IMF Working Paper

Intra-Regional Spillovers in South America: Is Brazil Systemic after All?

Gustavo Adler and Sebastián Sosa

INTERNATIONAL MONETARY FUND

IMF Working Paper

Western Hemisphere

Intra-Regional Spillovers in South America: Is Brazil Systemic after All?*

Prepared by Gustavo Adler and Sebastián Sosa

Authorized for distribution by Charles Kramer

June 2012

Abstract

Shocks stemming from Brazil—the large neighbor in South America—have historically been a source of concern for policy-makers in other countries of the region. This paper studies the importance of Brazil's influence on its neighboring economies, documenting trade linkages over the last two decades and quantifying spillover effects in a Vector Auto Regression setting. While trade linkages with Brazil are significant for the Southern Cone countries (Argentina, Bolivia, Chile, Paraguay, and Uruguay), they are very weak for others. Consistent with this evidence, econometric results show that, while the Southern Cone economies (especially Mercosur's members) are vulnerable to output shocks from Brazil, the rest of South America is not. Spillovers can take two different forms: the transmission of Brazil-specific shocks and the amplification of global shocks—through their impact on Brazil's output. Finally, we also find suggestive evidence that depreciations of Brazil's currency may not have significant impact on output of its key trading partners.

Contents   Page

I. INTRODUCTION

Latin America's economic landscape is characterized by the presence of two particularly large countries—Brazil in the south and Mexico in the north—with the potential to affect smaller neighboring economies significantly (Figure 1). Indeed, business cycles of countries in each sub-region have historically been highly correlated with those of the corresponding large neighbor (Table 1), suggesting that economic activity in smaller countries may be driven to a large extent by shocks stemming from these larger economies. Consistent with this view, cross-correlation coefficients suggest that Brazil's and Mexico's cycles either co-move with or lead those of most neighboring countries.

Figure 1. Latin America's Large Neighbors, 2010
(share of region's US$ GDP)
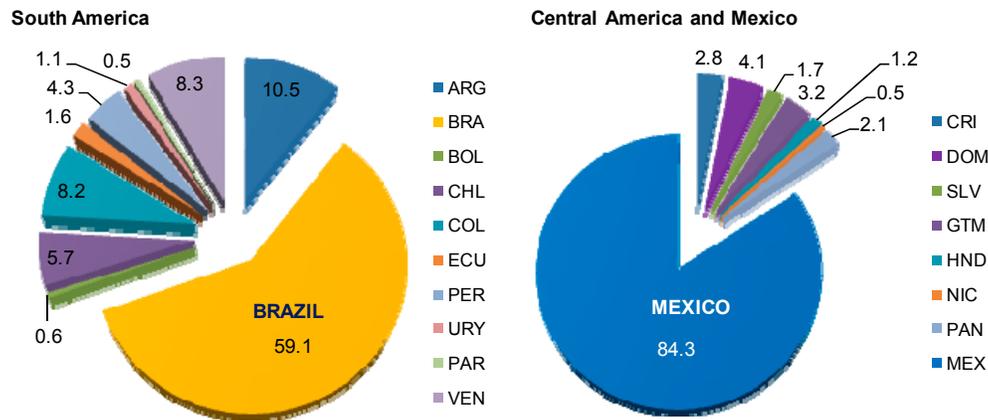
Source: IMF Internation Financial Statistics

These apparent spillovers from the larger economies have often been a source of concern for policy makers and analysts in the region. High correlations, however, could also reflect common global shocks that affect systemic and small economies alike (such as changes in commodity prices,[1] international financial conditions, global demand, or—in Mexico and Central America—U.S. economic conditions) and similar policy responses. Thus, coming to a view on the importance of spillovers from large neighbors requires a multivariate approach that disentangles such effect from the effect of common global factors.

Previous studies have documented the absence of significant spillovers from Mexico to Central American economies,[2] suggesting that the high comovement of economic cycles reflects mainly the role of U.S. factors as a common driver of output fluctuations. At the

---

[1] Commodity dependence is a common feature across Latin America. See Adler and Sosa (2011) for a documentation of this pattern.

[2] Kose, Rebucci, and Schipke (2005) and Swiston (2010) find that the impact of shocks stemming from Mexico on Central American countries is negligible. IMF (2012) documents that Mexico's trade linkages with Central America have been, and remain, very weak.

same time, the literature on intra-regional spillovers in South America—and in particular Brazil's spillovers to other South American countries—is very scant.[3] In fact, to our knowledge no other study has recently examined, in a systematic and unified framework, the extent of Brazil's spillovers to the rest of South America.[4,5] This paper attempts to fill this gap.

As direct financial ties (e.g., cross-border bank lending, portfolio and foreign direct investment links, and remittances) across the region are very limited, we focus on trade linkages. We first document the extent of trade exposures of other South American countries to Brazil, and their evolution in the last two decades. Next, we quantify Brazil's spillovers to its neighboring countries in a Vector Auto Regression (VAR) setting, studying two forms of spillovers: (i) those arising from Brazil-idiosyncratic shocks and (ii) those stemming from the amplification of global shocks (through their impact on Brazil). Finally, we study the role of movements in bilateral exchange rates to shed some light on the potential impact of a sharp depreciation of the Brazilian real on its neighbors.

Table 1. Business Cycle Comovement with Large Neighbors, 1990:Q1–2011:Q4[1]

	Cross-correlation of GDP cycle in period *t* and large neighbor's GDP cycle in period:				
	t-2	*t-1*	*t*	*t+1*	*t+2*
South America (large neighbor: Brazil)					
Argentina[2]	0.37	0.42	**0.43**	0.41	0.36
Bolivia	**0.59**	0.57	0.51	0.38	0.23
Chile	0.58	0.65	**0.65**	0.58	0.48
Colombia	0.59	0.66	**0.69**	0.67	0.62
Ecuador	0.33	**0.35**	0.32	0.24	0.13
Paraguay[2]	0.57	0.72	**0.76**	0.61	0.39
Peru[2]	0.75	0.85	**0.87**	0.75	0.62
Uruguay	0.41	0.44	0.47	**0.48**	0.45
Venezuela[2]	**0.48**	0.47	0.44	0.38	0.32
Central America (large neighbor: Mexico)					
Costa Rica	0.63	**0.65**	0.64	0.58	0.47
Dominican Rep	0.29	0.34	0.37	**0.39**	0.37
El Salvador	**0.40**	0.36	0.28	0.18	0.07
Guatemala[2]	0.58	**0.61**	0.60	0.41	0.16

Source: author's calculations.

[1] Cyclical components of GDP obtained using the Hodrick-Prescott filter. Figures in bold denote the highest correlation for each row.

[2] Sample period begins in 1992 (Argentina), 1993 (Peru, Venezuela), 1994 (Paraguay), and 2001 (Guatemala).

We show that, while trade linkages between the Southern Cone and Brazil are significant, trade between Brazil and the Andean region (Colombia, Ecuador, Peru, and Venezuela) is weak. In fact, econometric estimates confirm that while spillovers from Brazil are significant for its Southern Cone neighbors (particularly for Mercosur members), they are not for Andean countries. These effects operate through the transmission of Brazil-specific shocks, as well as Brazil's amplification of global shocks. We also find evidence suggesting that the impact of sharp movements in the bilateral real exchange rate (resulting from a depreciation of the real) is limited, as the expansionary effects of such shock on Brazil's domestic demand and output seem to largely offset the substitution effect.

The rest of the paper is organized as follows. The next section documents South America's export linkages with Brazil and their evolution over time. Section III quantifies spillover effects from Brazil to its neighbors, using a VAR approach, arising both from idiosyncratic output shocks as well as from the amplification of global shocks. Section IV zooms into the

---

[3] See a survey of the literature in Muhleisen, Roache, and Zettelmeyer (2008).

