



WP/08/137

# IMF Working Paper

---

## Fiscal Positions in Latin America: Have They Really Improved?

*Ivanna Vladkova-Hollar  
and Jeromin Zettelmeyer*



## IMF Working Paper

Western Hemisphere and Research Departments

### Fiscal Positions in Latin America: Have They Really Improved?

Prepared by Ivanna Vladkova-Hollar and Jeromin Zettelmeyer<sup>1</sup>

May 2008

#### Abstract

**This Working Paper should not be reported as representing the views of the IMF.**

The views expressed in this Working Paper are those of the author(s) and do not necessarily represent those of the IMF, its Executive Board, or its management. Working Papers describe research in progress by the author(s) and are published to elicit comments and to further debate.

Fiscal performance in Latin America looks much improved this decade compared to the 1980s or 1990s. Is this a “structural” improvement or likely to be transitory? This paper answers this question by estimating the relationship between non-commodity revenue and the economic cycle, and evaluating commodity revenues using alternative medium term commodity price projections. The main result is that structural revenues have indeed improved as a share of GDP, and structural primary balances are currently in surplus in many Latin American countries. However, the magnitude of these improvements is uncertain, in part due to uncertainty about the commodity price outlook.

JEL Classification Numbers: F40

Keywords: revenues, taxes, structural fiscal balance, commodity prices

Author's E-Mail Address: [ivladkovahollar@imf.org](mailto:ivladkovahollar@imf.org); [jzettelmeyer@imf.org](mailto:jzettelmeyer@imf.org)

---

<sup>1</sup>We are grateful to many IMF colleagues, including Caroline Atkinson, Nigel Chalk, Ben Clements, Ana Corbacho, Rodrigo Cubero, Marcelo Estevão, Aasim Husain, Herman Kamil, Martin Mühleisen, Rob Rennhack, David Robinson, Anoop Singh and John Thornton for comments and discussions, and to Lisandro Abrego, Olumuyiwa Adedeji, Rodrigo Cubero, Enrique Flores, Judith Gold, Maria Gonzalez, Rishi Goyal, Gil Mehrez, Claudio Paiva, Alvaro Piris, Wendell Samuel, and Jim Walsh for providing us with fiscal data and helping us understand it. Priya Joshi provided outstanding research assistance.

Contents	Page
I. Introduction .....	3
II. Methodology .....	5
A. Noncommodity Structural Revenue.....	5
B. Commodity Structural Revenue.....	7
C. Structural Balances.....	8
III. Results.....	9
A. Parameter Estimates and Statistical Tests.....	9
B. Structural Noncommodity Revenues .....	11
C. Structural Commodity Revenues .....	14
D. Structural Primary Balances.....	15
IV. Conclusion .....	18
References.....	20
Tables	
1. Latin America: Fiscal Developments.....	3
2. Long-Run Income Elasticity of Central Government Tax Revenues.....	10
Figures	
1. Actual and Structural Noncommodity Revenues.....	12
2. Actual and Structural Commodity Revenues.....	15
3. Actual and Estimated Structural Primary Balances .....	17
Appendices	
1. Revenue Data and Changes in Tax Structure .....	22
2. Output Gap Estimates .....	28
3. Commodity Price Indices and Projections.....	29
Appendix Tables	
A1. LAC Countries: Filter-Based Output Gap Estimates for 2007 .....	28
A2. Commodity Export Shares.....	29
A3. Commodity Price Indices and Medium Term Projections.....	30

## I. INTRODUCTION

The improvement of fiscal balances has been a cornerstone of Latin America's macroeconomic stabilization and recovery following the crises of 1994–2002. After hovering around 5 percent in the last decade, the average fiscal deficit in Latin America declined steadily beginning in 2003, and reached a surplus in 2006. Initially, this reflected a reduction in government spending as a share of GDP, which reached a low around 2004. Beginning in 2005, spending picked up again, but was outpaced by an even larger increase in revenue growth. As a result, fiscal balances continued to strengthen (Table 1).

