	0.285	0.803
[1977–2002]	(0.016)	(0.000)	(0.001)	[1975–2001]	(0.247)	(0.179)	(0.150)
Ecuador	3.077	0.355	0.882	Sierra Leone	19.25	0.408	0.694
[1976–2003]	(0.025)	(0.003)	(0.063)	[1977–2005]	(0.010)	(0.000)	(0.028)
Honduras	8.013	0.520	0.705	South Africa	1.621	0.215	0.320
[1974–2002]	(0.000)	(0.000)	(0.004)	[1960–2003]	(0.116)	(0.079)	(0.161)
India	1.291	0.442	0.150	Sri Lanka	11.81	0.848	0.743
[1975–2001]	(0.015)	(0.007)	(0.021)	[1975–2001]	(0.005)	(0.000)	(0.000)
Kenya	7.884	0.514	0.787	Tanzania	12.54	0.489	0.587
[1975–2003]	(0.000)	(0.000)	(0.004)	[1976–2002]	(0.003)	(0.000)	(0.009)
Malaysia	9.938	0.241	0.302	Togo	45.34	0.826	0.750
[1974–1999]	(0.269)	(0.191)	(0.235)	[1977–2000]	(0.085)	(0.000)	(0.000)
Mali	11.48	0.764	1.436	Tunisia	6.079	0.606	0.797
[1976–2003]	(0.000)	(0.000)	(0.000)	[1976–1999]	(0.002)	(0.000)	(0.008)
Mauritius	19.94	0.741	0.802	Uganda	0.125	0.027	0.035
[1976–2003]	(0.000)	(0.000)	(0.000)	[1980–2003]	(0.899)	(0.899)	(0.901)
Morocco	15.48	0.823	0.917	Uruguay	1.365	0.234	0.241
[1975–2003]	(0.008)	(0.000)	(0.000)	[1978–2001]	(0.044)	(0.064)	(0.270)
Nigeria	11.60	0.276	0.269	Venezuela	14.19	0.686	1.876
[1977–2004]	(0.131)	(0.072)	(0.156)	[1970–2001]	(0.000)	(0.000)	(0.000)

Note. *cov* refers to the sample estimates of the empirical covariance (multplied by 10000) between external and budget deficits. *corr* is the sample estimates of the correlation between external and budget deficits. *coeff* is the OLS estimates of the slope coefficient obtained by regressing the external deficit on a constant and the budget deficit. Numbers in parentheses are the p-values associated with t tests that the statistics are null, where these tests involve Newey-West standard errors. Entries in brackets represent the sample periods.

Table 2. Economic Environment: Coefficients of Rules

$$\boldsymbol{\Theta}_{pp} = \begin{pmatrix} (1-\rho) & -\rho\left(\frac{\nu+\rho}{\mu_r+\rho}\right) \\ 0 & \left(\frac{1}{1+\mu_y}\right) \end{pmatrix} \qquad \boldsymbol{\Theta}_{zp} = \begin{pmatrix} \left[\left(\frac{\mu_r}{1+\mu_y}\right) - (\nu+\rho)\right] \\ -\rho\left(\frac{\nu+\rho}{\mu_r+\rho}\right) \end{pmatrix}'$$

$$\boldsymbol{\Theta}_{pf} = \begin{pmatrix} -(1-\rho)\mu_{(f-b^*)} & 0 \\ 0 & 0 \\ 0 & 0 \\ (1-\rho)\mu_{(f-b^*)} & 0 \\ -e^{\mu_g}\lambda & 0 \\ -\rho(1+\mu_y)\left(\frac{\nu+\rho}{\mu_r+\rho}\right) & 1 \end{pmatrix}' \qquad \boldsymbol{\Theta}_{pa} = \begin{pmatrix} 1 \\ 0 \end{pmatrix}$$