[4] A few studies, however, have examined the influence of Brazilian factors on a particular country. Sosa (2010), for example, explores spillovers from Argentina and Brazil on the Uruguayan economy.

[5] Spillovers from systemic countries in other emerging market regions—notably China—have also been subject of recent study. See, for example, IMF 2011.

effect of a depreciation of the Brazilian real. Section V concludes with a brief discussion of the main findings.

II. EXPORT LINKAGES WITH BRAZIL

In the past decade, and after years of limited integration during the 1990's, countries in South America experienced a process of increased trade integration with the rest of the world, driven mainly by increased trade with emerging market economies outside the region, and to a lesser extent intra-regional trade (Figure 2). Despite its sheer economic size, trade with Brazil contributed only marginally to the deepening of intra-regional integration (Figure 3).[6] Furthermore, Brazil's share in its neighboring countries' exports, which had doubled from 8 to 16 percent during the 1990s—partly reflecting exchange rate developments— experienced a marked reversal in the early 2000's, falling back to levels seen in the early 1990s and remaining broadly stable thereafter.[7]

The story, however, varies significantly by country within South America (Figure 4). Southern Cone economies (Argentina, Uruguay, Paraguay, Bolivia and—to a lesser extent— Chile) have maintained relatively high export exposure to Brazil, despite some variations in the past two decades. In particular, trade integration with Brazil increased in the 1990s, in part reflecting the creation of Mercosur—a regional trade agreement comprising also Argentina, Paraguay, and Uruguay. However, after peaking in the late 1990s, Brazil's share of regional exports has fallen in most cases (except Bolivia and Argentina) and countries today less exposed to Brazil (in terms of its share in total exports of goods) than 15–20 years ago.[8] Despite these trends, today exports to Brazil represent around 20 (4) percent of total exports (GDP) for Paraguay, Uruguay and Argentina, and more than 40 (9) percent for Bolivia. On the other hand, exports to Brazil from the Andean region (Ecuador, Colombia, Peru, and Venezuela) have historically been, and remain, very limited—representing today less than 3 percent of total exports and ½ percent of GDP.

In addition, increased intra-regional trade could imply that indirect exposures to Brazil (through exposures to other countries in the region that also export to Brazil) may have become significant. To check this, we compute a measure of second order (or indirect) exposure to Brazil for country i as the weighted average of (direct) exposures to Brazil of country i's trading partners, weighted by their share in country i's total exports. Overall

---

[6] The analysis focuses on exports of *goods* from neighboring countries to Brazil, due to data limitations regarding trade in services. For some countries (e.g., Uruguay), the latter may also be relevant, although the overall trends do not change significantly if these are also considered.

[7] Figures A.1 and A.2, in the Appendix, show the evolution of these trends for each individual country.

[8] Bolivia experienced a remarkable increase in trade with Brazil during the past decade, explained almost completely by exports of gas.

exposures to Brazil are only marginally higher when indirect exposures are included (Figure 4).[9]

Weak trade linkages between Brazil for the Andean countries provide a priori evidence that real spillovers from this large neighboring economy are small. However, trade linkages are significant between Brazil and its Southern Cone neighbors, and spillovers may be important. We investigate this question in the next section. The analysis requires controlling for common external factors that may influence economic cycles across the region. Thus, we use a multivariate setting (a VAR approach) to disentangle the spillover effects from Brazil to the rest of the region.

Figure 2. South America: Exports of Goods by Region, 1990–2010[1]

Source: Direction of Trade Statistics; and authors' calculations.
[1] (US$ GDP) weighted average of South American countries, excluding Brazil (as origin).
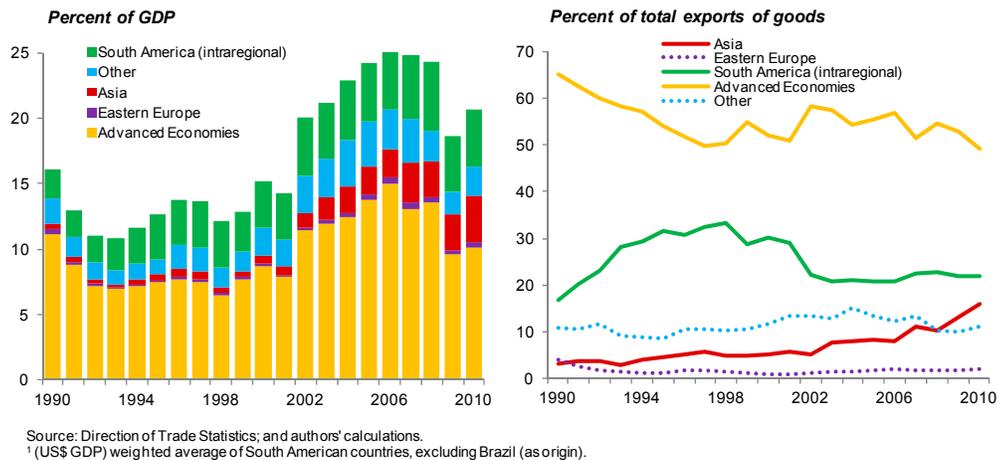
Figure 3. South America: Intra-regional Exports of Goods, 1990–2010[1]

Source: Direction of Trade Statistics; and authors' calculations.
1/ (US$ GDP) weighted average of exports from and to South American countries, excluding Brazil (as origin).
2/ Exports of other South American countries to Brazil.
3/ Exports of other South American countries to South America (excluding Brazil).

---
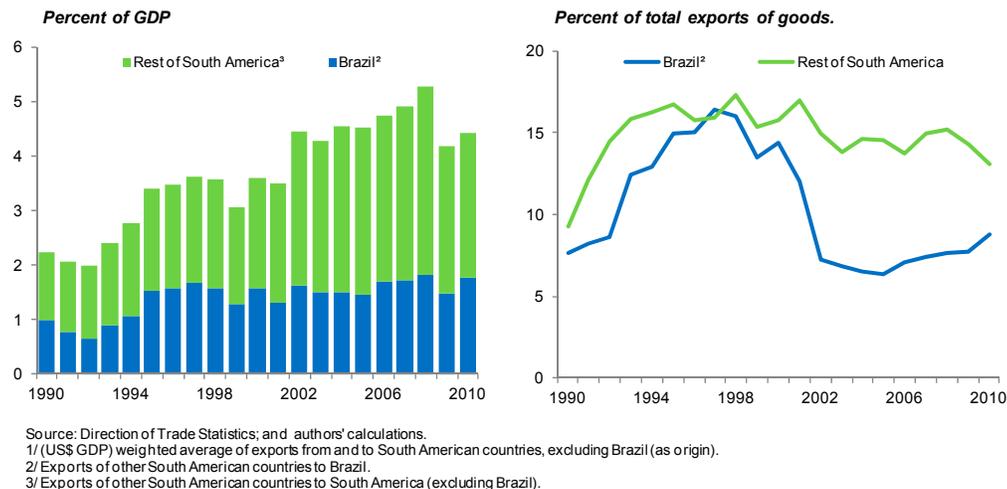
[9] A country's vulnerability to shocks stemming from a trading partner may also depend on the composition of trade flows, in particular whether exports are mainly commodities or manufactured products since the degree of 're-allocability' may be different across these categories.