Table 1. Latin America: Fiscal Developments  
(In percent of GDP) 1/

	1995-01	2002	2003	2004	2005	2006	2007
Public sector revenue	24.6	25.0	25.5	26.0	27.1	28.5	28.9
Public sector expenditures	27.6	29.6	28.7	27.9	27.9	28.2	28.7
Noninterest	24.2	25.2	25.0	24.6	24.9	25.4	26.2
Interest	3.4	4.3	3.7	3.3	3.0	2.8	2.5
Public sector overall balance	-2.6	-4.6	-3.2	-1.8	-0.7	0.3	0.2
Public sector primary balance	0.8	-0.3	0.5	1.5	2.2	3.1	2.7

Source: IMF and national authorities

1/ Unweighted averages of fiscal aggregates for Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Trinidad and Tobago, Uruguay, and Venezuela.

Are these improvements sustainable? Or do they merely reflect exceptionally favorable external economic conditions—including an unprecedented boom in commodity prices—and the strong cyclical recovery that Latin America has enjoyed in the last few years? The fact that Latin America's recent fiscal improvements have come exclusively from the revenue side is a cause for concern (IMF, 2006, 2007; IADB, 2008; Izquierdo, Ottonello, and Talvi, forthcoming). In light of continued high debt levels, a return to the deficits of the 1990s could jeopardize the region's newfound stability. The key question is hence how much of the recent revenue growth can be expected to be “permanent”—i.e. to survive a return to normal cyclical conditions—and how strong fiscal balances would be in these circumstances. This is the subject addressed in this paper.

We proceed in three steps. First, we analyze the sources of recent increases in the revenue to GDP ratio, distinguishing between revenues from commodity and noncommodity sources, and decomposing increases in the latter into three components: changes due to tax policy or tax administration; changes due to the economic cycle; and a residual. Based on this analysis as well as medium-term commodity price projections from two different sources, we compute “structural” revenue to GDP ratios separately for noncommodity and commodity revenues. Finally, we combine these with estimated structural expenditure ratios, under the assumption that expenditures in Latin America are not (automatically) linked to the economic cycle, to compute structural balance estimates for a number of countries in the region.

The approach used in this paper differs from standard structural balance methodology (Hagemann, 1999) in two ways. First, following Marcel et al. (2001), we distinguish between noncommodity and commodity revenues, and separately estimate the “structural” level for each. Second, when estimating noncommodity structural revenue, we consider the history of tax regime changes in each country in addition to the standard cyclical adjustment of observed revenues using the output gap. Conventional structural balance methodology implicitly assumes that all changes in the revenue ratio that are not identifiably cyclical—that is, cannot be statistically linked to the output fluctuations—are “structural,” whether or not they can be attributed to changes in the tax system. This approach might give too rosy a picture of the fiscal balance if revenue ratios are buoyant for temporary, but not identifiably cyclical reasons.

To address this problem, we adjust the observed tax revenue series, for each country, using the estimated revenue impact of all changes in the tax system that we are aware of, before regressing the adjusted series on changes GDP.<sup>2</sup> The residual from this regression reflects the portion of revenue that is unexpected, given the state of both the tax system and the tax base (GDP). Structural revenue and balance estimates are computed both under the (conventional) assumption that this residual is structural, and under the alternative view that it is not. We also take a position on which view is closer to the truth by examining the statistical properties of the residual.