$$\boldsymbol{\Theta}_{zf} = \begin{pmatrix} \nu+\rho-\frac{\mu_r}{1+\mu_y} \\ 0 \\ 0 \\ (1-\rho)\mu_{(f-b^*)} \\ -e^{u_g}\lambda \\ -\rho\left(\frac{\nu+\rho}{\mu_r+\rho}\right)(1+\mu_y) \end{pmatrix}' \qquad \boldsymbol{\Theta}_{af} = \begin{pmatrix} -(1-e^{\mu_t}) \\ \left[e^{\mu_c}\left(1-\frac{1}{\gamma}\right)\right]\left(1-\frac{1}{\epsilon_q}\right) \\ -\left[e^{\mu_c}\left(1-\frac{1}{\gamma}\right)\right]\left(1-\frac{1}{\epsilon_\tau}\right) \\ (1-e^{\mu_t})-e^{\mu_c}\left(1-\frac{1}{\gamma}\right) \\ e^{\mu_g}\left(\frac{\nu+\rho}{1+\nu}\right) \\ -\rho\left(\frac{\nu+\rho}{\mu_r+\rho}\right)(1+\mu_y) \end{pmatrix}'$$

$$\lambda = \frac{1-\rho}{1+\nu} \qquad \nu = \mu_r - \mu_y > 0$$

$$\epsilon_q = 1 + \left(\frac{1-\omega}{\omega}\right)e^{(1-\xi)\mu_q} \qquad \epsilon_\tau = 1 + \left(\frac{1-\varpi}{\varpi}\right)e^{(1-\zeta)\mu_\tau}$$

Note. μ_y, μ_q, μ_τ, μ_r, μ_g, μ_d, $\mu_{(f-b^*)}$, u_c, and u_t are the means of $\Delta \log Y_t$, $\log q_t$, $\log \tau_t$, r_t, $\log g_t$, d_t, $(f_t - b_t^*)$, $\log c_t = \log(P_t C_t / Y_t)$, and $\log t_t = \log(T_t/Y_t)$. Also, γ is the reciprocal of the elasticity of intertemporal substitution of consumption, ξ is the elasticity of substitution between tradable and non-tradable goods, ζ is the elasticity of substitution between home and foreign tradable goods, ω is the weight of tradable goods in total consumption, ϖ is the weight of home tradable goods in total tradable consumption, and ρ is the probability of death.

Table 3. Results: Estimates of the Structural Parameters

Country	ρ	γ	ϵ_q	ϵ_τ	ω	ξ	ϖ	ζ	J
Costa Rica	0.168	1.116	1.078	1.469	0.3	5.533	0.3	3.285	3.491
	(0.169)	(0.889)	(0.349)	(0.738)	0.7	3.277	0.7	0.872	[0.479]
Honduras	0.494	0.871	1.046	1.316	0.3	7.575	0.3	4.934	11.45
	(0.006)	(0.681)	(0.190)	(0.524)	0.7	4.743	0.7	1.602	[0.022]
India	0.876	3.142	1.410	1.271	0.3	2.797	0.3	3.259	10.56
	(0.065)	(0.000)	(0.663)	(0.301)	0.7	1.045	0.7	1.482	[0.032]
Malaysia	0.566	3.675	1.193	1.434	0.3	5.961	0.3	5.472	6.317
	(0.083)	(0.975)	(0.640)	(0.765)	0.7	2.586	0.7	0.969	[0.117]
Mauritius	0.001	5.500	1.500	1.500	0.3	3.507	0.3	3.838	10.58
	(0.975)	(0.959)	(0.814)	(0.625)	0.7	0.749	0.7	0.716	[0.032]
Morocco	0.001	3.300	1.500	1.500	0.3	3.435	0.3	3.367	7.248
	(0.978)	(0.980)	(0.881)	(0.784)	0.7	0.756	0.7	0.763	[0.123]
Nigeria	0.017	3.268	1.883	1.119	0.3	2.043	0.3	3.585	6.606
	(0.866)	(0.957)	(0.759)	(0.057)	0.7	0.225	0.7	2.113	[0.158]
Pakistan	0.125	2.200	1.350	1.500	0.3	3.325	0.3	3.155	5.396
	(0.194)	(0.851)	(0.795)	(0.474)	0.7	1.248	0.7	0.784	[0.249]
Sierra Leone	0.948	2.284	1.988	1.100	0.3	1.911	0.3	8.446	9.459
	(0.001)	(0.099)	(0.888)	(0.792)	0.7	0.114	0.7	4.440	[0.051]
South Africa	0.001	7.216	1.517	1.067	0.3	4.944	0.3	4.204	4.187
	(0.991)	(0.000)	(0.000)	(0.000)	0.7	0.508	0.7	2.678	[0.381]
Sri Lanka	0.623	6.727	1.055	1.908	0.3	8.113	0.3	2.979	9.115
	(0.434)	(0.987)	(0.696)	(0.879)	0.7	4.899	0.7	-0.575	[0.058]
Tunisia	0.001	0.249	1.125	1.736	0.3	5.921	0.3	2.731	1.652
	(0.993)	(0.081)	(0.076)	(0.689)	0.7	3.065	0.7	0.189	[0.799]