Figure 4. South America's Exports: Exposure to Brazil, 1990-2010

Source: Direction of Trade Statistics; and authors' calculations.
[1] Direct exposure measures exports to Brazil.
[2] Indirect (second order) exposure is computed as the weighted average of exports to Brazil for all other South American countries, weighted by each of these countries' shares in total exports of the country under consideration.
[3] Maximum exposure during the period 1990–2010, based on three-year average. Corresponding year is reported next to observation.
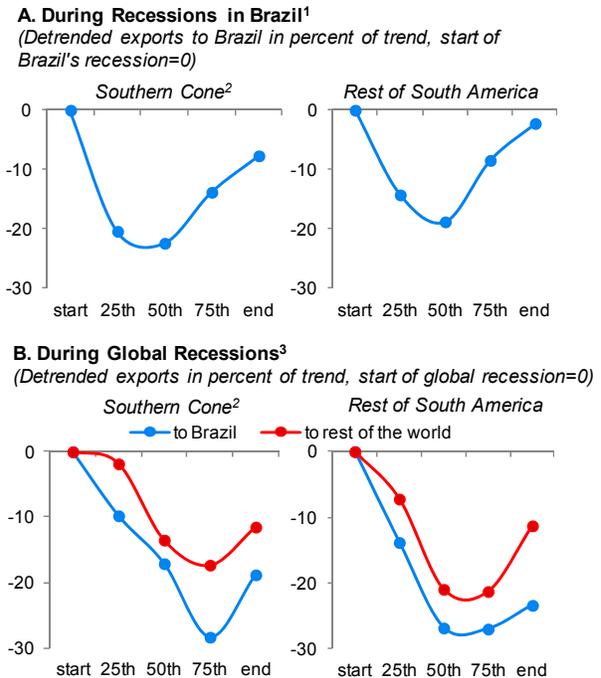
III. HOW IMPORTANT ARE SPILLOVERS FROM BRAZIL? A VAR APPROACH

A close look at exports from South American countries to Brazil provides some insights into how spillovers may operate and, thus, motivates the specific objectives of the econometric exercise. Two patterns are worth highlighting:

- Trade with Brazil is quite sensitive to the economic cycle of the latter, with exports contracting sharply (near an average of 20 percent) during recessions in Brazil (Figure 5-panel A). This suggests that spillovers from Brazil-specific shocks are likely to be important. The sensitivity of exports to Brazil's economic conditions is visible both for Southern Cone countries as well as for the rest— although the overall economic impact is likely to be limited for the latter group, given the small economic importance of such flows (in percent of GDP).

- Interestingly, South America's exports to Brazil appear to suffer significantly also during (exogenous) episodes of *global* recessions, at least for the period of

Figure 5. Export Performance in Brazil's Neighbors, 1990–2011

A. During Recessions in Brazil[1]
(Detrended exports to Brazil in percent of trend, start of Brazil's recession=0)

B. During Global Recessions[3]
(Detrended exports in percent of trend, start of global recession=0)

Sources: Direction of Trade Statistics; and authors' calculations.
[1] A slowdown is defined as a recession if the negative domestic demand gap is at least one standard deviation of the domestic demand cycle (2.2 percent of potential domestic demand). Length of each recession normalized to a 0 (start) –100 (end) scale.
[2] Includes Argentina, Bolivia, Chile, Paraguay, and Uruguay.
[3] Recessions defined as in Adler and Sosa (2011).

analysis (1990–2011), with exports to Brazil contracting even more sharply than those to the rest of world (Figure 5-panel B). This pattern holds for every global recession, and both for Southern Cone and other South American economies, and suggests that, in addition to spillover effects from idiosyncratic Brazilian shocks, Brazil may also play a role in amplifying the effect of global shocks on its neighbors.

In line with this evidence, we estimate country-specific vector auto regressive (VAR) models to quantify the influence of Brazil on other South American economies, focusing on two types of spillovers: those resulting from Brazil-specific shocks, and those arising from the amplification of global shocks, through their impact on Brazil.

The econometric approach allows us to determine the relative importance of Brazil as a source of disturbances affecting neighboring countries, and to identify the responses of output in these economies to shocks to Brazil's output. The use of VAR models also allows us to trace out the indirect impact of changes in other external forces (such as global demand, international financial conditions, and commodity prices) through their feedback on Brazil's output.

The structural model can be expressed—omitting the constant terms for simplicity—as:

$$A(L)y_t = \gamma_t$$

where y_t is an n vector of variables, $A(L)$ denotes a lag polynomial matrix, and γ_t is an n vector of structural disturbances or shocks. A_0, which represents the contemporaneous relationships between the variables of the model, is a non-singular matrix normalized to have ones on the diagonal. The reduced form of the model can be written as:

$$B(L)y_t = u_t$$

where $B(L)$ is a lag polynomial matrix such that $B(L) = (A_0)^{-1}A(L)$ and $B_0 = I$, and u_t is an n vector of mean zero reduced form disturbances with covariance matrix Γ, such that.

$$u_t = (A_0)\text{-}1\gamma_t.$$

The vector y_t includes, for each country-specific VAR, a set of global factors (global demand, international financial conditions, and commodity prices), Brazil's real GDP, and domestic real GDP. The specifications for Bolivia, Chile, Paraguay, and Uruguay also include Argentina's real GDP, because this country may also be a source of spillovers for these relatively smaller economies.[10]

The global variables are measured as follows:

---

[10] We do not formally test whether the shocks are propagated through trade channels, due to lack of data on bilateral exports in real terms. However, given the limited financial linkages, our prior is that trade is the most relevant transmission mechanism. Our results are consistent with this prior.

- Global demand is proxied by a weighted average of real GDP of the Group of Seven countries and China, with weights proportional to their purchasing-power-parity-adjusted GDPs;

- International financial conditions are proxied by the Chicago Board Options Exchange Market Volatility Index (VIX);[11] and

- Commodity prices are measured by a broad price index, in real terms and stripped of exchange rate effects (as in Adler and Sosa, 2011).[12]

The model is estimated using quarterly data from 1990:Q1 through 2011:Q4. All the variables are expressed in log levels, and the model is estimated in first differences (except the VIX, which is expressed in levels), using two lags.[13] The data sources are primarily the IMF's *International Financial Statistics* (IFS) and *World Economic Outlook* (WEO), and Haver Analytics.

To identify the structural parameters of the model, a set of restrictions must be specified. Following Sims (1980), the reduced form errors are orthogonalized by standard Choleski decomposition. This identification strategy assumes that the correlation of errors across equations is assigned to the equation that appears first in the ordering. Hence, the selected Choleski ordering–characterized by the idea that the more exogenous variables of the model precede the endogenous ones—is as follows: first, the global variables (global output, the VIX, and commodity prices); second, the regional variables (Brazil's and Argentina's output); and finally domestic output.[14]

A. Impact of Brazil-Idiosyncratic Shocks

The econometric results provide some interesting insights, confirming that countries with economically significant export linkages with Brazil (Southern Cone, and especially Mercosur countries) are subject to spillovers from the large neighboring economy, but countries with limited trade linkages (Andean region) are not. The only exception within the latter group is Peru.

---

[11] Previous studies on external factors driving economic cycles in Latin America had focused on the EMBI. Since we are looking for a pure exogenous global financial variable, any EMBI measure would need to exclude Latin America's EMBI. More importantly, data on the EMBI is available starting only in the mid-1990s, so using such measure would imply losing a significant number of observations.

[12] The use of a broad commodity price index, as opposed to country specific commodity price indices, allows to gauge the indirect impact of commodity price shocks through the *knock-on* effect on Brazil's output, and also to preserve degrees of freedom in the estimation.

[13] Standard unit root tests (augmented Dickey-Fuller) show that all the variables are stationary in first differences (except the VIX, which is stationary in levels). In addition, most co-integration tests suggest that the variables in the model are not co-integrated (i.e., the null hypothesis of no co-integration cannot be rejected). Hence, it is adequate to estimate the model in first differences. The number of lags is based on the Akaike Information Criterion (AIC), which suggested two lags in most cases, and one in the rest.

[14] Results are robust to different orderings within the group of global variables.