We are aware of four related recent studies of fiscal performance in Latin America. Alberola and Montero (2006) examine the relationship between the fiscal stance and the economic cycle in a paper that is primarily interested in debt sustainability. As an intermediate step, they estimate structural fiscal balances in nine Latin American up to 2004 using the standard assumption that all non-cyclical revenue changes are structural, and disregarding changes in tax structure in their regressions.<sup>3</sup> Lozano and Toro (2007) compute structural balances for Colombia, based on the standard approach, and a revenue series that is adjusted for changes in the tax structure. Cubero and Sowerbutts (forthcoming) analyze structural revenue in Costa Rica using a very similar methodology as this paper, with consistent results. Finally Izquierdo, Ottonello, and Talvi (forthcoming; see also IADB, 2008, which is based on their analysis) calculate structural balances for a group of Latin American countries using a different methodology, which relies on statistical filtering of the observed fiscal data. The flavor of their results is different from those of this paper, in that they attribute a much larger portion of the recent revenue increase to cyclical factors.<sup>4</sup>

---

<sup>2</sup>This approach follows Swiston, Mühleisen and Mathay (2007).

<sup>3</sup>Alberola and Montero (2006) do not take account of changes in revenue regimes when estimating elasticities of revenue with respect to income and commodity prices. This may explain the fact that their estimated income elasticities of revenue are generally much higher than ours (see section II below).

<sup>4</sup>Their methodology consists in applying a Hodrick-Prescott filter with a smoothing parameter calibrated to reproduce the degree of smoothing that is implicit in the structural fiscal balance estimates of the Chilean authorities. Because the commodity prices that drive the Chilean balance exhibit much less persistence than those of other commodities produced in Latin America (see appendix 3), this leads to a far larger adjustment than if structural balances are based on country-by-country properties of commodity prices, as in this study.

Our study has three main findings.

First, not surprisingly, commodity related revenues play an important role in the recent revenue boom of commodity producing countries. Whether or not these revenue increases should be viewed as permanent or not depends on the commodity. For fuel commodities, medium term projections by the IMF and World Bank envisage largely flat prices in the medium run. For non-fuel commodities, declines are envisaged, particularly for some metals. Furthermore, the assessment of whether non-fuel commodity price increases should be viewed as permanent or not turns out to depend on the forecast source. Model-based forecasts by the World Bank envisage greater declines over the medium term than IMF projections, which are largely based on futures markets data.

Second, revenue increases that are identifiably due to the business cycle play virtually no role in explaining the rise of the revenue-to-GDP ratio. The main reason is that estimated income elasticities of revenue are close to unity in most cases (they range between 0.8 and 1.35, with most elasticities clustered between 0.95 and 1.11). Hence, while noncommodity revenue *levels* are highly cyclical, revenue *ratios* should be quite insensitive to the cycle. Moreover, the estimated cyclical position of most Latin American countries is currently not very far from neutrality, namely in the order of 0–4 percent above “potential output.” Hence, a return to a cyclically neutral position would not have a big impact on revenue ratios.

Third, residual revenue changes that can be attributed neither to cyclical factors nor to identifiable changes in the tax regime are quite large in a handful of countries, in the order of 1–3 percent of GDP. In these countries, structural balance estimates are sensitive to whether these residuals are interpreted as reflecting unobserved structural changes, or as temporary. Statistical tests indicate that for the most part they ought to be interpreted as temporary, but there are some exceptions.

In sum, there is little doubt that fiscal positions in Latin America have “really” improved in recent years. The business cycle cannot have played a significant direct role in raising revenue *ratios*. Improved fiscal positions seem to mostly reflect *persistently* higher commodity prices, as well as changes in taxation and tax administration. This said, structural balances in Latin America are weaker than reported balances, particularly in the case of nonfuel commodity exporters, which are projected to suffer significant price declines in the medium term. Furthermore, they are subject to a large margin of uncertainty, both because of uncertain commodity price projections, and because some of the recent changes in noncommodity revenues as a share of GDP are hard to attribute *either* to cyclical conditions or to changes in the tax system.