Note. ρ, γ, ϵ_q, and ϵ_τ are the GMM estimates of structural and composite parameters. ξ and ζ are obtained from the definitions $\epsilon_q = 1+\left(\frac{1-\omega}{\omega}\right)e^{(1-\xi)\mu_q}$ and $\epsilon_\tau = 1+\left(\frac{1-\varpi}{\varpi}\right)e^{(1-\zeta)\mu_\tau}$, given some values of the weights ω and ϖ, and the estimated values of the means μ_q and μ_τ. J is the J-statistic. Numbers in parentheses are the p-values associated with t tests that the estimates are null, where these tests involve Newey-West standard errors. Entries in brackets are the p-values associated with the χ^2 test that the J-statistic is null.

Table 4. Results: Covariance Decomposition

Country	cov	$-\sigma_{zd}$	ψ_r	ψ_τ	ψ_q	ψ_y	ψ_g	ψ_d	ψ_a
Costa Rica	7.871	6.090	0.725	1.260	0.286	0.285	2.449	0.932	0.153
	[0.188]	(0.000)	(0.000)	(0.006)	(0.055)	(0.019)	(0.028)	(0.090)	(0.254)
Honduras	8.013	8.175	1.231	0.278	1.418	0.301	4.574	0.253	0.120
	[0.931]	(0.000)	(0.043)	(0.179)	(0.029)	(0.160)	(0.000)	(0.123)	(0.239)
India	1.291	1.594	0.573	0.237	0.134	0.084	0.130	0.418	0.019
	[0.738]	(0.079)	(0.017)	(0.020)	(0.000)	(0.300)	(0.135)	(0.268)	(0.587)
Malaysia	9.938	10.15	1.803	3.563	0.988	1.444	1.555	0.359	0.436
	[0.948]	(0.002)	(0.204)	(0.004)	(0.366)	(0.330)	(0.155)	(0.190)	(0.322)
Mauritius	19.94	15.22	-0.219	3.369	1.246	0.922	7.559	1.363	0.985
	[0.439]	(0.012)	(0.835)	(0.064)	(0.238)	(0.023)	(0.024)	(0.613)	(0.061)
Morocco	15.48	13.16	1.092	0.669	0.236	0.955	7.486	1.295	1.427
	[0.828]	(0.218)	(0.166)	(0.062)	(0.802)	(0.088)	(0.147)	(0.711)	(0.001)
Nigeria	11.60	11.90	0.679	0.885	-4.929	18.10	2.594	-2.360	-3.102
	[0.991]	(0.634)	(0.912)	(0.587)	(0.058)	(0.000)	(0.793)	(0.010)	(0.612)
Pakistan	10.57	10.38	1.004	3.122	0.103	0.496	4.898	0.504	0.251
	[0.958]	(0.005)	(0.003)	(0.028)	(0.754)	(0.201)	(0.007)	(0.473)	(0.342)
Sierra Leone	19.25	10.80	2.125	0.947	0.895	0.429	4.442	1.274	0.661
	[0.701]	(0.624)	(0.640)	(0.159)	(0.886)	(0.308)	(0.809)	(0.640)	(0.669)
South Africa	1.621	1.972	0.588	0.162	0.017	0.347	0.082	0.582	0.192
	[0.959]	(0.772)	(0.238)	(0.003)	(0.879)	(0.807)	(0.985)	(0.073)	(0.000)
Sri Lanka	11.81	7.705	0.943	1.101	0.308	1.557	1.422	1.366	1.008
	[0.430]	(0.139)	(0.173)	(0.275)	(0.339)	(0.054)	(0.258)	(0.413)	(0.269)
Tunisia	6.079	2.193	0.121	0.080	0.378	0.199	1.353	0.049	0.014
	[0.001]	(0.058)	(0.551)	(0.075)	(0.522)	(0.688)	(0.152)	(0.586)	(0.203)