Even after controlling for common global factors, Brazil-specific output shocks have a significant impact on its Southern Cone partners (Figure 6), with the impact being stronger in the members of Mercosur.

Figure 6. Output Response to a Shock to Brazil's Output[1]
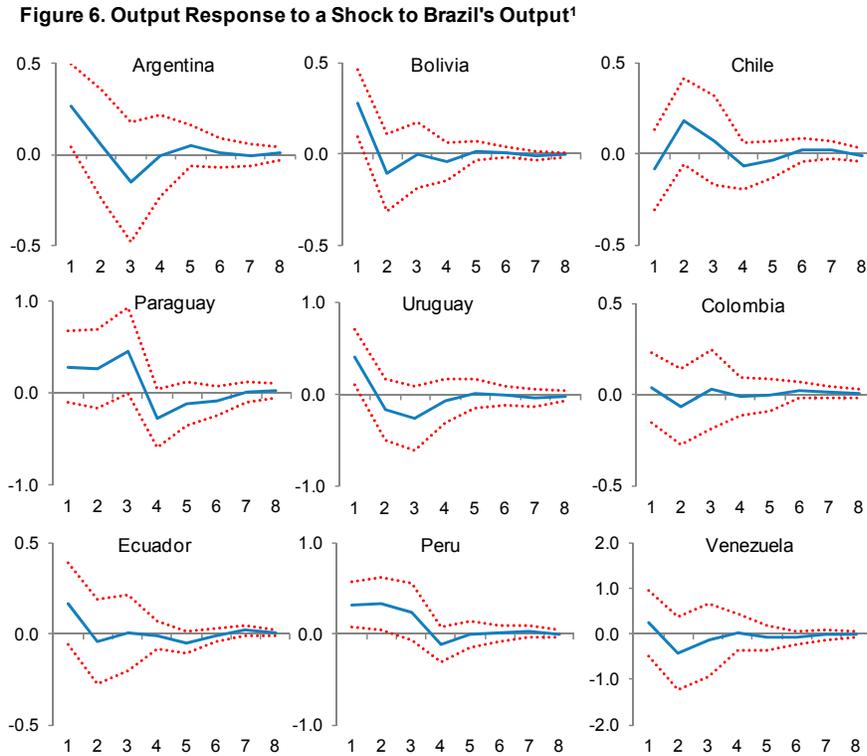
Source: authors' calculations.
[1] Response to one standard deviation (positive) shock to Brazil's GDP growth rate (1.2–1.7 percentage points) ± 1.5 standard errors. Time horizon in quarters.

Those shocks are transmitted fairly quickly—with most of the impact taking place within the same quarter (except in Chile, where the effects are small and transmitted with a one-quarter lag).[15] The impact on growth is typically short-lived (except in Paraguay, where the effects last for three quarters), consistent with the fact that these are temporary (one-quarter) shocks to Brazil's output. In contrast, the impact of idiosyncratic shocks to Brazil's output to domestic output is generally not significant across the Andean region, except in Peru.[16]

To gauge the economic significance of the impact of Brazil-specific output shocks, a set of elasticities can be derived from the impulse responses, evaluating the output responses at their peak as well as at an 8-quarter horizon for the Southern Cone countries.

---

[15] Results for Bolivia should be interpreted with caution, because its exposure to Brazil changed markedly over the period (Figure 3), and trade linkages mostly reflect gas exports, which are governed by long-term contracts, with minimum volumes.

[16] The result for Peru is puzzling, given the lack of direct (trade or financial) linkages with Brazil, and may reflect the existence of other common factor driving cycles in both countries, not captured by the model.

The peak cumulative impact is particularly strong in Paraguay, where a 1 percentage point decrease in Brazil's growth reduces output by 0.9 percent (Table 2). The effect is markedly smaller, albeit still significant, in Argentina, Bolivia, and Uruguay (with peak cumulative impact of about ¼ percent), and even lower in Chile. In general, the cumulative impact reaches its peak within 1–2 quarters, after which these economies are able to adjust to the shock, at least partially, as suggested by the fact that the cumulative effect fades after reaching that peak and is considerably smaller at an 8-quarter horizon. Such reversion is particularly marked in the case of Uruguay, where the impact fully vanishes over this time frame.

Table 2. Cumulative Impact on Output (Percent)

	One standard deviation shock to:						
	Brazil's GDP[1]			VIX[2]			
				Peak effect		At eight quarters	
Country	Peak effect	At 8 quarters	Output loss[3]	Total impact	Of which: Brazil's spillovers	Total impact	Of which: Brazil's spillovers
Argentina	0.32	0.22	1.8	-1.45	-0.26	-1.45	-0.22
Bolivia	0.28	0.13	1.3	-0.39	-0.12	-0.39	-0.10
Chile	0.16	0.10	0.6	-1.44	-0.17	-1.44	-0.12
Paraguay	1.00	0.55	4.8	-0.88	-0.24	-0.49	-0.04
Uruguay	0.40	-0.15	0.1	-0.96	-0.28	-0.96	-0.25
Southern Cone	0.43	0.17	1.7	-1.02	-0.21	-0.94	-0.14
Colombia	0.04	0.03	0.1	-0.99	-0.05	-0.99	-0.03
Ecuador	0.17	0.08	0.8	-0.33	-0.13	-0.28	-0.08
Peru	0.90	0.79	5.8	-1.11	-0.40	-1.11	-0.34
Venezuela	0.23	-0.51	-2.5	-2.35	-0.05	-2.35	0.11
Andean Region[4]	0.14	-0.13	-0.5	-1.22	-0.08	-1.20	0.00

Source: authors' calculations.

[1] Equivalent to 1.2–1.6 percentage points of Brazil's quarterly GDP growth.
[2] Equivalent to 4.6–4.8 units.
[3] Percent of quarterly GDP.
[4] Excluding Peru.

While not being the main focus of the paper, Appendix Figures A.3 to A.6 present the dynamic response of domestic output across the region to shocks to foreign variables in the model, to check the consistency of the model. Impulse responses display the expected dynamics. A positive shock to global output is expansionary in all countries. Domestic business cycles appear to be especially vulnerable to changes in international financial conditions, with a shock to the VIX having a significant impact on output in most countries (except in the less financially-integrated economies, such as Bolivia and Ecuador). A positive shock to commodity prices, in turn, is generally expansionary across South America. Finally, output in Southern Cone economies, particularly in Uruguay, is also affected by shocks to output in Argentina.

B. Amplification of Global Shocks

Spillovers from Brazil to the region are not limited to the impact of idiosyncratic Brazilian shocks. The large regional neighbor also plays a role as a channel of transmission of global shocks. This is especially relevant in the current juncture, given the downside risks to the global outlook. To detect possible spillovers from Brazil's amplification of global shocks, we follow the approach proposed by Bayoumi and Swiston (2008). The methodology requires estimating a second set of VARs that include Brazil's output as an exogenous variable. In

that specification, the estimated output response to a global shock would capture only that shock's direct impact (not the indirect effects through Brazil). Thus, Brazil's amplification effect can be gauged by the difference between the responses to the global shock in the two models, as follows:

$$B_t = r_t - r^B_t$$

where r_t is the response of domestic output in period t from the original model and r^B_t is the response from the modified specification where Brazil is included as exogenous. This amplification effect encompasses (1) the sensitivity of Brazil's output to global shocks and (2) the effect of that output response in Brazil on its neighboring country.