## II. METHODOLOGY

### A. Noncommodity Structural Revenue

The standard approach to estimating noncommodity structural revenue (Hagemann, 1999; see also Chalk, 2002) assumes a constant elasticity relationship between revenue,  $R$ , and its tax base (for example, GDP or national income, denoted  $Y$ ):

$$R_t^{nc} = AY_t^\varepsilon . \quad (1)$$

Using a star to denote potential output, it follows that  $R_{s,t}^{nc} = AY_t^{*\varepsilon}$ . Substituting the parameter  $A$ , noncommodity structural revenue can hence be estimated by applying a simple cyclical correction to actual noncommodity revenue:

$$\hat{R}_{s,t}^{nc} \equiv R_t^{nc} \left( \frac{Y_t^*}{Y_t} \right)^{\hat{\varepsilon}} \quad (2)$$

where  $\hat{\varepsilon}$  is either an estimate of the revenue elasticity using time-series data for  $R_t$  and  $Y_t$  or an assumed value (most studies indicate that  $\hat{\varepsilon}$  is in a narrow range between about 1 and 1.3).

A potential problem with this approach arises from the fact that, for any specific  $\varepsilon$  and  $A$ , equation (1) does of course not hold period by period: in general,  $R_t^{nc} \neq AY_t^\varepsilon$ . That is,  $R_t^{nc} / Y_t^\varepsilon \equiv A_t$  is not constant over time. However, it could still be the case that equation (1) holds, conditional on a particular state of the tax system, as a characterization of the relationship between *structural* balances and *potential* GDP:  $R_{s,t}^{nc} = AY_t^{*\varepsilon}$ . In this paper, we will assume this to be the case. In that case, computing structural balances according to equation (2) amounts to assuming that  $A = A_t$ —that is, that the “structural” parameter  $A$  shifts in every period in line with the actual realization of revenues in relation to GDP. In other words, in the standard approach, *any change in revenues that cannot be explained by cyclical factors is considered structural*.

This is implausible in many cases, as fluctuations in  $A_t$  may reflect one-off or other factors that are reversed over time, consistent with a long-run stable  $A$ . Indeed, it could be the case that there are no structural breaks in  $A$  other than these associated with identifiable policy actions, which can be accounted for using dummy variables or by adjusting the revenue data. This hypothesis can be tested by testing for the existence of a long-run “co-integrating” relationship between the *adjusted* revenue series  $\tilde{R}_t^{nc}$  and  $Y_t$ , that is, by testing the proposition that although  $\tilde{R}_t^{nc}$  and  $Y_t$  are “integrated”—i.e., follow a stochastic trend—the residual from a regression of revenue on income is stationary. If this can be confirmed, it would imply that *any change in revenues that cannot be explained by either changes in the tax system or cyclical factors should be considered temporary*. Structural revenues would then be given by the fitted value in a regression of  $\tilde{R}_t^{nc}$  on  $Y_t$ , evaluated at a cyclically neutral level of output ( $\hat{R}_{s,t}^{nc} = \hat{A}Y_t^{*\hat{\varepsilon}}$ ), plus any effect of tax policy changes that was previously removed from the series in order to estimate the parameters in the above equation.

This study uses both approaches—that is, Equations (2) and (3)—to derive alternative estimates of the noncommodity structural revenues, based on output gap estimates and parameter estimates presented in Section III below.

## B. Commodity Structural Revenue

Commodity revenues depend on commodity production or export volumes, prices, and the fiscal regime. Fiscal regimes and production/export volumes are taken to be part of the “structure” that in principle is under the control of the authorities. Hence, making the same functional form assumption as in the last subsection,  $R_t^c = Bp_t^\gamma$ , and  $R_{s,t}^c = Bp_t^{*\gamma}$ , where  $p_t^*$  is the long-run commodity price expected at time  $t$ ,  $R_t^c$  stands for commodity revenues,  $B$  and  $\gamma$  are parameters, and the subscript  $s$  is used to denote structural revenue.