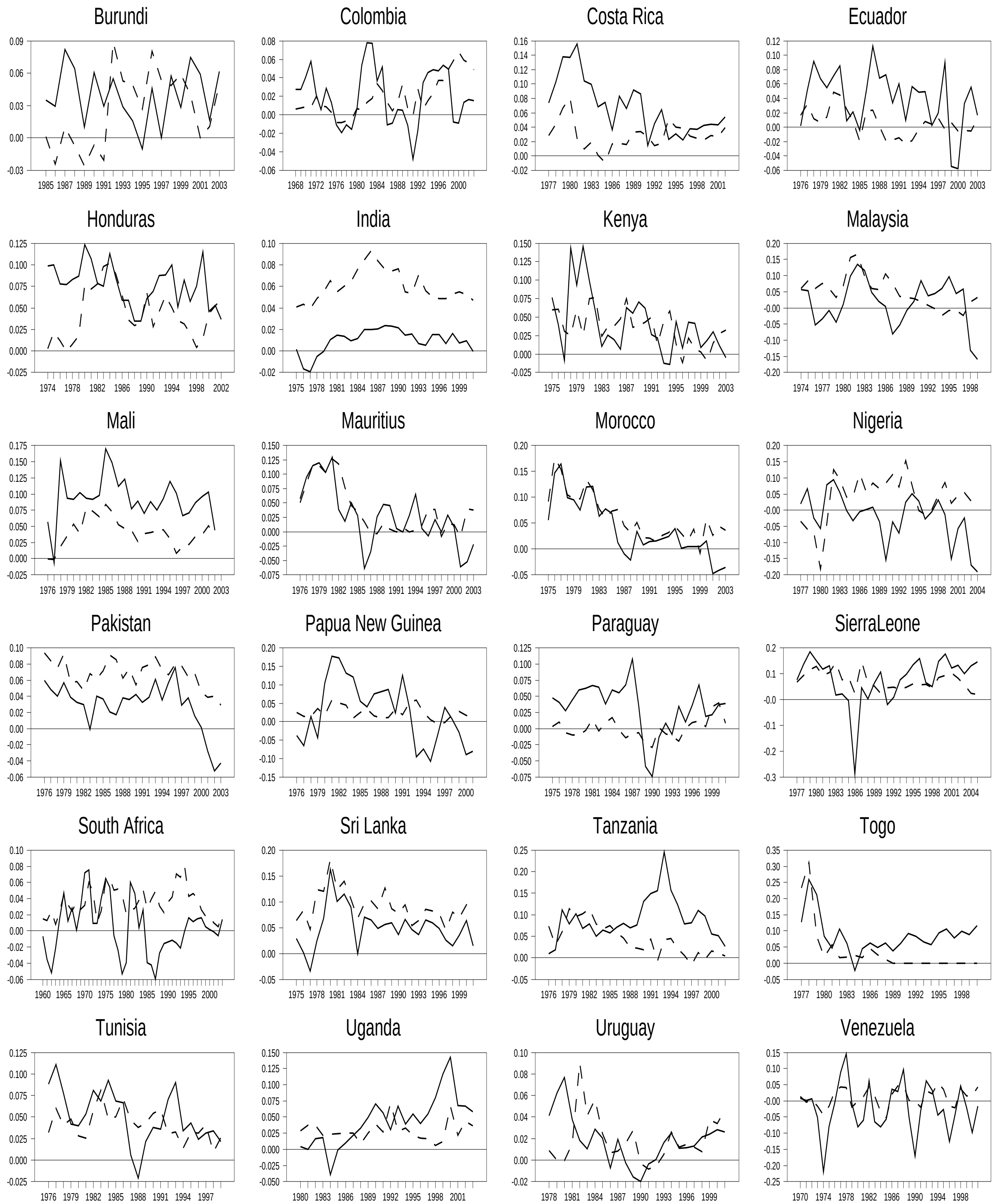
Note. cov and $-\sigma_{zd}$ refer to the estimates of empirical and predicted covariances (multplied by 10000) between external and budget deficits. ψ's are the estimates of components (multplied by 10000) of the predicted covariance obtained from the ordering r_t, $\Delta \log \tau_t$, $\Delta \log q_t$, $\Delta \log Y_t$, $\log g_t$, d_t, a_t. Numbers in parentheses are the p-values associated with χ^2 tests that the components are null. Entries in brackets are the p-values associated with the χ^2 test that the difference between empirical and predicted covariances is null. The tests take into account the uncertainty related to the estimates of structural and composite parameters, using the δ-method.