The results suggest that Brazil indeed amplifies global shocks, particularly financial ones, in most Southern Cone countries. While an adverse financial shock (measured by an increase in the VIX) tends to have a negative impact on output in these countries, a significant fraction of this effect may be attributed to its indirect effect—through its impact on Brazil's GDP (Figure 7).[17] More specifically, according to the estimations, a 10 unit increase in the VIX would lead to a cumulative output decline (at the peak) due to the Brazilian "knock-on" effect, of 0.5–0.6 percent in Argentina, Paraguay, and Uruguay (Table 2). The impact is smaller in Bolivia and Chile (0.3–0.4 percent). Finally, spillovers from Brazil's amplification of global shocks are not statistically significant for the Andean countries (with the exception of Peru, as noted above). This mainly reflects that, even though Brazil's output is sensitive to VIX shocks, changes in Brazil's GDP tend to have a small impact on these countries' GDP.

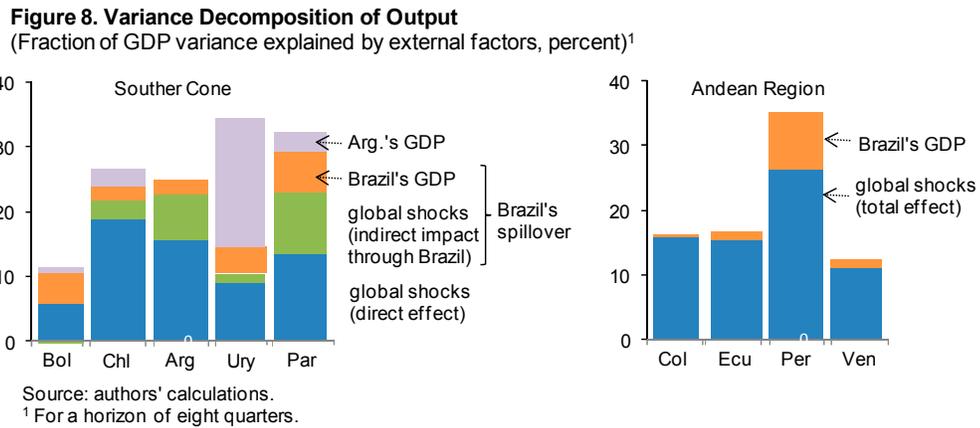**Figure 7. Output Response to a VIX Shock: Brazil's Amplifying Role[1]**
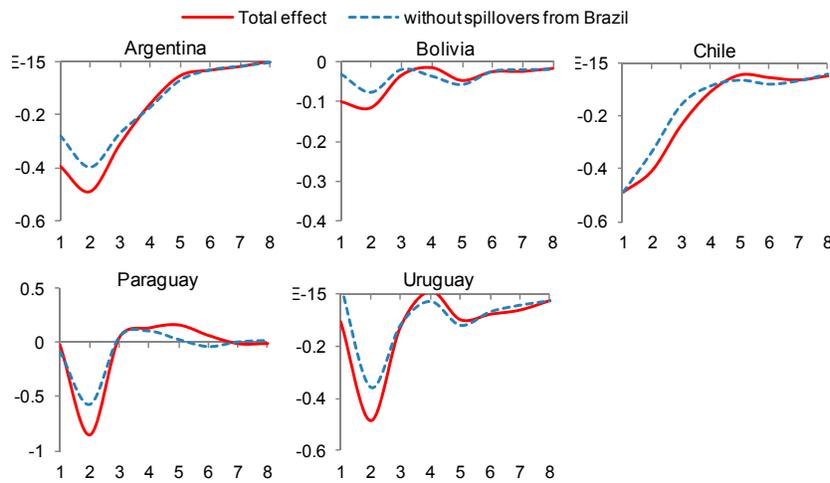
Source: authors' calculations.
[1] Response to one standard deviation shock to the VIX (4.6–4.8 units). Time horizon in quarters.

---

[17] Results also point to amplification effects of other global shocks (global demand and commodity prices).

C. Variance Decomposition Analysis

Spillovers from Brazil on Southern Cone countries are also evident from a simple variance decomposition analysis (Figure 8). They account for a large fraction of GDP variance in Paraguay (16 percent) and Argentina (10 percent) at standard horizons.[18] In Uruguay, spillovers also are non-negligible (6 percent), but they play a much more limited role than spillovers from Argentina (20 percent). In Bolivia and Chile, in turn, Brazil's spillovers explain about 5 percent of output fluctuations. Finally, and consistent with the findings discussed above, the share of the variance of GDP in the Andean region explained by Brazil's spillovers is negligible—except in Peru.

Figure 8. Variance Decomposition of Output
(Fraction of GDP variance explained by external factors, percent)[1]

Source: authors' calculations.
[1] For a horizon of eight quarters.

IV. THE IMPACT OF BRAZILIAN REAL DEPRECIATIONS

Policymakers—and private analysts—in the region, particularly in the Southern Cone, have often expressed concern about the potential impact of a large depreciation of the Brazilian real on their economies, especially in countries with limited exchange rate flexibility. Such concerns hinge on the effect that a pronounced movement of the bilateral real exchange rate could have on exports to Brazil.

The sharp real depreciation of the Brazilian real in January 1999 provides a clear example that permits an assessment of the impact of such events on Brazil's trading partners. The performance of exports to Brazil suggests that those events may not have a significant impact on its neighbors, as exports to Brazil collapsed mostly before the depreciation and either stabilized or recovered afterward (Figure 9 and Figure A.7 in the Appendix). This response may reflect expansionary effects on output and domestic demand in Brazil that are stronger than the substitution effect arising from movements in the bilateral exchange rate. This pattern holds even for trading partners that were unable to adjust their exchange rates in response to Brazil's depreciation, implying sharp movements in bilateral real exchange rates. For a country with a flexible exchange rate regime—which can adjust to the depreciation of

---

[18] The analysis focuses on a horizon of 8 quarters.

the real with respect to the U.S. dollar, thus maintaining an unchanged bilateral exchange rate—a depreciation of the real would be unequivocally beneficial because only the expansionary effect would operate.

To test whether this stylized fact holds after controlling for the effect of other (common) factors, we run a slightly different specification of the VAR presented in Section III.A, incorporating the real effective exchange rates of both Brazil and the smaller neighbor. The estimated impulse responses show that a real effective exchange rate shock in Brazil does not have statistically significant effects on output in the smaller

Figure 9. Real Exchange Rate Depreciation in Brazil: Export Performance in Southern Cone Neighbors
(Exports in US$, August 1998=100)[1]
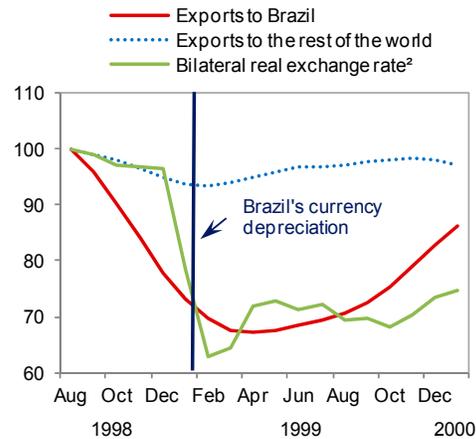
Sources: Direction of Trade Statistics; and authors' calculations.
[1] Simple average of Argentina, Chile, Paraguay, and Uruguay.
[2] A decline reflects a real depreciation of the Brazilian *real* with respect to the other countries' currencies.

neighboring economies (Figure 10). These responses suggest that the expansionary impact of a real depreciation of Brazil's real on output in Brazil appears to at least compensate any negative substitution effect in most Southern Cone economies.[19] The case of Argentina is particularly interesting, since depreciations of the real led, on average, to appreciations of Argentina's real effective exchange rate (reflecting, in part, the long period of currency board) but there is no evidence of a negative effect on Argentina's output, despite the fact that exports to Brazil have represented, on average, about 4 percent of GDP.