Ideally, parameters  $B$  and  $\gamma$  should be estimated in the same way as parameters  $A$  and  $\varepsilon$  in the previous section; namely by regressing an *adjusted* commodity revenue series  $\tilde{R}_t^c$  on an index of relevant commodity prices. In practice, this is very difficult, since it requires adjusting  $R_t^c$  for both changes in production volumes and changes in commodity fiscal regimes. We do not attempt to do so in this paper. Instead, we take two shortcuts. First, we substitute  $B$  (as in the standard structural balance methodology), to obtain:

$$R_{s,t}^c \equiv R_t^c \left( \frac{p_t^*}{p_t} \right)^\gamma \quad (4)$$

Second, rather than using unadjusted data for  $R_t^c$  to derive what would surely be a biased estimate of  $\gamma$ , we assume that  $\gamma = 1$ . In other words, following standard practice (see, for example, Marcel and others, 2001) we assume that commodity revenues are proportional to commodity prices.<sup>5</sup>

For  $p_t^*$ , we use commodity price forecasts published by international organizations. To obtain an idea of the sensitivity of our results to alternative forecasts, we use two sources: IMF projections of commodity prices, which are primarily based on futures prices and are available over a five-year period; and projections from the World Bank, which are based on an econometric model, and are available for a somewhat longer period (until 2015). We use the five-year horizon—that is,  $p_t^* = E[p_{t+5}]_t$ —because it is the longest available from both sources. In either case, export-share-weighted commodity price indices were created for each country, so that  $p_t^*$  is a weighted average of the expected prices of each commodity exported by that country (see appendix 3).

---

<sup>5</sup>Note that relationships do not explicitly recognize the role of the exchange rate in translating dollar commodity revenues into local currency revenues (implicitly, the exchange rate is subsumed in the parameter  $B$ ). This is admissible so long as the real exchange rate is close to its equilibrium value, which is an acceptable assumption for most countries studied here. If exchange rates are not close to equilibrium, this would create an additional reason why structural commodity revenues could be different from actual revenues. An undervalued exchange rate implies that structural commodity revenues are lower than actual revenues, while an overvalued currency implies that they are higher.

### C. Structural Balances

By definition, the structural balance equals structural revenue minus structural expenditures:

$$B_{s,t} \equiv R_{s,t} - E_{s,t} \equiv R_{s,t}^{nc} + R_{s,t}^c - E_{s,t}, \quad (5)$$

where  $B$  stands for balance and  $E$  for expenditure (or noninterest expenditure, if the focus is the structural *primary* balance), and the remaining notation is unchanged.

Unlike some industrial countries, expenditure commitments tied to the economic cycle (for example, unemployment benefits) do not play a major role in Latin American budgets. For this reason, we follow the literature (for example, Alberola and Montero, 2006) in assuming that all expenditure is “structural,” i.e., that it lacks any automatic countercyclical link to output and employment:  $E_{s,t} = E_t$ .<sup>6</sup> Structural revenues are computed as described in the previous two subsections.

The structural balance as a share of GDP is obtained by dividing both sides by potential output  $Y_t^* \equiv Y_t/g$ , where  $g$  denotes the output gap expressed as a ratio. Using lower-case letters to denote shares of current GDP and setting  $\gamma = 1$ , this yields, based on Equation (2):

$$\frac{\hat{B}_{s,t}}{Y_t^*} = r_t^{nc} g_t^{1-\hat{\epsilon}} + r_t^c \frac{E[p_{t+5}]_t}{p_t} g_t - e_t g_t \quad (6)$$

and based on Equation (3):

$$\frac{\tilde{B}_{s,t}}{Y_t^*} = AY_t^{*(\hat{\epsilon}-1)} + r_t^c \frac{E[p_{t+5}]_t}{p_t} g_t - e_t g_t. \quad (7)$$

Hence, when actual GDP is above potential GDP ( $g \equiv Y_t/Y_t^* > 1$ ), computing the structural balance involves an upward adjustment both to the reported expenditure-to-GDP ratio and to commodity revenues as a share of GDP, as the denominator (GDP) is larger than it would be at potential, while the numerator in these expressions is assumed to be independent of GDP. The upward adjustment of the expenditure ratio will lead to a weaker structural balance as a share of GDP compared to the actual balance, while the upward adjustment to commodity revenues will tend to strengthen it. Finally, the direction of the adjustment to noncommodity revenue will depend on the income elasticity of revenue. In equation (6), when the elasticity is smaller than one (taxes react less than proportionally to output), there the reported revenue-to-GDP ratio will be adjusted upward; when it is greater than one, there is a downward adjustment.