Table 5. Robustness: Covariance Decomposition

Country	*cov*	$-\sigma_{zd}$	ψ_y	ψ_g	ψ_d	ψ_r	ψ_τ	ψ_q	ψ_a
Costa Rica	7.871	6.090	0.973	2.586	1.594	0.635	0.004	0.153	0.153
	[0.188]	(0.000)	(0.014)	(0.016)	(0.000)	(0.006)	(0.689)	(0.126)	(0.254)
Honduras	8.013	8.175	1.565	4.451	0.728	0.243	0.308	0.760	0.120
	[0.931]	(0.000)	(0.171)	(0.000)	(0.015)	(0.000)	(0.013)	(0.000)	(0.239)
India	1.291	1.594	0.094	0.671	0.568	0.078	0.109	0.054	0.019
	[0.738]	(0.079)	(0.357)	(0.002)	(0.033)	(0.722)	(0.360)	(0.024)	(0.587)
Malaysia	9.938	10.15	4.541	2.189	1.393	0.722	0.816	0.050	0.436
	[0.948]	(0.002)	(0.005)	(0.111)	(0.025)	(0.140)	(0.026)	(0.804)	(0.322)
Mauritius	19.94	15.22	3.655	7.397	2.637	-0.185	0.091	0.644	0.985
	[0.439]	(0.012)	(0.003)	(0.003)	(0.352)	(0.879)	(0.456)	(0.461)	(0.061)
Morocco	15.48	13.16	1.462	7.417	2.797	0.060	0.071	-0.075	1.427
	[0.828]	(0.218)	(0.045)	(0.145)	(0.498)	(0.761)	(0.746)	(0.858)	(0.001)
Nigeria	11.60	11.90	16.39	-1.448	-3.197	1.334	1.234	0.700	-3.102
	[0.991]	(0.634)	(0.000)	(0.878)	(0.391)	(0.845)	(0.115)	(0.657)	(0.612)
Pakistan	10.57	10.38	0.232	7.426	0.379	0.980	0.668	0.441	0.251
	[0.958]	(0.005)	(0.540)	(0.003)	(0.606)	(0.008)	(0.342)	(0.003)	(0.342)
Sierra Leone	19.25	10.80	0.595	6.391	1.715	0.067	1.293	0.051	0.661
	[0.701]	(0.624)	(0.000)	(0.608)	(0.875)	(0.968)	(0.297)	(0.977)	(0.669)
South Africa	1.621	1.972	0.085	0.280	1.382	-0.163	0.037	0.160	0.192
	[0.959]	(0.772)	(0.957)	(0.955)	(0.000)	(0.000)	(0.390)	(0.000)	(0.000)
Sri Lanka	11.81	7.705	0.777	1.600	1.450	0.967	1.167	0.736	1.008
	[0.430]	(0.139)	(0.089)	(0.330)	(0.369)	(0.127)	(0.149)	(0.068)	(0.269)
Tunisia	6.079	2.193	0.291	0.908	0.709	0.134	0.070	0.068	0.014
	[0.001]	(0.058)	(0.054)	(0.173)	(0.301)	(0.172)	(0.509)	(0.001)	(0.203)

Note. *cov* and $-\sigma_{zd}$ refer to the estimates of empirical and predicted covariances (multplied by 10000) between external and budget deficits. ψ's are the estimates of components (multplied by 10000) of the predicted covariance obtained from the ordering $\Delta \log Y_t$, $\log g_t$, d_t, r_t, $\Delta \log \tau_t$, $\Delta \log q_t$, a_t. Numbers in parentheses are the p-values associated with χ^2 tests that the components are null. Entries in brackets are the p-values associated with the χ^2 test that the difference between empirical and predicted covariances is null. The tests take into account the uncertainty related to the estimates of structural and composite parameters, using the δ-method.

