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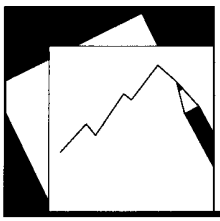

# IMF Working Paper

# The Dynamic Effects of Commodity Prices on Fiscal Performance in Latin America

*Leandro Medina*

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**IMF Working Paper**

Western Hemisphere Department

# The Dynamic Effects of Commodity Prices on Fiscal Performance in Latin America

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## Abstract

The recent boom and bust in commodity prices has raised concerns about the impact of volatile commodity prices on Latin American countries' fiscal positions. Using a novel quarterly data set—which includes unique country-specific commodity price indices and a comprehensive measure of public expenditures—this paper analyzes the dynamic effects of commodity price fluctuations on fiscal revenues and expenditures for eight commodity-exporting Latin American countries. The results indicate that Latin American countries' fiscal positions react strongly to shocks to commodity prices, yet there are marked differences across countries. Fiscal variables in Venezuela display the highest sensitivity to commodity price shocks, with expenditures reacting significantly more than revenues. At the other end of the spectrum, in Chile expenditure reacts very little to commodity price fluctuations, and the dynamic responses of its fiscal indicators are very similar to those seen in high-income commodity-exporting countries. This distinct behavior across countries may relate to institutional arrangements, which in some cases include the efficient application of fiscal rules amid political commitment and high standards of transparency.



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Contents Page

I. Introduction ....3

II. Commodity Prices And Their Dynamic Impact On Fiscal Positions: Methodology ....5
A. Vector Autoregression Approach ....5
B. Data ....6

III. Results ....8
A. The dynamic responses of fiscal variables to commodity price shocks ....8
B. Looking at fiscal rules ....10

IV. Conclusion ....11

References ....12

Appendix 1. Data ....14

Tables
1. The Importance of Commodity Exports ....15
2. Composition of Country-Specific Commodity Price Indices ....16
3. Commodity Price Shocks as a Source of Fluctuations in Primary Expenditures ....17
4. Sample Period by Country ....18
5. Responses to Commodity Price Shocks ....19

Figures
1. Country-Specific Commodity Price Indices ....20
2. Commodity-Related Fiscal Revenues ....21
3. Contribution of Commodity Price Shocks to the Variance of Primary Expenditure Growth ....22
4. Response of Commodity Prices to One Standard Cholesky Innovation in ....23
5. Accumulated Response of Commodity Prices to One Standard Cholesky ....24
6. Accumulated Response of Primary Expenditures to One Standard Cholesky ....25
7. Accumulated Response of Total Revenues to One Standard Cholesky ....26
8. Accumulated Response of GDP to Commodity Price One Standard Cholesky ....27

## I. INTRODUCTION

The recent boom and bust in commodity prices has raised concerns about the impact of these prices on Latin American countries' fiscal positions. From 2004 to almost the end of 2008, rising commodity prices boosted government revenues, and likely spurred foreign direct investment and overall economic activity in many countries in Latin America (LA). While some governments in the region saved a large proportion of buoyant revenues and accumulated financial assets, others used revenue windfalls to fuel growing government spending. Subsequently, the plunge in commodity prices and global trade since late 2008 affected net commodity-producing countries (Figure 1), putting pressure on government finances in many countries in the region.

Episodes of booms and busts in commodity prices generate volatility in the fiscal revenues of emerging commodity-exporting countries (Figure 2). Some governments, perhaps assuming that a boom in prices will be permanent, increase expenditures more than proportionally.[2] Once government expenditures rise (and when the effects of the boom have faded), it may be very difficult to lower them, as described in Boccara (1994). Since this kind of behavior has been pervasive in the region, it is important to explore its causes and consequences.

The literature typically has focused on documenting the reaction of fiscal positions to the output cycle rather than directly at commodity price cycles; i.e., only indirectly linking commodity price fluctuations with fiscal outcomes, looking at the impact of commodity prices only through their possible effect on gross domestic product (GDP). For instance, Gavin and Perotti (1997) identify fiscal policy in LA as procyclical, particularly in periods of low growth. Talvi and Végh (2005) generalize this claim to all developing countries. Kaminsky, Reinhart, and Végh (2005) not only find evidence of procyclicality of fiscal policy, capital flows, and monetary policy in developing countries, particularly in middle-high-income countries, but also analyze which indicators are appropriate for measuring the procyclical behavior. Ilzetzki and Végh (2008) discover evidence that fiscal policy in developing countries is procyclical and expansionary as well. By way of explanation, the literature has attributed this procyclical behavior to international credit constraints and political distortions,[3] but it has not focused on the direct impact of external commodity price shocks on fiscal positions. This omission can be a serious one for some commodity-exporting countries, in which the volatility of total fiscal revenue comes mainly from commodity price movements rather than the output cycle.

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[2] See Di Bella, Kamil, and Medina (2009).

[3] On the international credit constraint literature, see Gavin and Perotti (1997), Riascos and Végh (2003), and Caballero and Krishnamurthy (2004). With respect to the literature on political distortions, see Tornell and Lane (1999), Talvi and Végh (2005), Alesina and Tabellini (2005), and Ilzetzki (2008).

To quantitatively characterize the cyclicality of fiscal policy, several measures have been employed. Ilzetzki and Végh (2008) use government consumption (from the national accounts), and Kaminsky, Reinhart, and Végh (2005) utilize government spending, while Gavin and Perotti (1997) and Alesina and Tabellini (2005) exploit the fiscal deficit. The use of government consumption misses the role of changes in government investment (capital expenditures), key in emerging exporting economies especially during commodity price booms, it also misses the relevance of tax policy changes (e.g., tax cuts implemented during commodity price booms). On the other hand, use of the overall fiscal balance makes it difficult to understand the effects of an external shock, because when a positive shock hits, government revenues increase immediately and automatically (without discretionary policy action), while discretionary expenditure may be increased possibly in a one-for-one response. In such a case, looking only at the overall fiscal balance could suggest that external shocks have no impact on fiscal positions, whereas in reality there is an impact on both revenues (automatically through export taxes) and expenditures (discretionary).

Other research has examined the impact of commodity price shocks on economic aggregates and performance rather than on fiscal positions. Hirschman (1977) cites the mid-nineteenth-century Peruvian guano boom, the benefits of which were misspent in railway investments. Collier and Gunning (1994) attribute the Egyptian loss of the Suez Canal to the unsustainable Egyptian public expenditure programs following the cotton price boom during the U.S. Civil War. Deaton and Miller (1995) assess the impact of commodity price shocks on Sub-Saharan Africa and discuss whether poor macroeconomic results should be attributed to the inherent difficulty of predicting commodity price fluctuations or, rather, to flawed internal political and fiscal arrangements. Raddatz (2007) finds that, among external shocks, those to commodity prices are the most important source of fluctuation in low-income countries' per capita GDP and that, in response to shocks, government expenditure and the current account tend to move in tandem with total GDP. However, this literature has not analyzed the dynamic responses of fiscal positions to commodity price shocks.

To assess the impact of commodity prices on economic aggregates, some studies have constructed country-specific commodity price indices. For example, Deaton and Miller (1995) assemble a measure of export prices for 32 countries. To generate the index values, they calculate the total value of exports of 21 commodities for each country in 1975 and assign a weight to each commodity by dividing the value of the commodity's exports in 1975 by this total value. The weights are then held constant for the rest of the exercise and are applied to the world prices of the same commodities. Collier and Goderis (2007) construct a commodity export price index composed of agricultural and nonagricultural commodities at a yearly frequency with fixed commodity export weights; to allow the effect of commodity export price to be greater for countries with higher exports, they weight the index by the share of commodity exports in the country's GDP. The use of fixed weights in these indices precludes accounting for the impact of changes in the trade shares.