---

<sup>6</sup>If anything, expenditures in Latin America have tended to be *procyclical* (Clements, Faircloth, and Verhoeven, 2007), as governments took advantage of buoyant revenue to expand expenditure in good times, and were forced to compress it in bad times owing to borrowing constraints or high borrowing costs.

In sum: with an income elasticity of revenue greater than one, the downward adjustment to reported balances will be larger (1) the higher actual GDP relative to potential; (2) the larger the income elasticity of revenue; and (3) the lower medium-term expected commodity prices are relative to actual commodity prices.

### III. RESULTS

#### A. Parameter Estimates and Statistical Tests

Structural noncommodity revenues according to Equation (2) and (3) were estimated using the following steps.

First, for countries considered commodity producers—defined here as having commodity-related revenues in excess of 2 percent of GDP—central government revenue was adjusted to exclude commodity revenues. Next, for each country, the resulting *noncommodity* central government revenue series was adjusted for the impact of changes in tax policy.<sup>7</sup>

Our preferred approach was to directly adjust the revenue series for the revenue effect of changes in the tax structure based on impact estimates by country tax authorities, IMF staff, or other sources (see appendix for a description of tax structure changes and adjustments made for each country). In cases in which a direct estimate could not be obtained, the effect of changes in the tax structure was controlled for through step dummies. We generally avoided the use of dummies in the latter part of the sample (2004–06), since a dummy in this period could also pick up cyclical improvement along with the effect of tax system changes.<sup>8</sup>

Non-commodity, tax change-adjusted revenue data was then regressed on GDP using both ordinary least squares and dynamic ordinary least squares (the latter, to obtain correct standard errors, given the non-stationarity of the series). We also attempted to estimate the relationship between adjusted revenue and GDP using the Johansen procedure, but this was feasible only in a few cases because of the short data series. For most countries, there is at least weak evidence of cointegration according to either the Johansen test or tests for stationarity of the residuals from the OLS regression (see columns “ADF” and “KPSS” of Table 2). One exception is Peru, for which the null hypothesis of nonstationary residuals cannot be rejected using the ADF test, while the null hypothesis of stationary residuals can be rejected using the KPSS test. For Argentina and Costa Rica, the tests deliver contradictory messages. The ADF test suggests stationary residuals (and hence cointegration) for Costa Rica, but this is not picked up by the Johansen test. For Argentina, the Johansen test suggests cointegration, but tests of the residuals indicate that these are nonstationary (Table 2).

---

<sup>7</sup>This required extensive information on changes in the tax system and their revenue impact, which was available only for some countries. As a result, our sample in this step of the analysis is limited to eight countries: Argentina, Brazil, Colombia, Costa Rica, Chile, El Salvador, Panama, and Peru.

<sup>8</sup>The only exception was Costa Rica, which introduced an automation of customs administration in 2005, whose impact is very difficult to estimate independently.

Table 2. Long-Run Income Elasticity of Central Government Tax Revenues  
(standard errors in parentheses)