Figure 1. Empirical Regularities: Data



Note: The solid (dashed) lines correspond to the external deficit (budget deficit).

Figure 2. Results: Dynamic Responses

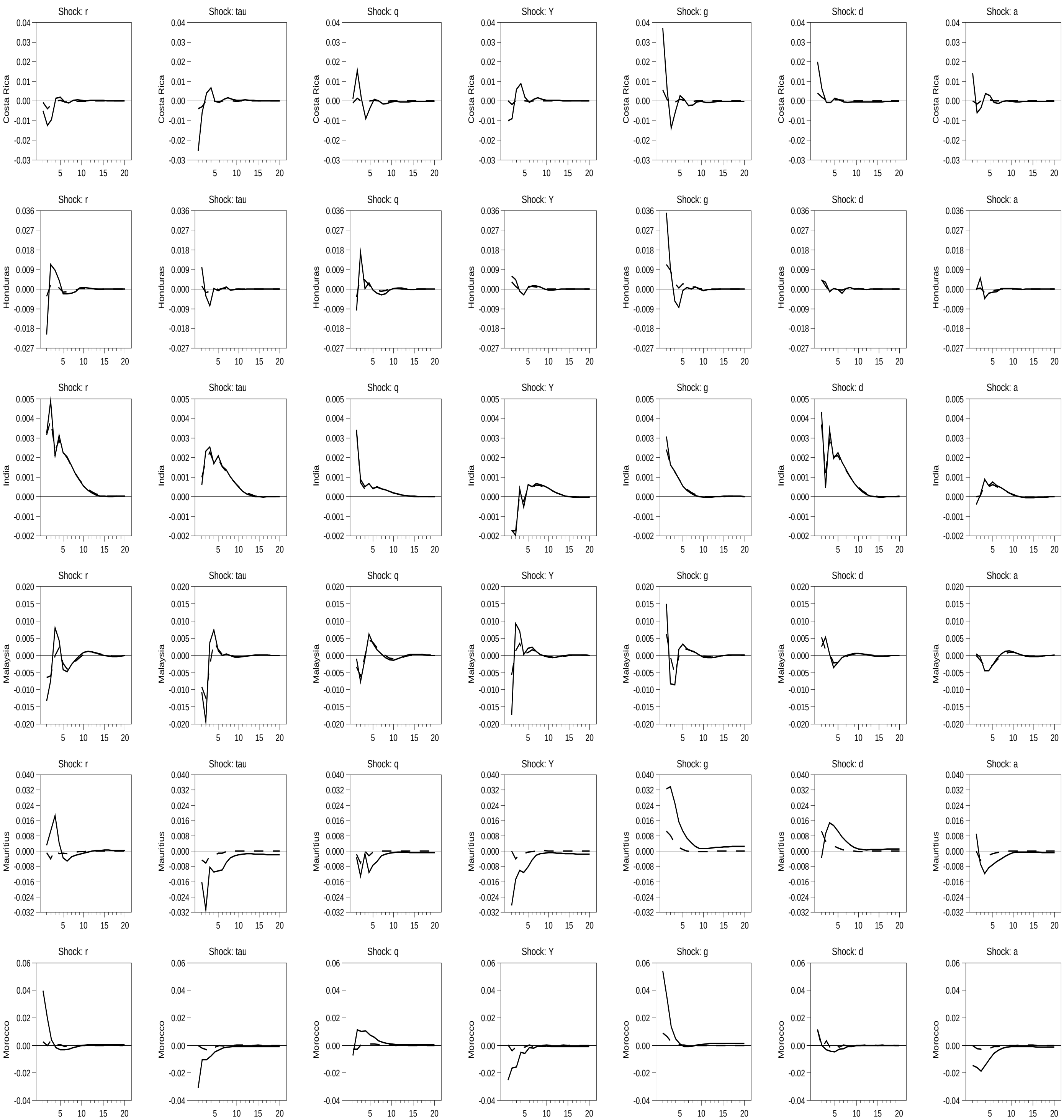