Taking into account the literature discussed above, as well as the unprecedented magnitude of the most recent boom-and-bust behavior of commodity prices, an analysis that focuses on understanding the direct impact of commodity prices on fiscal positions is needed. This paper makes three contributions to the existing literature: (i) it uses a novel quarterly data set that includes a unique country-specific commodity price index that allows examination of changes in commodity prices and changes in commodity export shares; (ii) it exploits a comprehensive measure of public expenditure; and (iii) it analyzes the dynamic effects of commodity prices on revenues, expenditures, and GDP using vector autoregression (VAR) methodology that relies on Cholesky decomposition of matrices for the identification strategy. The novelty of this approach is that it enables me to estimate the impact of commodity price shocks on fiscal variables using a unique data set, whereas the existing empirical studies focus typically on the procyclicality of fiscal variables (government expenditure, primary surplus) with respect to GDP and on the impact of fiscal variables on GDP (fiscal multiplier).

The results of the estimations indicate that Latin American countries' fiscal positions generally react strongly to shocks to commodity prices, however, they also highlight that there exists a spectrum of responses. At one end of this spectrum, Chile behaves like an outlier in the Latin American region, with dynamic fiscal responses to commodity price fluctuations very similar to those found in high-income commodity-exporting countries, such as Australia, Canada, New Zealand, and Norway. At the other end of the spectrum is Venezuela, where expenditures rise even more than proportionally than revenues when faced with a commodity price shock.

The remainder of this paper is organized as follows: The next section presents a suggested methodology for studying the impact of commodity prices on fiscal positions and describes the data used. The third section describes and analyzes the main results. The last section concludes and suggests possible avenues for future research.

## II. Commodity Prices And Their Dynamic Impact On Fiscal Positions: Methodology

### A. Vector Autoregression Approach

To estimate the effects of commodity price shocks on fiscal positions, I estimate a VAR model using as identification strategy the Cholesky decomposition of matrices. VARs have the desirable property (given the purpose of this exercise) of focusing on the impact of shocks: first, the relevant shocks are identified, and then the response of the system to shocks is described through the analysis of impulse responses (the propagation mechanism). Furthermore, the use of variance decomposition analysis makes it possible to quantify the relative importance of commodity price shocks as sources of expenditures, revenues, and GDP fluctuations. Another advantage of using VARs over cross-sectional regressions is the

ability they provide to look at the dynamic effects of commodity price shocks on fiscal revenues and expenditures; the cross-sectional method, in contrast, estimates only a one-period effect. Furthermore, the use of VARs permits commodity prices' direct and indirect effect on fiscal positions (through their effect on GDP) to be disentangled.

To identify the structural parameters for the VAR, a set of restrictions must be specified. Following Sims (1980), the reduced-form errors are orthogonalized through Cholesky decomposition. The ordering is characterized as follows: a Country-Specific Commodity Price Index (CSCPI) ordered first, under the assumption that countries are small enough to be price takers. Given that the literature on procyclicality has emphasized the effects of GDP on fiscal policy, after the CSCPI comes GDP, and then government expenditures and revenues. This ordering is consistent with the literature that highlights the effects of external shocks on economic aggregates, the procyclicality of fiscal policy, and the nexus between public revenues and expenditures.

The VAR is estimated using quarterly data. All the variables are expressed as logs of the real level, and the model is estimated in first differences,[4] because standard unit root tests show that the variables are stationary in first differences. The number of included lags (1 to 6) is determined based on the Hannan-Quinn information criterion.

## B. Data

In order to study the effects of commodity price fluctuations on fiscal positions, I use a novel database for 12 commodity-exporting countries, covering a period that differs from country to country, beginning as early as the first quarter of 1975, depending on the country, and ending in the last quarter of 2008. This data set uses unique Country-Specific Commodity Price Indices (CSCPI) that combine international prices of 55 commodities (from the International Monetary Fund's monthly commodity price indices) and commodity export shares by country (from the Standard International Trade Classification, found in the World Integrated Trade Solutions). The CSCPIs allow me to look not only at changes of commodity prices, but also at the composition of commodity exports.

Included in the sample of 12 countries selected for this exercise are the largest Latin American commodity-exporting countries and four high-income commodity-exporting countries. The Latin American sample consists of Argentina, Brazil, Chile, Colombia, Ecuador, Mexico, Peru, and Venezuela. Together, these eight countries account for more than 90 percent of LA's GDP. Furthermore, their commodity exports represent, in the case of each country, more than 55 percent, on average, of the country's total exports of goods, and

[4] Similar results are obtained by using the cyclical component from linear quadratic detrending and the Hodrick-Prescott (1997) filter.

also account for a large share of the country's GDP (Table 1). In order to compare the performance of Latin American economies with those with similar features, four high-income commodity-exporting countries are included in the sample: Australia, Canada, New Zealand, and Norway.

The variables of interest are government primary expenditures, revenues, real GDP, and the CSCPIs. Data on government revenues and primary expenditures for the nonfinancial public sector are used because this broader aggregation level provides a more complete picture. When these series are not available at the nonfinancial public sector level, central government variables are employed. See the Appendix for a more-detailed description of the data used and their sources.

Each country's CSCPI is based on both the IMF monthly commodity price indices and trade information from the Standard International Trade Classification (SITC) found in the World Integrated Trade Solutions (WITS).[5] The procedure for creating the CSCPIs requires linking commodity prices from the IMF with the commodity's trade value from the WITS. When a commodity is found in both data sets, this relationship is direct. Nonetheless, since the IMF data set provides data for only 55 commodities, whereas the WITS includes information for 196, the link for many commodities is an indirect one. Linking data from these two sources requires some assumptions: either more than one commodity from the WITS can be classified in some or all of the commodity groups of the IMF, or some of the commodities in the WITS cannot be linked to a commodity price in the IMF data set. It is important to note that the frequency of the information in the two sources is also different. The IMF database is monthly, whereas the WITS is annual. To take advantage of the higher frequency for the prices database, I assume that the weights for each commodity in the data set are the same throughout each individual year in the sample period. The weights reflect, on average, 80 to 90 percent of a given country's total commodity exports.

All variables are expressed in real terms. Whenever the original series are not in real terms, the nominal variables are deflated by the country's Consumer Price Index (except for GDP, for which the GDP deflator is used). All series are in logs and, except for the CSCPI, when not reported in seasonally adjusted terms, they are adjusted using the X-12 quarterly seasonal adjustment method.[6]

As the data are likely to be nonstationary, tests for unit roots were performed and the unit roots hypothesis could not be rejected. The Johansen cointegration procedure was performed

[5] The SITC has had three revisions; for this research, I use the third one, because it includes more commodities than the previous data. Data can be disaggregated at the 3-digit or 4-digit SITC levels.

[6] This method (published by the U.S. Department of Commerce, U.S. Census Bureau) modifies the X-11 variant of Census Method II by J. Shiskin A.,H. Young, and J. C. Musgrave of February 1967.

for all the variables in the system, and the results do not suggest a cointegration vector under the model considered. In consequence, the series were adjusted (first-differenced) to be stationary, so that they can be included in the VAR estimation. The results are robust to other specifications, such as the cyclical component of the series obtained by using the Hodrick-Prescott filter.

## III. RESULTS

### A. The Dynamic Responses of Fiscal Variables to Commodity Price Shocks

**The size of the shock**

One can observe (Figure 1) a significant acceleration in commodity prices starting at the end of 2003, a pattern that continued until September 2008, when there was a substantial reversal, although not to such an extent that prices ever returned to their pre-2003 levels.

When the price shocks are computed in the VARs, on average, the size of the one-standard-deviation shock in Latin American countries is around 13 percent, with Venezuela having the largest, at 16.4 percent, and Brazil the smallest, at 7.8 percent, as shown in Figure 4. With respect to high-income commodity exporters, the largest on-impact response is that of Norway, which reaches almost 10 percent.

Another interesting feature of these indices—that affects the size of the shocks—is their commodity composition. While Argentina mainly focuses on soy and beef, other Latin American countries and high-income commodity exporters heavily rely on metals, minerals, and oil.