---

[19] In Uruguay, even though a depreciation of Brazil's *real* did not lead to a (statistically significant) change in the real effective exchange rate—suggesting that Uruguay tended to adjust its exchange rate in response to this shock—domestic output declined on impact, and the effect was statistically significant. This result likely reflects the average contractionary effects of a depreciation in Uruguay, given the high degree of liability dollarization and associated currency mismatches displayed during the early part of the period of analysis.

Figure 10. Responses to a Shock to Brazil's Real Exchange Rate[1]
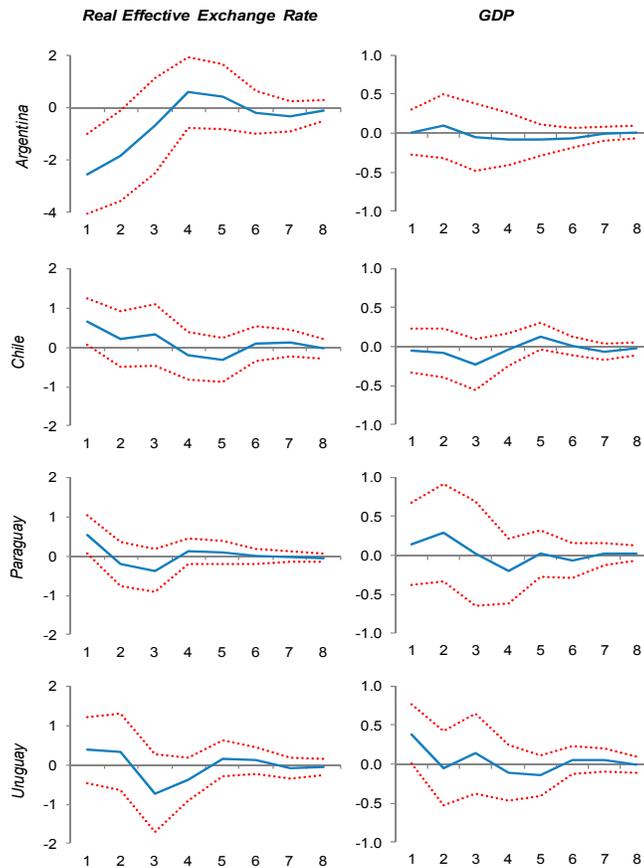
Source: authors' calculations.
1/ Responses to one standard deviation shock to Brazil's real exchange rate ± 1.5 standard errors.

V. CONCLUSIONS

Despite its economic size, the importance of Brazil as a source of potential shocks for smaller neighboring economies is uneven across the region. Southern Cone countries (Argentina, Bolivia, Chile, Paraguay, and Uruguay) have sizeable export linkages with and are subject to spillovers from this large economy. Econometric estimates confirm that output in these countries (especially Mercosur members) is affected by both output shocks stemming from Brazil and by Brazil's amplification of global shocks. For other South American economies (the Andean region), however, spillovers from Brazil are—in general—not economically meaningful. This result is consistent with the weak trade linkages with Brazil, suggesting that the strong business cycle synchronization mainly reflects the effect of common shocks rather than spillovers from the latter.

Finally, we find no evidence of a significant impact on output in Southern Cone countries from a sharp depreciation of Brazil's *real*, suggesting that the expansionary impact of the depreciation on Brazil's output may largely (or fully) offset any substitution effects associated with an appreciation of the bilateral real exchange rate vis-à-vis Brazil.
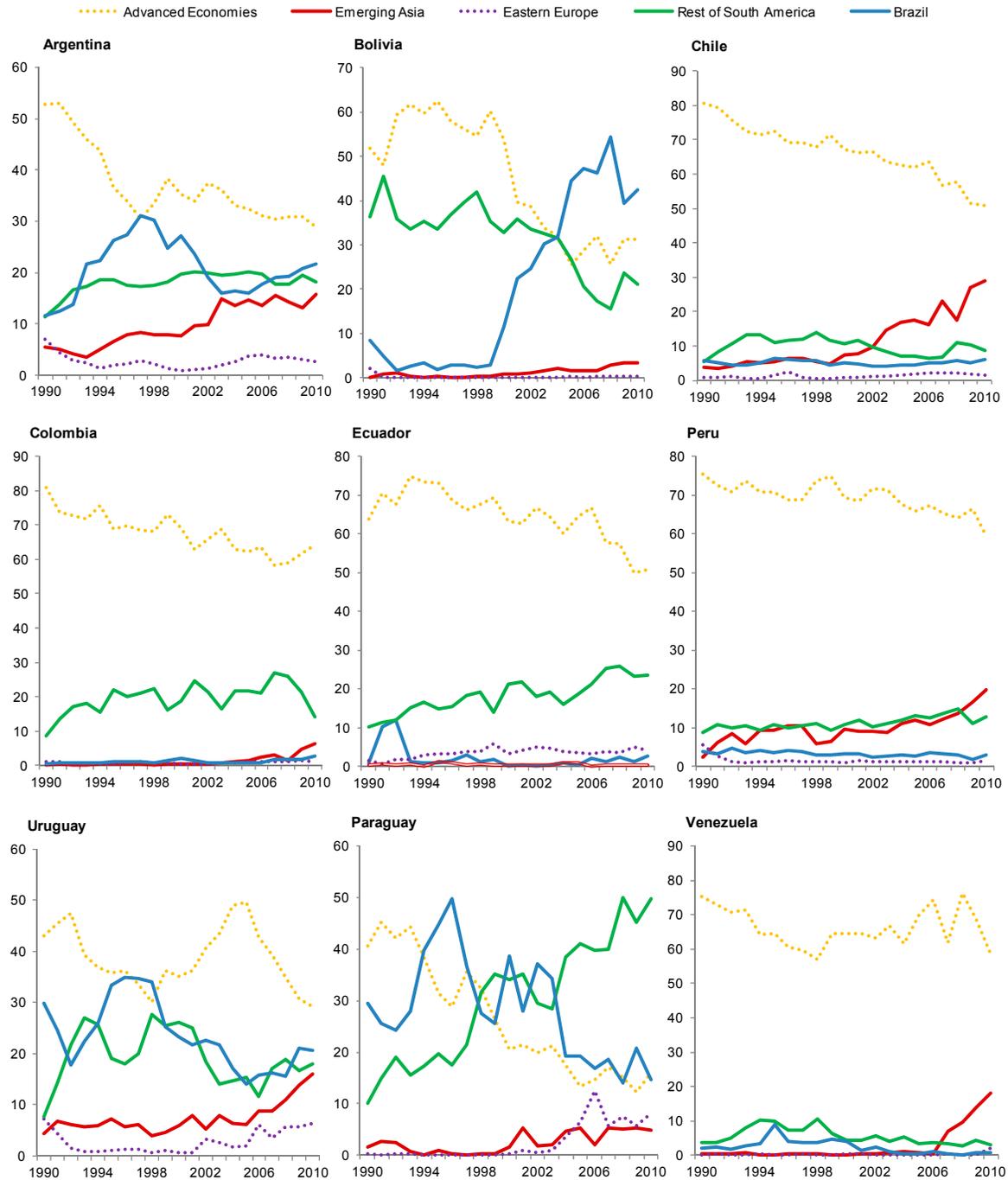
APPENDIX