	Ordinary Least Squares (OLS)		Johansen procedure			Dynamic OLS 3/		N		
	Estimated income elasticity	ADF test (test statistic) 1/	KPSS test (test statistic) 2/	Estimated income elasticity	Trace test Eigenvalue	Chi-square test statistic $\beta=1$	Estimated income elasticity		Chi-square test statistic $\beta=1$	
Argentina	1.00 (0.01)	-2.24	0.29*	1.06 (0.07)	2	2	0.34	1.02 (0.01)	4.94*	24
Brazil	1.03 (0.01)	-1.82	0.21	1.14 (0.01)	3	1	37.95**	1.03 (0.02)	3.14	15
Chile	0.96 (0.03)	-2.63	0.14	0.85 (0.07)	0	0	5.32*	0.94 (0.03)	2.91	13
Colombia	1.10 (0.04)	-1.73	0.12	...	...	...	...	1.21 (0.03)	37.9**	10
Costa Rica	1.11 (0.02)	-4.92**	0.25	0.94 (0.03)	0	0	2.74	1.01 (0.04)	0.12	14
El Salvador	1.36 (0.17)	-2.05	0.09	...	...	...	...	1.27 (0.08)	12.07**	14
Panama	0.80 (0.16)	-1.95	0.11	...	...	...	...	0.67 (0.19)	3.05	13
Peru	1.11 (0.07)	-3.42	0.14*	...	...	...	...	0.85 (0.08)	3.80	16

1/ \* and \*\* denote rejection of the null hypothesis that the residuals are nonstationary at the 5% and 1% significance level, respectively. Critical values for the Dickey-Fuller  $t$ -statistics when applied to residuals are taken from Hamilton (1994), Table B.9.

2/ \* and \*\* denote rejection of the null hypothesis that the residuals are stationary at the 5%, and 1% significance level, respectively. Critical values for the KPSS LM-statistics when applied to residuals are taken from Shin (1994), Table 1.

3/ Number of leads and lags chosen on basis of Wald test of coefficient restrictions. Number of lags/leads considered is limited by small sample size.  
4/ Number of observations

The dynamic-least-squares estimates of the long-run policy-adjusted income elasticity of noncommodity central government tax revenues suggest that the estimated income elasticity is statistically different from unity only for Argentina, Colombia and El Salvador. It is also economically close to 1 in most cases. Colombia and El Salvador are the exceptions on the upside (coefficients of 1.21 and 1.27, respectively, according to dynamic OLS). Panama has a much lower point estimate of the income elasticity of tax revenues than the other countries, which could perhaps be explained by the lack of full inclusion of some dynamic sectors of the economy in the tax base (relating to entrepot trade, and the canal zone). However, the elasticity is imprecisely estimated and statistically insignificantly different from unity.