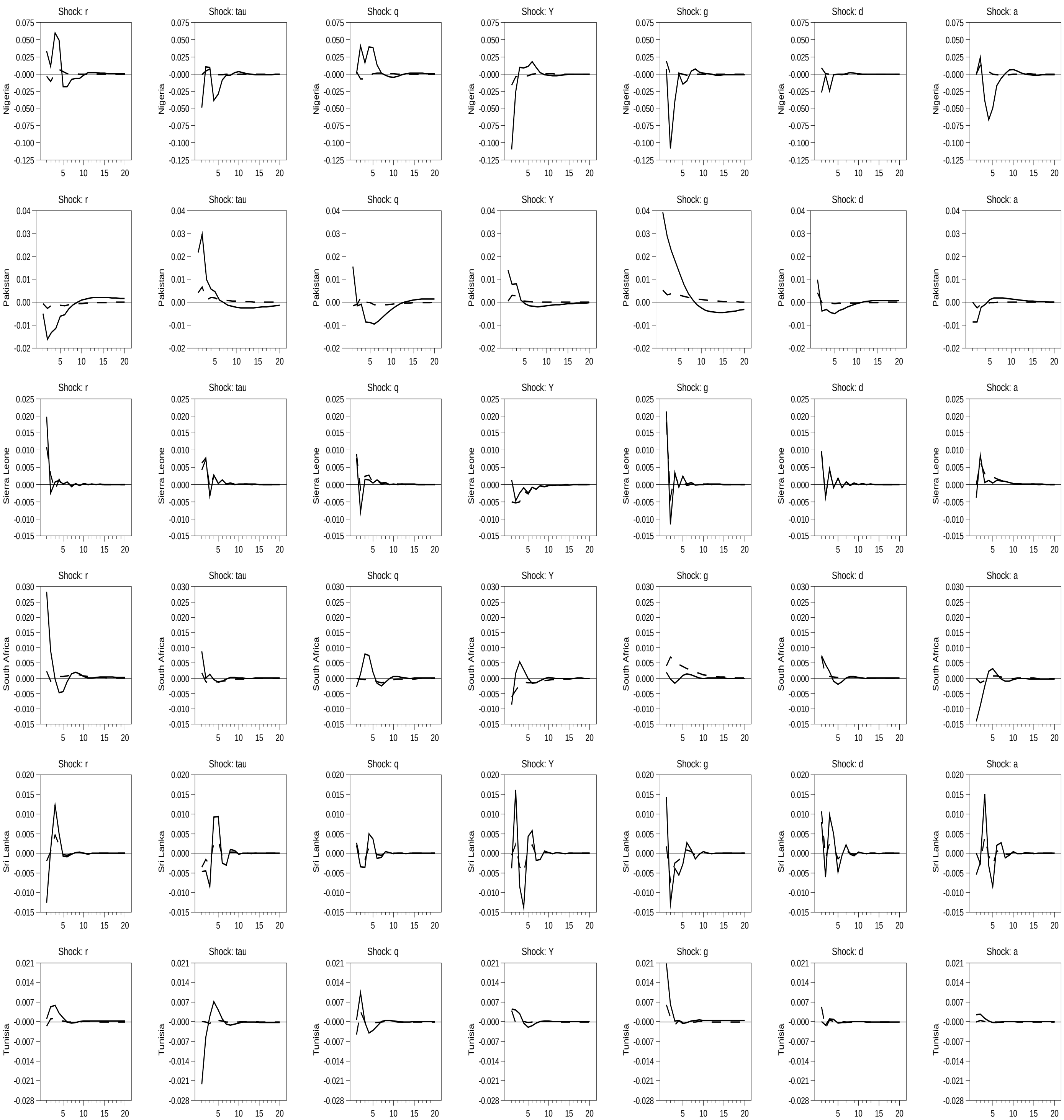


Figure 2 (continued). Results: Dynamic Responses



Note: The solid (dashed) lines correspond to the responses of external deficit (budget deficit).