Figure A1. South America: Exports of Goods by Region, 1990–2010[1]
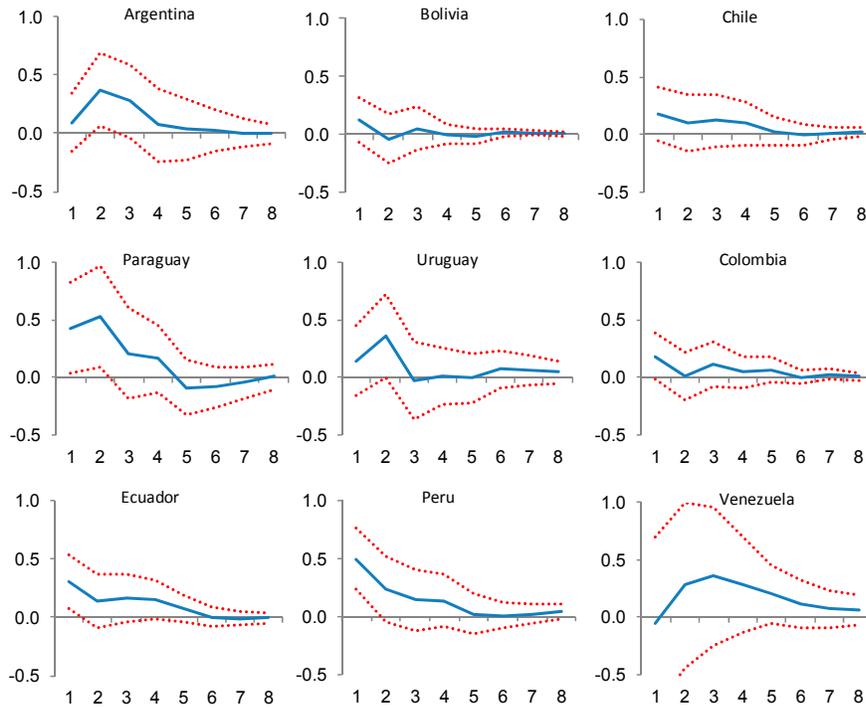*(Percent of GDP)*
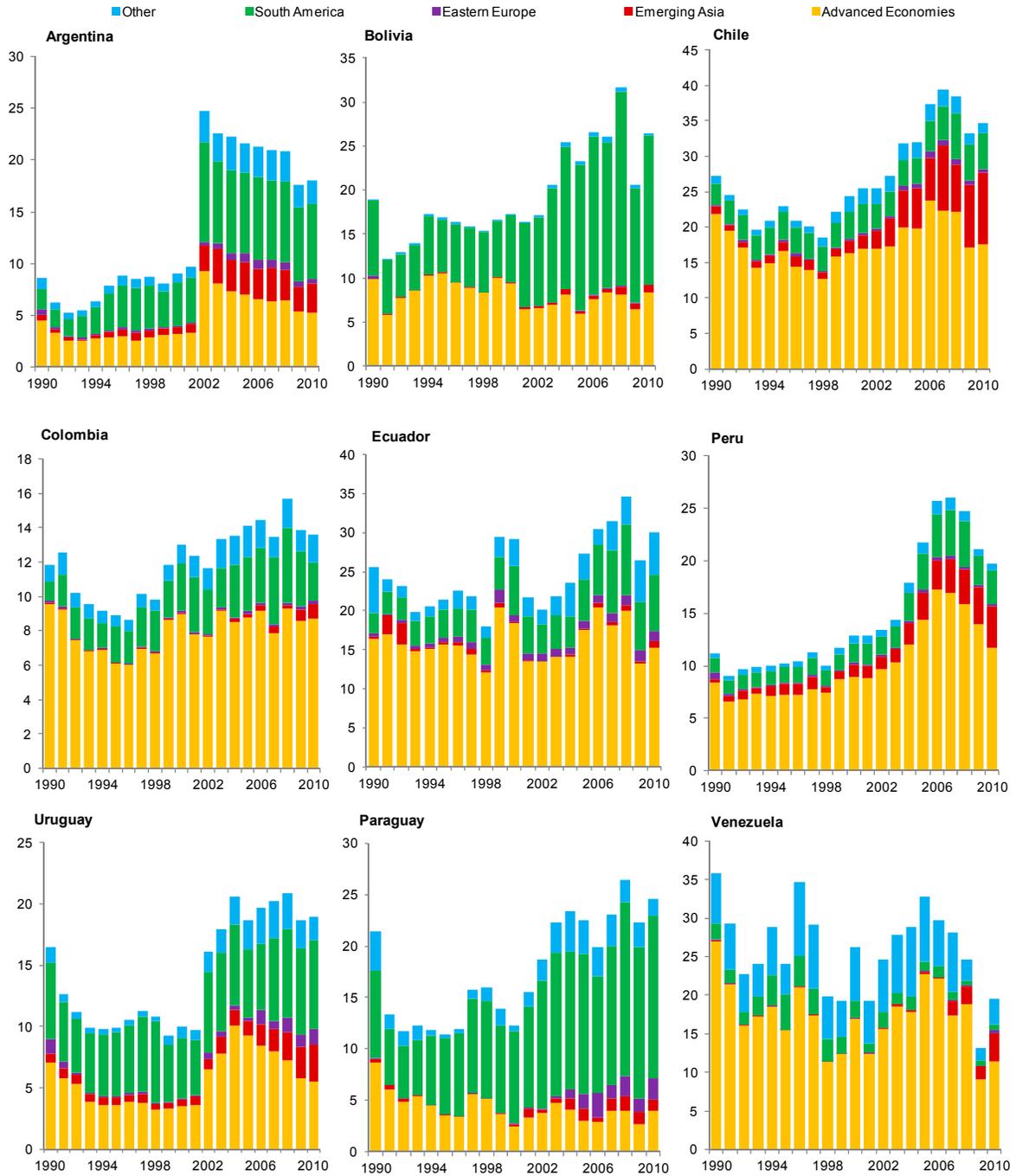
Sources: Direction of Trade Statistics; and authors' calculations.

Figure A2. South America: Exports of Goods by Region, 1990–2010[1]
*(Percent of total exports of goods)*

Sources: Direction of Trade Statistics; and authors' calculations.

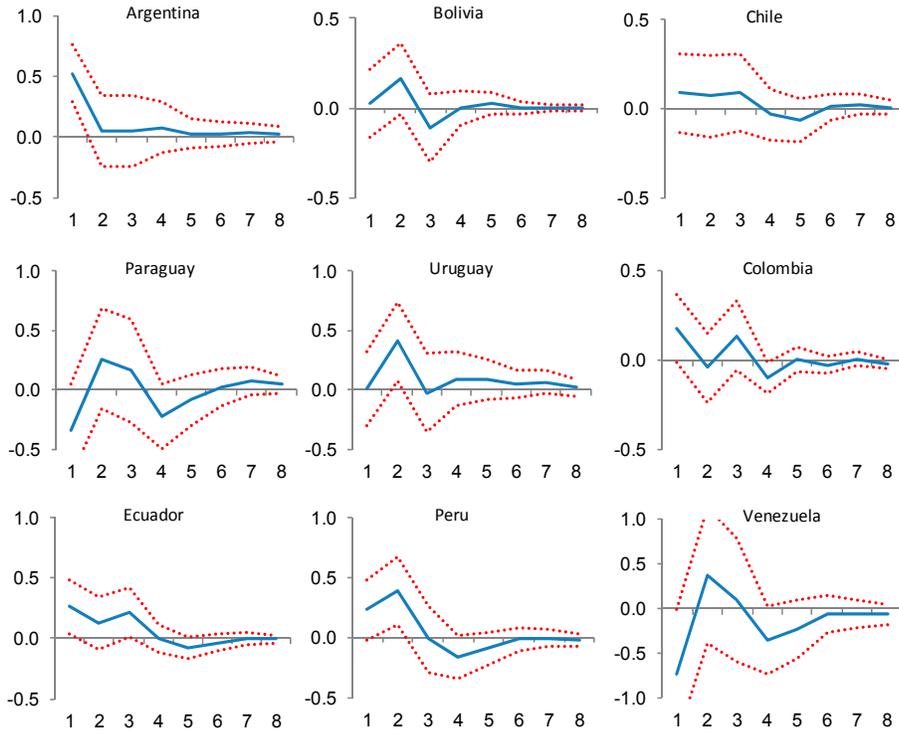**Figure A.3. Output Response to a Shock to Global Output[1]**