**Impulse response function analysis**

The estimated accumulated impulse response functions are shown in Figures 5, 6, 7, and 8. Dotted lines reflect one-standard deviation bands. The solid line represents the respective accumulated response to Cholesky one standard deviation commodity price shocks.

For both Latin American and high-income countries, positive commodity price shocks have the expected positive impact on real revenues and GDP. A one-standard-deviation shock to commodity prices in a quarter leads to an increase in government real revenues that ranges from around 2 percent in Brazil and Canada to 10 percent in Venezuela and around 14 percent in Ecuador. With respect to GDP, the same shock generates a response that varies from around 1 percent in Australia to 2.5 percent and 3 percent in Argentina and Norway, respectively. In most cases, the peak response of revenues and GDP occurs two quarters after the shock (Figures 7 and 8).

Compared with the behavior of revenues and GDP, the response of primary expenditures to commodity prices is substantially more heterogeneous across Latin American countries. A positive innovation in the commodity price leads to expenditures responses that range from 0 percent in the case of Chile to an increase of almost 12 percent in Venezuela.[7] The median response is around 4 percent, and the second-largest response (from Ecuador) is less than 8 percent, indicating that Venezuela behaves like an outlier in the regional context (Figure 6).

In the case of high-income commodity exporters, a one-standard-deviation shock to the commodity price in a quarter generates no reaction of primary expenditures in Australia and New Zealand. In Canada and Norway, primary expenditures actually decrease on impact (with reactions of -0.2 percent and -1.5 percent, respectively), suggesting a form of countercyclical fiscal policy.

Taken together, the results show that while both Latin American and high-income countries' revenues and GDP react positively to commodity price shocks, a completely different set of effects is found when the impact on primary expenditures is examined. Within LA there is a wide dispersion in countries' responses, with Venezuela and Chile at opposing ends of the response spectrum. The response of fiscal indicators in Chile, in particular, resembles those seen in high-income commodity-exporting countries.

**Variance decomposition analysis**

To quantify the contribution of commodity price shocks to fluctuations in government expenditures, I estimate variance decomposition of forecast errors. Interestingly, the results from this analysis (Table 3 and Figure 3) show that commodity price fluctuations play a dominant role in Venezuela (the highest), accounting for almost 17 percent of government spending fluctuations at a 10-quarter horizon. In Chile, on the other hand, commodity price fluctuations hardly explain expenditure fluctuations at all, accounting for less than 4 percent over the same time horizon, less than one-fourth of the figure in Venezuela. The other six Latin American countries all lie between Chile and Venezuela, with an average contribution (excluding Venezuela and Chile) of 9.5 percent at a 10-quarter horizon.

Results for high-income commodity-exporting countries indicate that, on average, commodity price fluctuations explain a smaller fraction of fluctuations in government expenditures than in Latin American countries, averaging 3.9 percent at a 10-quarter horizon.

[7] The results for Chile are consistent with findings by other authors, such as Kaminsky, Reinhart, and Végh (2005) and Calderon and Schmidt-Hebbel (2003).

## B. Looking at Fiscal Rules

A possible explanation for the variation in behavior among Latin American countries in regard to expenditures may lie in the heterogeneous institutional frameworks that govern fiscal policy decisions. It seems that formal fiscal rules may help—or they may not. For instance, Corbacho and Schwartz (2007) suggest that for Argentina, Colombia, and Peru, fiscal performance did not improve after fiscal responsibility laws were implemented (in Argentina in 1999, Colombia in 2003, and Peru in 1999). According to these authors, these laws "fail to substitute for political commitment and society's support for needed fiscal consolidation. Numerical targets where successively breached, undermining credibility in the fiscal framework established in the law" (Page 69). With respect to Chile, Kaminsky, Reinhart, and Végh (2005) and Calderon and Schmidt-Hebbel (2003) find evidence that supports the hypothesis that a country with better fundamentals, stronger institutions, and more stable policy rules will be able to avoid procyclical policy responses and indeed pursue countercyclical policies. The adoption of fiscal rules specifically designed to encourage public saving in good times may have helped in this effort in the case of Chile.

In high-income commodity-exporting countries, either formal or informal fiscal rules seem to be accompanied by strong institutions, political commitment, and high standards of transparency, which allow fiscal rules to work. According to Bhattacharyya and Williamson (2009), commodity price shocks that essentially matched in size those in most of the primary-product-exporting countries never caused the same levels of volatility in Australia (either in aggregates, or in sectoral and regional performance). Their explanation is that (i) revenues come from fairly diverse sources in Australia, so that commodity price volatility does not produce as much volatility of total revenue as elsewhere; and (ii) diversification also offsets the impact of commodity price shocks. A big and growing industrial sector before the 1970s and a big and growing service sector after that period seem to be what makes the difference.

In the case of Canada, its strong fiscal record in recent years rests on a proven budgetary framework, including a well-established forecasting process. Canadian public finances are highly transparent, and the prudent fiscal policies of recent governments have had public support. Unlike in many other countries, fiscal policy in Canada is not constrained by budget rules imposed under the constitution or the law. Instead, between 1998 and 2006, Canada followed a de facto fiscal rule of "budget balance." The new government that took power in 2006 abandoned this de facto rule in favor of targeting a moderate surplus of 0.25 percent of GDP.

For New Zealand, by the early 1990s, policy advice was oriented toward fiscal consolidation and a medium-term focus. The institutional framework was altered, following the introduction of the country's Fiscal Responsibility Act (1994), which is based on "principles"

of responsible fiscal management, including strong disclosure and reporting requirements, but does not set fixed numerical targets.

In Norway, a key fiscal rule sets the non-oil structural budget deficit of the central government at 4 percent (allowing for temporary deviations over the business cycle). To manage the country's oil wealth, a Government Petroleum Fund[8] was established in 1990. It receives most of Norway's petroleum revenue and invests it in financial assets abroad. The fund was created to preserve assets for future generations and avoid potential crowding-out effects (Dutch disease) that the rapid spending of oil wealth might generate.

## IV. CONCLUSION

The recent boom and bust in commodity prices has raised concerns about the impact of commodity prices on Latin American countries' fiscal positions. Given that the size of the most recent shock has been unprecedentedly large, it is important to study its effect on commodity-exporting countries' fiscal positions.

This paper estimates the dynamic effects of commodity price shocks in a group of Latin American commodity-exporting countries and compares VAR impulse response functions with those of high-income commodity-exporting countries. This methodology exploits a unique quarterly data set that includes a novel country-specific commodity price index. The results of the estimations show that the impact of commodity price shocks on fiscal revenues is not that different among the two groups of countries. In contrast, there is a spectrum of primary expenditures responses within Latin American countries, with Chile and Venezuela being at the extremes of the distribution. Furthermore, Chile behaves similarly to high-income countries, with no positive expenditure response to higher commodity prices. A potential explanation for this behavior is the efficient application of fiscal rules, accompanied by strong institutions, political commitment, and high standards of transparency. This hypothesis has been recognized in other literature, where there seems to be agreement about the influence of fiscal institutions on fiscal performance (e.g., Corbacho and Schwartz, 2007). A next step for research in this area is to look for structural breaks in countries that during the last decade adopted fiscal rules, to determine whether it is possible to detect changes in fiscal behavior and establish whether there is a clear empirical link with such rules.

[8] Known as the "Government Pension Fund Global" since 2006.

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## APPENDIX 1. DATA

The data presented in this paper go as far back as the first quarter of 1975. For more information about the length of the time series for each country, please see Table 4.

The series and data sources are as follows:

**Country-Specific Commodity Price Indices**
Author's estimations based on the IMF monthly commodity price indices and trade data from the Standard International Trade Classification, found in the World Integrated Trade Solution.

**Real GDP**
Data were obtained by Haver Analytics using primary data from each country's authorities. When real data were not available, nominal data were deflated by each country's CPI.

**CPI**
The series on CPI were obtained by Haver Analytics using primary data from each country's authorities.

**Revenues and Primary Expenditures**
Revenues encompass total revenues, and the aggregation level depends on data availability for each country. In the case of primary expenditures, the variable covers total expenditures (i.e., current expenditures plus capital expenditures) minus interest payments, with the aggregation level depending also on the country's definitions and data availability.

For Argentina, author's estimations from nonfinancial public sector data, published by the Finance Ministry, were used. In the case of Australia, central government aggregation data from the Reserve Bank of Australia were employed. For Brazil, series from the central bank database were used at the central government level (including federal government, central bank, and social security administration). Data for Canada were obtained by Haver Analytics using primary data from Canada's Department of Finance at the federal government aggregation level. The series for Chile were obtained from the Finance Ministry at the central government level. For Colombia, data for the nonfinancial public sector were gathered from the Finance Ministry's CONFIS. In the case of Ecuador, data were obtained at the nonfinancial public sector level from Ecuador's central bank. For Mexico, central government data were acquired from the Finance and Public Credit Department. New Zealand data on government revenues and expenditures were not available on a quarterly basis; therefore, data on government consumption (from the country's national accounts) were used. The series for Norway were gathered at the central government level (including the national insurance scheme) from Statistics Norway. For Peru, data were obtained at the central government level from Peru's central bank. In the case of Venezuela, data were gathered at the central government level from Venezuela's central bank.

Table 1. The Importance of Commodity Exports
(In percent)

| | As a Share of Total Merchandise Exports 1/ | As a Share of GDP 1/ |
|---|---|---|
| *Latin American Countries* | | |
| Argentina (ARG) | 55.6 | 11.2 |
| Brazil (BRA) | 41.0 | 5.4 |
| Chile (CHL) | 65.4 | 24.1 |
| Colombia (COL) | 46.0 | 9.5 |
| Ecuador (ECU) | 75.7 | 23.2 |
| Mexico (MEX) | 17.5 | 5.3 |
| Peru (PER) | 53.5 | 11.4 |
| Venezuela (VEN) | 80.9 | 25.6 |
| *High Income Commodity Exporting Countries* | | |
| Australia (AUT) | 49.6 | 9.8 |
| Canada (CAN) | 30.0 | 12.3 |
| New Zealand (NZL) | 48.6 | 15.2 |
| Norway (NOR) | 56.3 | 24.4 |

1/ Average 1999-2006

# Table 2. Composition of Country-Specific Commodity Price Indices 1/
(2005, in percent)

| | ARG | BRA | CHL | COL | ECU | MEX | PER | VEN | AUS | CAN | NZL | NOR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Aluminum | 1.9 | 4.9 | 0.1 | 0.6 | 0.3 | 0.3 | 0.0 | 2.1 | 5.6 | 6.1 | 5.4 | 5.0 |
| Banana | 3.0 | 1.6 | 6.0 | 5.2 | 14.1 | 3.7 | 1.6 | 0.0 | 0.7 | 0.1 | 6.4 | 0.0 |
| Barley | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.9 | 0.3 | 0.0 | 0.0 |
| Beef | 6.9 | 10.6 | 1.6 | 2.0 | 0.0 | 2.2 | 0.0 | 0.0 | 9.3 | 4.0 | 27.8 | 0.0 |
| Butter | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 5.3 | 0.0 |
| Cheese | 0.6 | 0.1 | 0.2 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.1 | 6.0 | 0.1 |
| Chicken | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Coal | 0.0 | 0.0 | 0.0 | 25.0 | 0.0 | 0.0 | 0.0 | 0.7 | 26.9 | 2.8 | 0.0 | 0.0 |
| Cocoa | 0.4 | 0.9 | 0.1 | 0.5 | 2.1 | 0.3 | 0.4 | 0.0 | 0.2 | 0.7 | 0.6 | 0.0 |
| Coconut oil | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Coffee | 0.0 | 6.9 | 0.0 | 15.7 | 1.1 | 0.8 | 3.2 | 0.0 | 0.1 | 0.2 | 0.0 | 0.0 |
| Copper | 3.4 | 1.7 | 64.4 | 0.3 | 0.0 | 2.5 | 37.1 | 0.0 | 5.3 | 2.8 | 0.2 | 0.3 |
| Cotton | 0.2 | 1.3 | 0.0 | 0.2 | 0.1 | 1.0 | 0.5 | 0.0 | 1.3 | 0.2 | 0.0 | 0.0 |
| Cotton seed oil | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Crude oil | 11.6 | 9.9 | 0.0 | 38.8 | 66.8 | 74.7 | 2.0 | 96.7 | 7.8 | 23.3 | 2.2 | 61.5 |
| Eggs | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Fish | 3.5 | 1.0 | 9.1 | 1.7 | 12.1 | 1.6 | 3.4 | 0.1 | 1.5 | 3.3 | 6.9 | 6.3 |
| Groundnut oil | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Groundnuts | 0.2 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Hides | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.4 | 0.0 | 0.0 | 0.8 | 0.5 | 1.2 | 0.1 |
| Iron | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 | 0.8 | 0.5 | 0.1 |
| Iron ore | 0.1 | 17.1 | 1.1 | 0.1 | 0.0 | 0.3 | 2.3 | 0.0 | 13.5 | 1.3 | 0.1 | 0.1 |
| Jute | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Lead | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 4.6 | 0.0 | 1.4 | 0.2 | 0.1 | 0.0 |
| Linseed oil | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Maize | 6.2 | 0.3 | 0.3 | 0.0 | 0.1 | 0.0 | 0.1 | 0.0 | 0.1 | 0.3 | 0.0 | 0.0 |
| Manganese ores | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.6 | 0.0 | 0.0 | 0.0 |
| Milk | 1.9 | 0.2 | 0.2 | 0.4 | 0.0 | 0.2 | 0.4 | 0.0 | 1.6 | 0.1 | 17.7 | 0.0 |
| Nat gas | 5.6 | 0.1 | 0.2 | 0.2 | 0.0 | 0.2 | 0.9 | 0.0 | 5.6 | 29.6 | 0.0 | 23.7 |
| Nickel | 0.0 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.6 | 3.2 | 0.0 | 1.6 |
| Olive oil | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Palm oil | 0.0 | 0.0 | 0.0 | 0.9 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Pepper | 0.0 | 0.2 | 0.1 | 0.1 | 0.0 | 0.1 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Platinum | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 |
| Poultry | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.0 |
| Rice | 0.4 | 0.1 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 |
| Rubber | 0.2 | 0.7 | 0.0 | 0.0 | 0.0 | 0.6 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 |
| Silver | 0.1 | 0.2 | 0.7 | 0.4 | 0.0 | 1.9 | 3.6 | 0.0 | 0.2 | 0.5 | 0.0 | 0.0 |
| Soft Log | 0.6 | 3.1 | 3.7 | 0.1 | 0.5 | 0.3 | 1.3 | 0.0 | 0.2 | 9.0 | 7.2 | 0.2 |
| Soy oil | 13.4 | 3.0 | 0.0 | 0.1 | 0.0 | 0.2 | 0.0 | 0.0 | 0.1 | 0.5 | 0.0 | 0.0 |
| Soybean meal | 17.7 | 7.0 | 0.0 | 0.1 | 0.3 | 0.2 | 12.4 | 0.0 | 0.9 | 0.6 | 1.0 | 0.2 |
| Soybeans | 10.2 | 12.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 |
| Sugar | 1.9 | 10.2 | 0.6 | 5.3 | 1.2 | 2.9 | 0.4 | 0.0 | 0.7 | 1.8 | 4.6 | 0.1 |
| Swine | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.7 | 0.0 | 0.0 |
| Tea | 0.3 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Tin | 0.0 | 0.2 | 11.1 | 1.0 | 0.1 | 2.9 | 14.3 | 0.1 | 0.9 | 1.3 | 0.5 | 0.1 |
| Tobbaco | 0.9 | 3.9 | 0.0 | 0.1 | 0.3 | 0.1 | 0.1 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 |
| Uranium | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.7 | 0.0 | 0.0 | 0.0 |
| Wheat | 7.0 | 0.3 | 0.3 | 0.8 | 0.0 | 1.5 | 0.5 | 0.1 | 4.4 | 3.9 | 2.4 | 0.0 |
| Wool | 0.7 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 2.8 | 0.0 | 3.8 | 0.0 |
| Zinc | 0.1 | 0.2 | 0.1 | 0.0 | 0.0 | 1.1 | 9.3 | 0.0 | 2.2 | 0.8 | 0.0 | 0.3 |

1/ Highlighted commodities represent more than 50 percent of each index composition.