Source: authors' calculations.
1/ Response to one standard deviation shock to global GDP growth rate (0.4 percentage points) ± 1.5 standard errors. Time horizon in quarters.
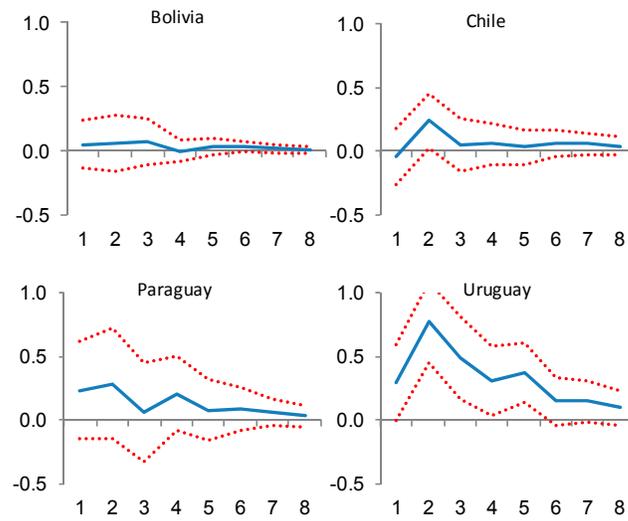
Figure A.4. Output Response to a Shock to the VIX[1]
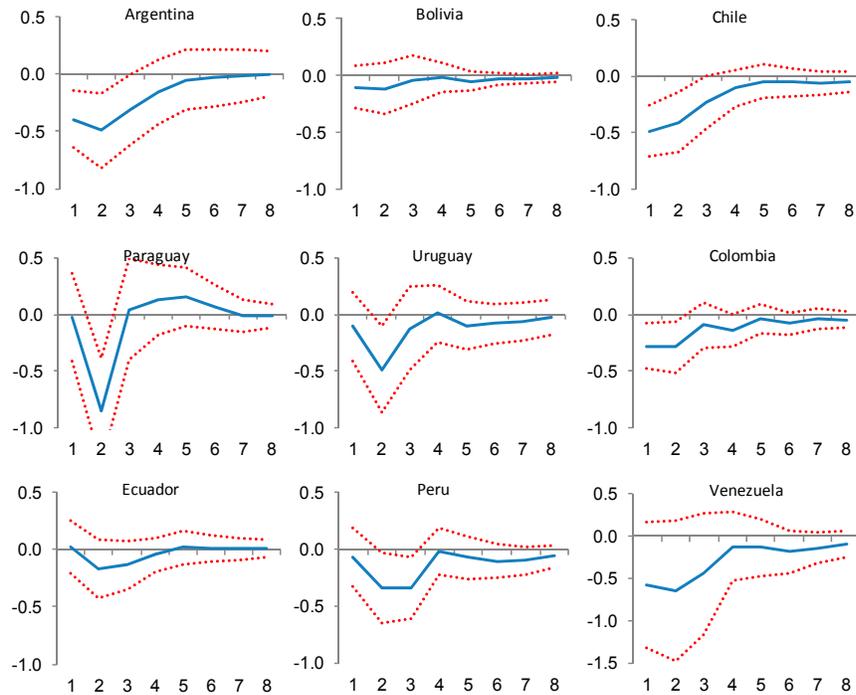
Source: authors' calculations.
1/ Response to one standard deviation shock to the VIX (4.6–4.9 units) ± 1.5 standard errors. Time horizon in quarters.

**Figure A.5. Output Response to a Shock to Commodity Prices[1]**

Source: authors' calculations.
1/ Response to one standard deviation shock to commodity prices (5.1–5.5 percentage points) ± 1.5 standard errors. Time horizon in quarters.

Figure A.6. Output Response to a Shock to Argentina's Output[1]

Source: authors' calculations.
1/ Response to one standard deviation shock to Argentina's GDP (1.3–1.6 percentage points) ± 1.5 standard errors. Time horizon in quarters.

Figure A.7. Real Exchange Rate Depreciation in Brazil: Export Performance in Southern Cone Neighbors
(Exports in US$, August 1998=100)
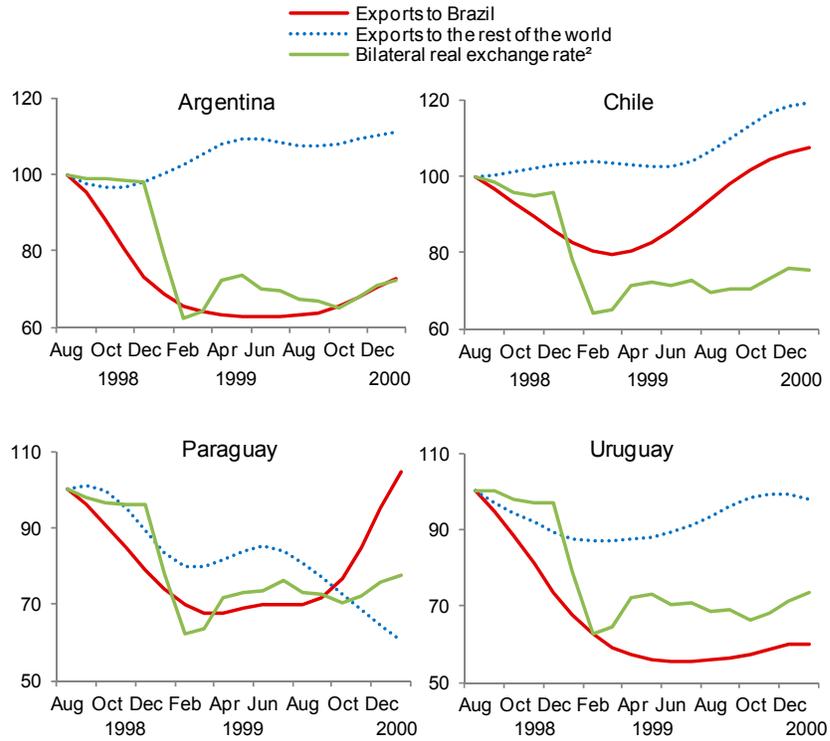
Sources: Direction of Trade Statistics; and authors' calculations.
[1] A decline reflects a real depreciation of the Brazilian *real* with respect to the other countries' currencies.

References

Adler, G. and S. Sosa, 2011, *"Commodity Price Cycles: The Perils of Mismanaging the Boom,"* IMF Working Paper 11/283 (Washington: International Monetary Fund).

Bayoumi, T. and A. Swiston, 2008, *"Spillovers Across NAFTA,"* IMF Working Paper 08/3 (Washington: International Monetary Fund).

International Monetary Fund, 2008, *"Who's Driving Whom? Analyzing External and Intra-Regional Linkages in the Americas,"* ed. by M. Mühleisen, S. Roache, and J. Zettelmeyer (Washington).

_____, 2011, *"People's Republic of China, 2011 Spillover Report—Selected Issues,"* (Washington, June)

_____, 2012, *Regional Economic Outlook: Western Hemisphere* (Washington, April).

Kose, M., A. Rebucci, and A. Schipke, 2005, *"Macroeconomic Implications of CAFTA-DR,"* in *Central America: Global Integration and Regional Cooperation*, ed. by M. Rodlauer and A. Schipke (Washington: International Monetary Fund).

Sosa, S., 2010, *"The Influence of 'Big Brothers:' How Important are Regional Factors for Uruguay?,"* IMF Working Paper 10/60 (Washington: International Monetary Fund).

Swiston, A., 2010, *"Spillovers to Central America in Light of the Crisis: What a Difference a Year Makes,"* IMF Working Paper 10/35 (Washington: International Monetary Fund).