Table 3. Commodity Price Shocks as a Source of Fluctuations in Primary Expenditures
(Contribution of commodity price shocks to the variance of primary expenditure growth)

| Quarters after the shock | VEN | COL | ARG | ECU | MEX | BRA | PER | CHL |
|---|---|---|---|---|---|---|---|---|
| 1 | 5.73 | 6.84 | 0.02 | 4.19 | 10.57 | 2.61 | 1.56 | 0.60 |
| 2 | 14.52 | 11.13 | 0.60 | 9.69 | 6.74 | 7.38 | 1.49 | 1.96 |
| 4 | 16.83 | 15.57 | 12.97 | 9.47 | 8.22 | 7.42 | 3.40 | 3.64 |
| 8 | 16.61 | 14.32 | 12.47 | 9.69 | 8.23 | 7.84 | 4.12 | 3.92 |
| 10 | 16.59 | 14.26 | 12.90 | 9.72 | 8.23 | 7.85 | 4.12 | 3.92 |

| Quarters after the shock | CAN | NZL | NOR | AUT |
|---|---|---|---|---|
| 1 | 0.38 | 0.00 | 0.86 | 0.60 |
| 2 | 1.79 | 3.26 | 2.72 | 0.54 |
| 4 | 5.54 | 5.26 | 3.47 | 1.49 |
| 8 | 5.70 | 5.39 | 2.92 | 1.50 |
| 10 | 5.71 | 5.39 | 2.91 | 1.50 |

Table 4. Sample Period by Country
(For real GDP, primary expenditures, and revenues)

| Country | Beginning Date | End Date |
|---|---|---|
| ARG | 1993Q1 | 2008Q4 |
| BRA | 1993Q1 | 2008Q4 |
| CHL | 1995Q1 | 2008Q4 |
| COL | 1995Q1 | 2008Q4 |
| ECU | 1998Q1 | 2008Q4 |
| MEX | 1993Q1 | 2008Q4 |
| PER | 1995Q1 | 2008Q4 |
| VEN | 1998Q1 | 2008Q4 |
| AUT | 1975Q1 | 2008Q4 |
| CAN | 1985Q2 | 2008Q4 |
| NZL1/ | 1988Q1 | 2008Q4 |
| NOR | 1991Q1 | 2008Q4 |

1/ Primary expenditure data not available at quarterly frequency; therefore government consumption expenditure is used as a proxy. Revenue series are not available at a quarterly frequency.

## Table 5. Responses to Commodity Price Shocks

(Response to one-standard-deviation shock, quarterly percentage change)

| | Primary Expenditures | | | Revenues | | | GDP | | |
|---|---|---|---|---|---|---|---|---|---|
| | Impact Response | Peak Response (max deviation) | Quarter of the Peak Response | Impact Response | Peak Response (max deviation) | Quarter of the Peak Response | Impact Response | Peak Response (max deviation) | Quarter of the Peak Response |
| Argentina | 0.0 | 2.0 | 4th | 1.3 | 2.9 | 2nd | 0.3 | 0.5 | 2nd |
| Brazil | 0.0 | 0.7 | 2nd | 0.8 | 0.3 | 1st | 0.8 | 0.8 | 1st |
| Chile | 0.0 | 0.0 | - | 1.3 | 2.1 | 2nd | 0.5 | 0.5 | 1st |
| Colombia | 2.0 | 3.0 | 2nd | 0.0 | 1.7 | 4th | 0.4 | 0.5 | 2nd |
| Ecuador | 3.0 | 4.8 | 2nd | 6.4 | 7.1 | 2nd | 0.5 | 0.5 | 1st |
| Mexico | 2.1 | 2.1 | 1st | 0.8 | 2.0 | 2nd | 0.3 | 0.3 | 1st |
| Peru | 0.7 | 1.0 | 3rd | 2.0 | 2.0 | 1st | 0.1 | 0.7 | 2nd |
| Venezuela | 3.0 | 5.3 | 2nd | 2.6 | 6.5 | 2nd | 0.0 | 1.2 | 2nd |
| Australia | 0.0 | -0.6 | 3rd | 1.0 | 1.0 | 1st | 0.2 | 0.2 | 1st |
| Canada | 0.0 | 0.6 | 3rd | 0.0 | 0.5 | 3rd | 0.6 | 0.6 | 1st |
| New Zealand | 0.0 | 0.1 | 2nd | - | - | - | 0.0 | 0.1 | 2nd |
| Norway | -0.4 | -0.9 | 2nd | 1.8 | 1.8 | 1st | 1.5 | 1.5 | 1st |

# Figure 1. Country-Specific Commodity Price Indices
(2005=100, in nominal U.S. dollars)

## LATIN AMERICAN COUNTRIES

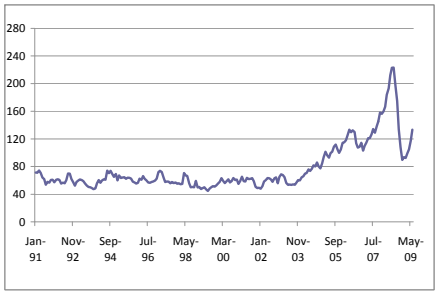
ARGENTINA


BRAZIL


CHILE


COLOMBIA


ECUADR



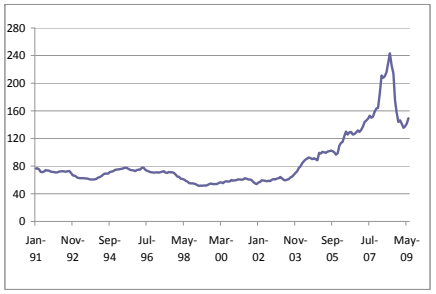

MEXICO


PERU


VENEZUELA


## HIGH INCOME COMMODITY EXPORTING COUNTRIES

AUSTRALIA




CANADA


NEW ZEALAND


NORWAY

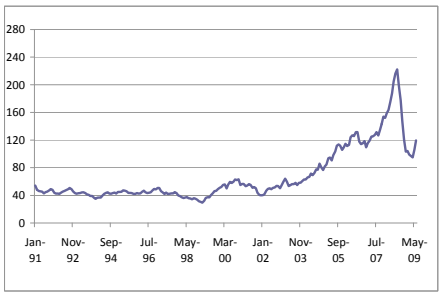


Figure 2. Commodity-Related Fiscal Revenues
(In percent of GDP)

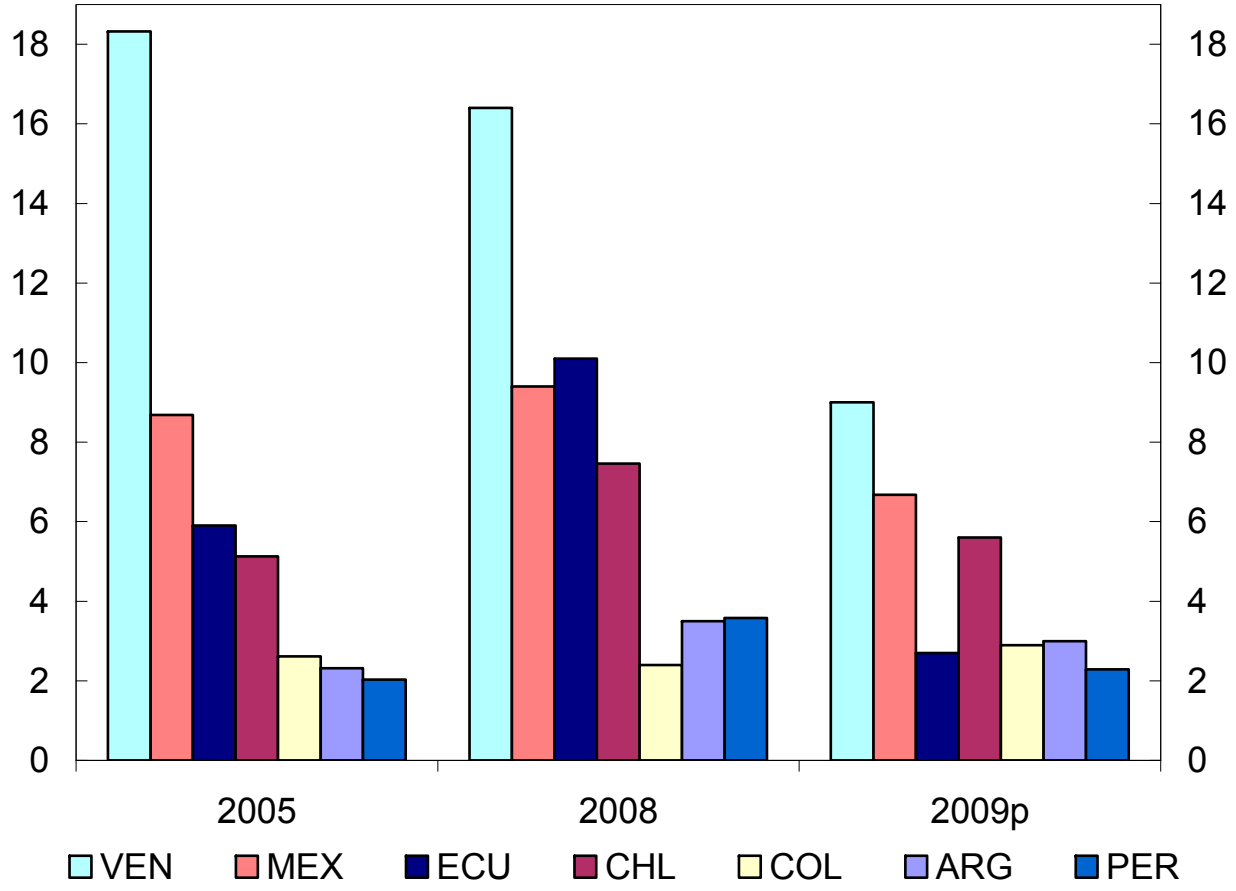


Figure 3. Contribution of Commodity Price Shocks to the Variance of Primary Expenditure Growth
(In percent)

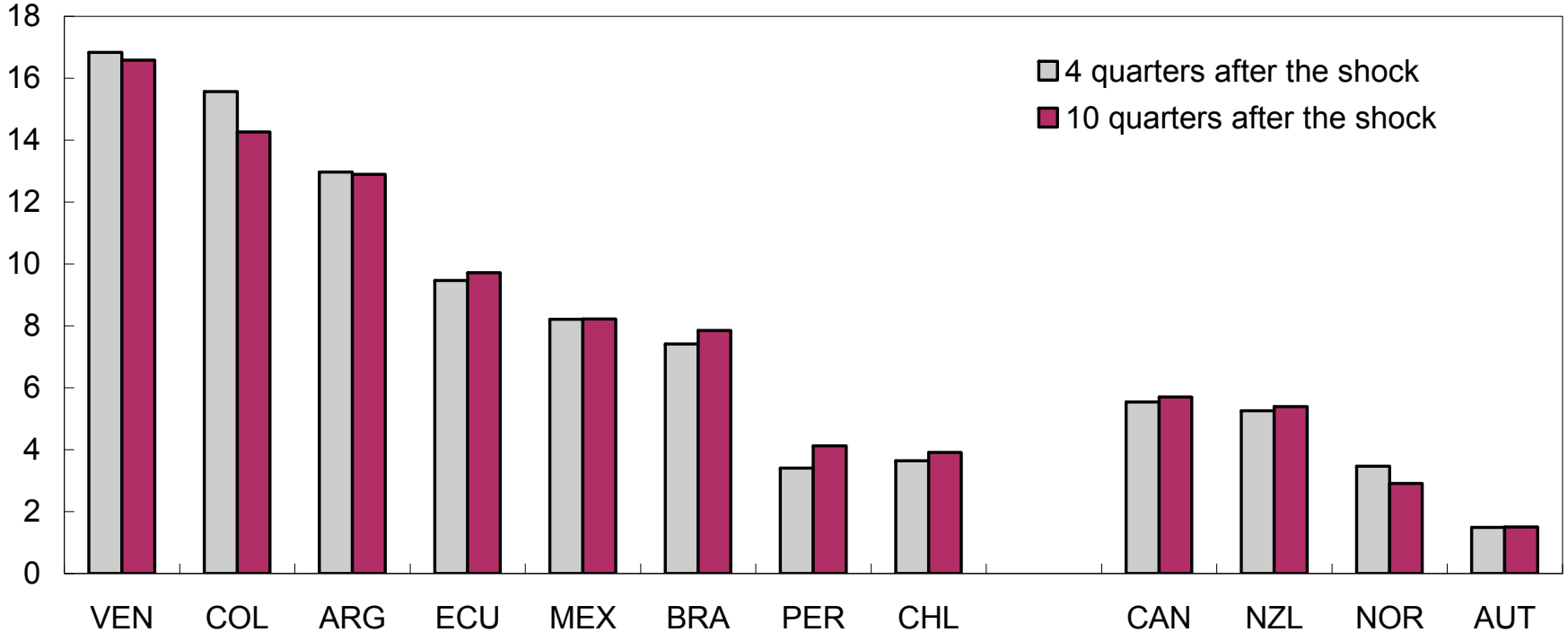


Figure 4. Response of Commodity Prices to One Standard Cholesky Innovation in Commodity Price
(In percent)

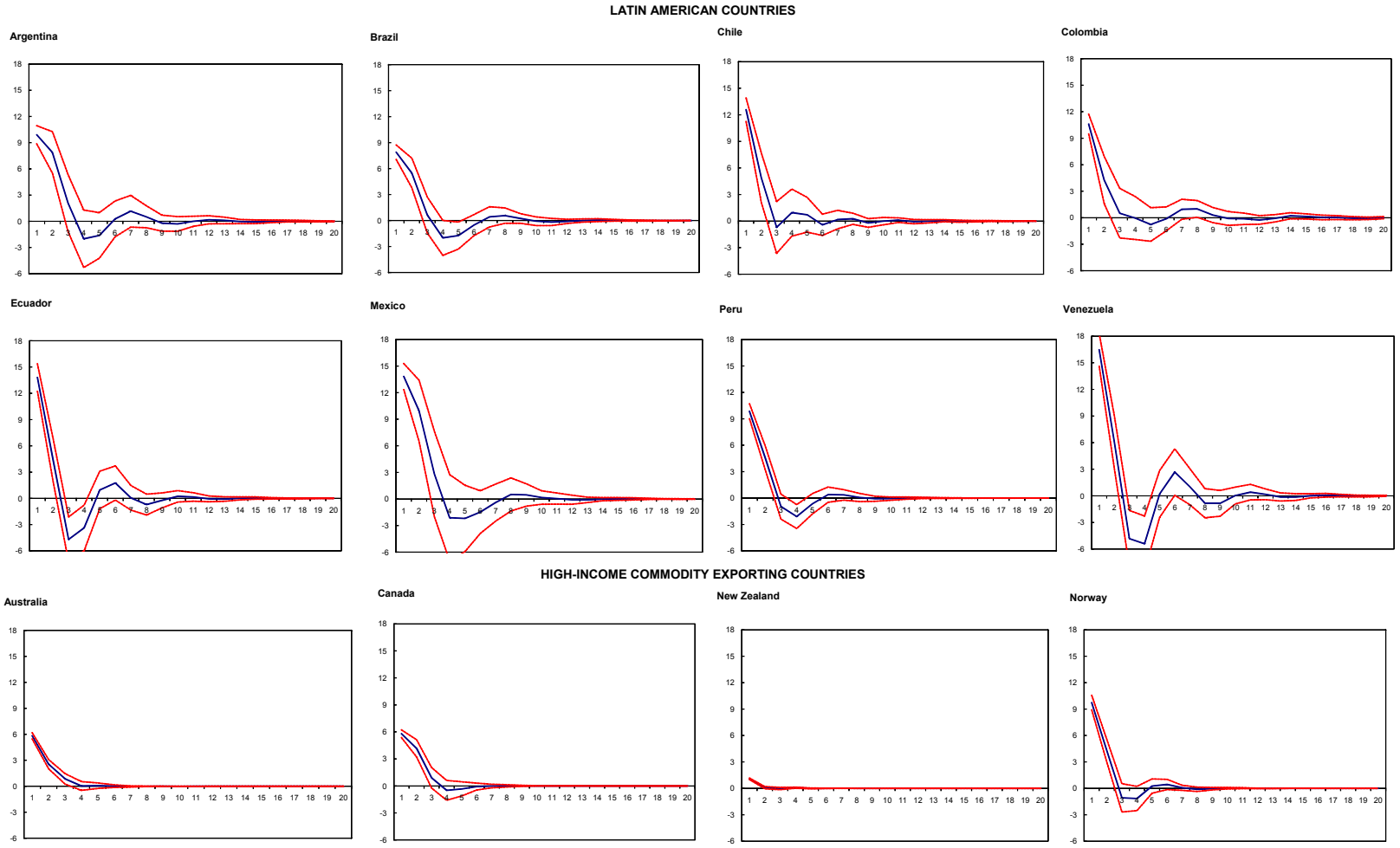


Figure 5. Accumulated Response of Commodity Prices to One Standard Cholesky Innovation in Commodity Price

(In percent)

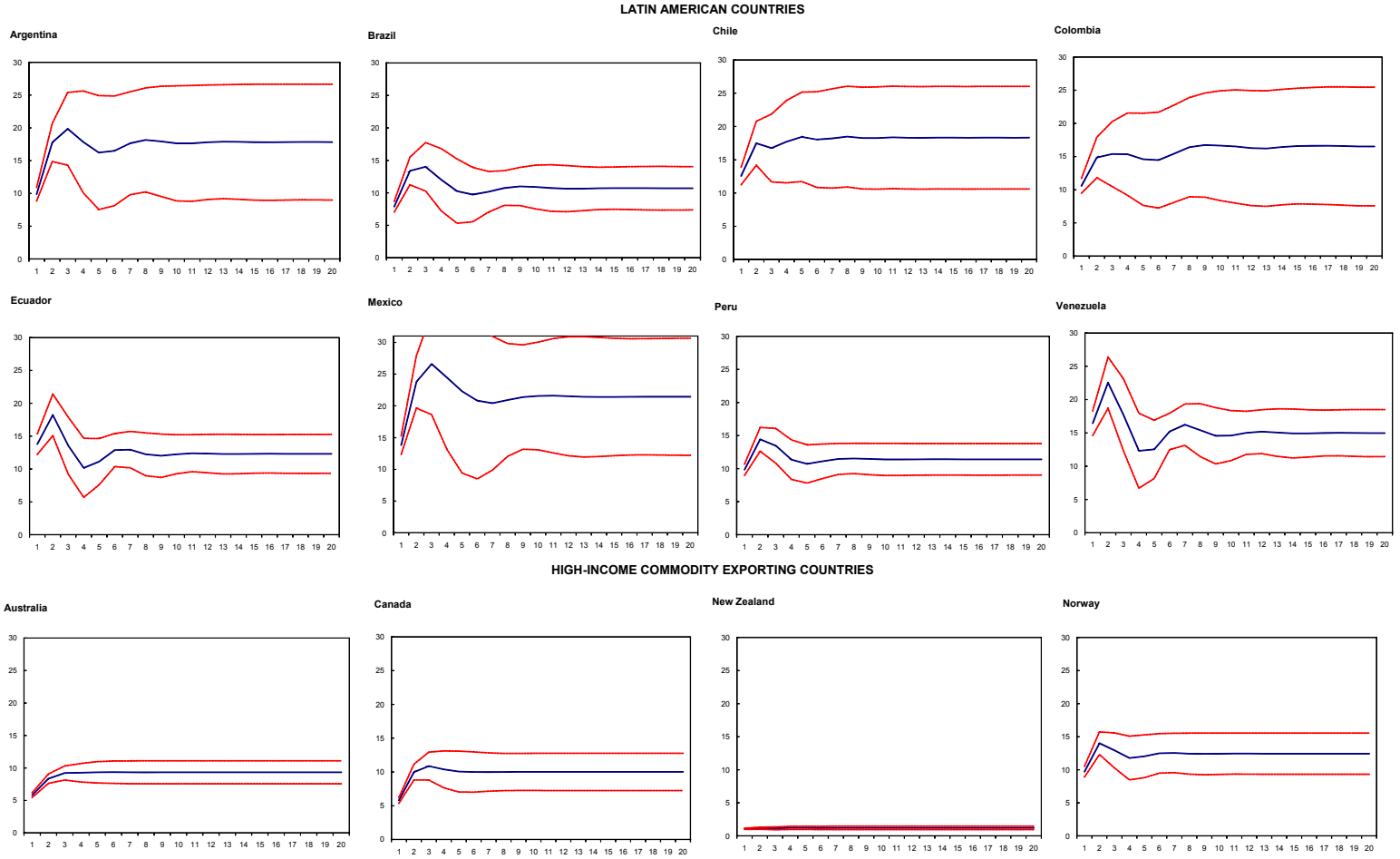


Figure 6. Accumulated Response of Primary Expenditures to One Standard Cholesky Innovation in Commodity Price

(In percent)

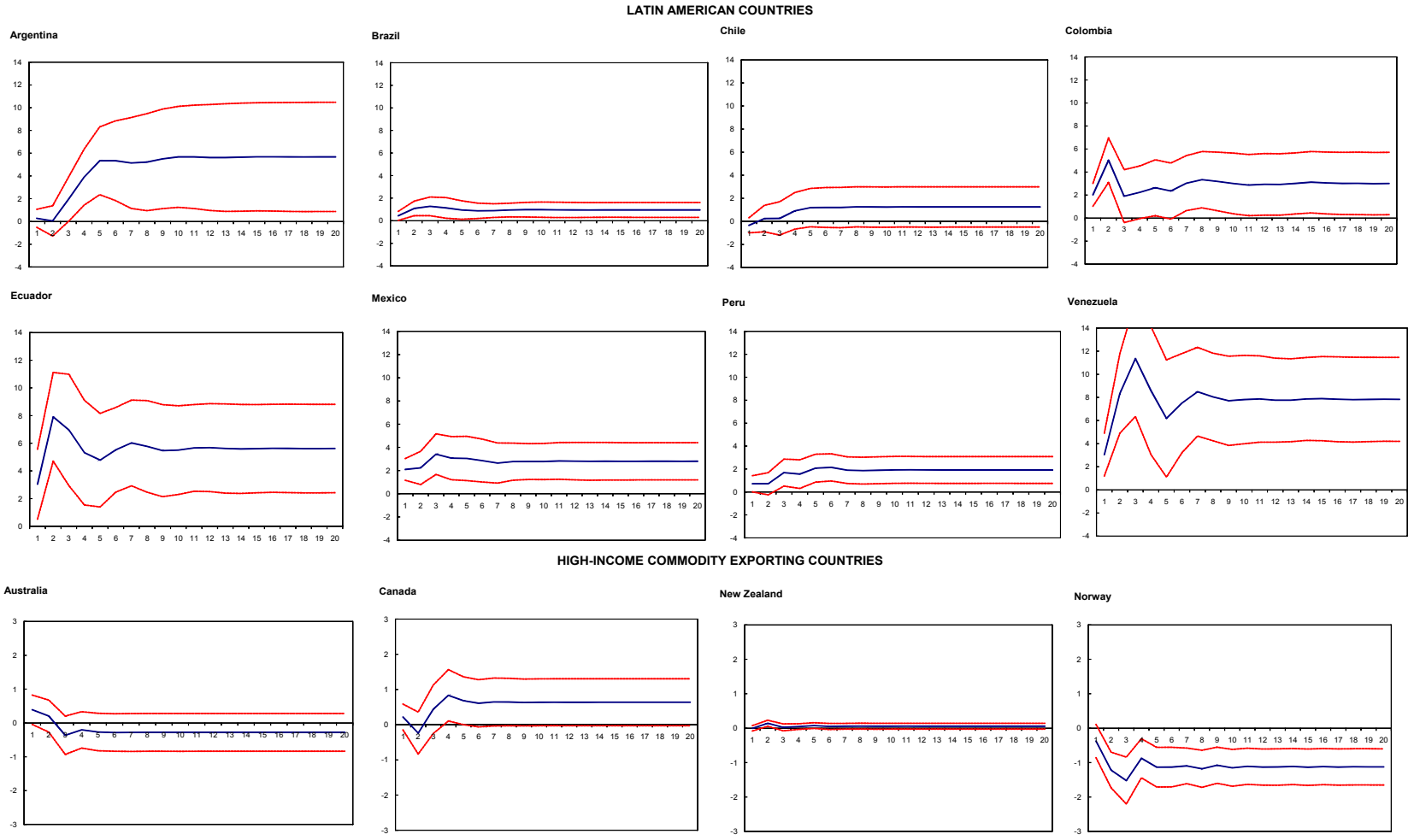


Figure 7. Accumulated Response of Total Revenues to One Standard Cholesky Innovation in Commodity Price

(In percent)

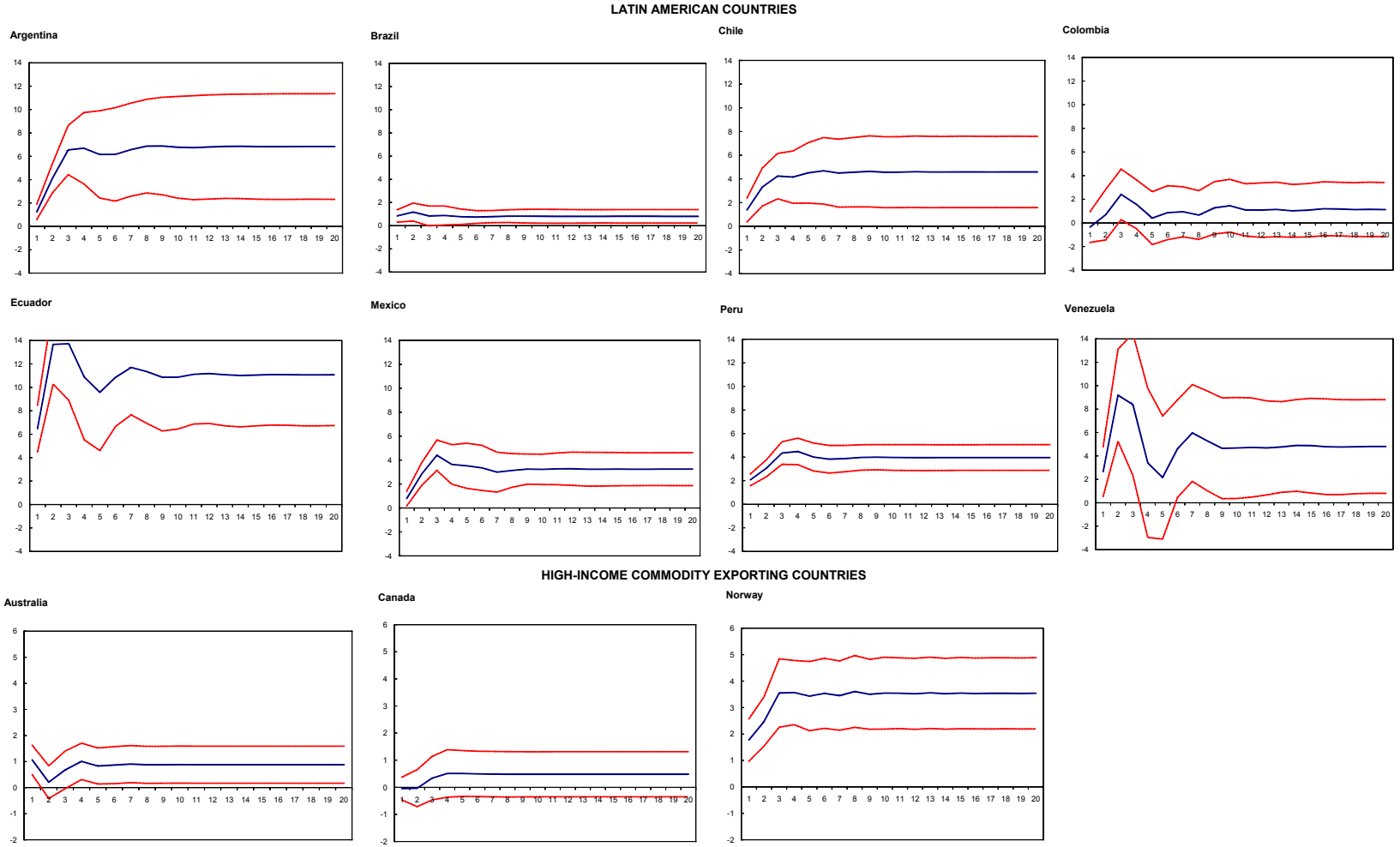
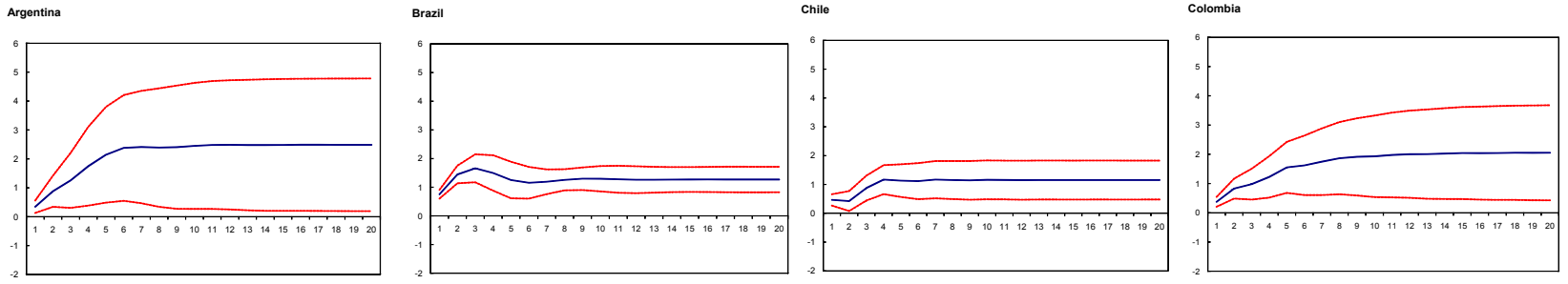


Figure 8. Accumulated Response of GDP to Commodity Price One Standard Cholesky Innovation in Commodity Price

(In percent)

**LATIN AMERICAN COUNTRIES**




**HIGH-INCOME COMMODITY EXPORTING COUNTRIES**