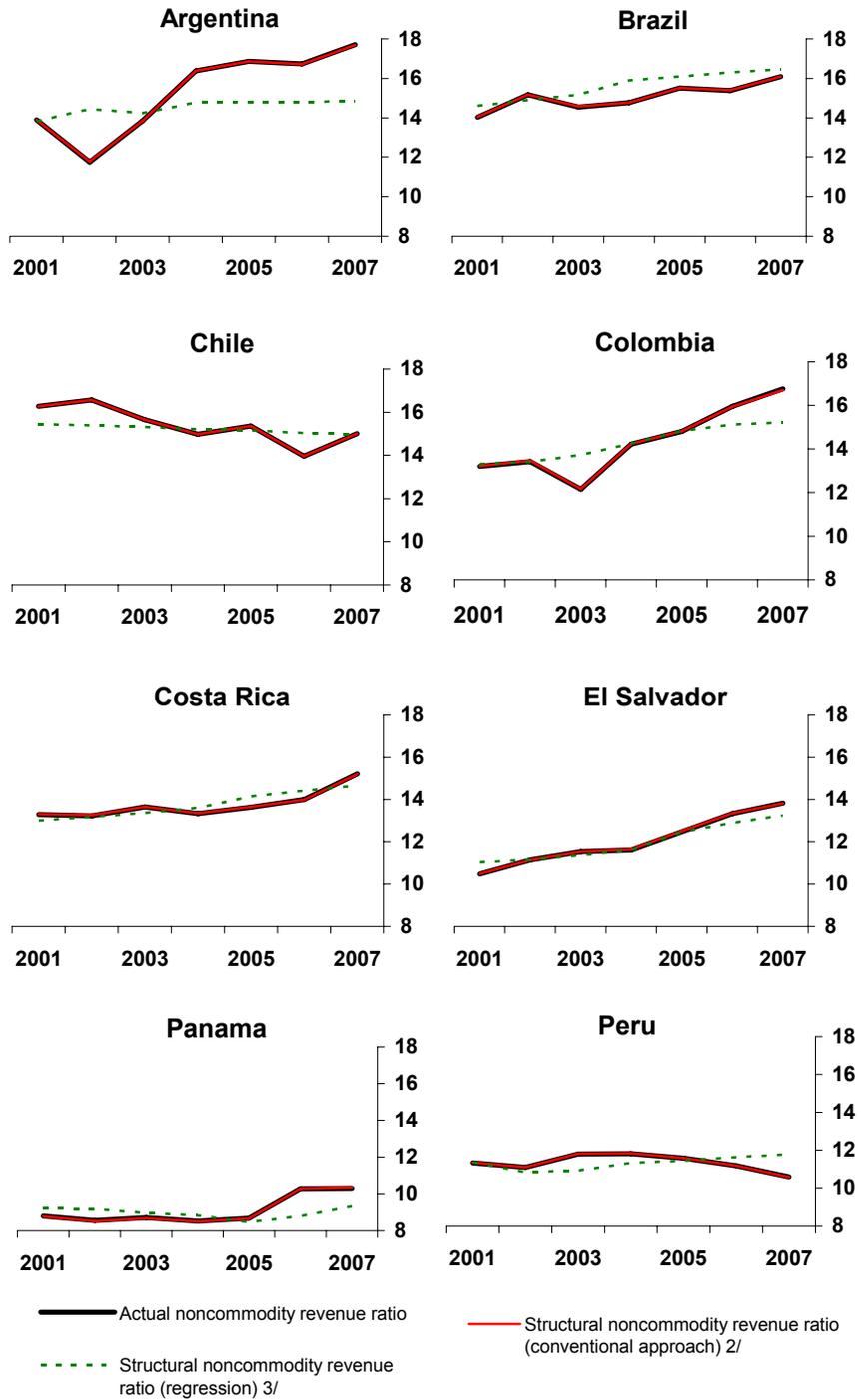
### B. Structural Noncommodity Revenues

Using the parameter estimates in Table 2, we now present estimates of structural non-commodity revenues based on the two approaches discussed at the beginning of section II. First, we show the standard cyclical adjustment to headline revenues (equation 2), which implicitly assumes that any non-cyclical increase in revenues is structural. This cyclical adjustment uses output gap measures based on a Hodrick-Prescott filtered series of output (our results are not sensitive to using this particular filter; see appendix). Second, we present the alternative approach, in which structural revenues are computed as “fitted” revenue based on the estimated long-run relationship between (tax-change adjusted) revenues and GDP (equation 3). In this approach, any deviation from the fitted values is viewed as temporary, regardless of whether it has cyclical or other causes, except if it can be attributed to specific changes in the tax system. In either approach, we use the *maximum* estimated income elasticity of revenue among the coefficients estimated for each country (Table 2). This stacks the empirical exercise in favor of the view that the current revenue boom is cyclical, and that structural revenues are currently low relative to actual revenues.

The results are presented in Figure 1, which compares the actual noncommodity revenue-to-GDP ratio (black line) with the structural ratio according to both the standard approach (red, solid line) and the alternative approach (green, broken line). Three facts are worth noting:

- In most cases (5 out of 8) both actual and structural non-commodity revenues appear to have been on an upward trend in recent years, regardless of which structural adjustment approach is used.
- The black and red solid lines turn out to be almost exactly “on top of each other” In other words, cyclically adjusted revenue ratios (i.e. adjustment according to the “standard approach”) are almost indistinguishable from actual revenue ratios.
- There are much greater discrepancies between actual and structurally adjusted revenue ratios using the alternative approach. The difference is particularly large in the case of Argentina.

**Figure 1. Actual and Structural Noncommodity Revenues**  
(Central Government, in percent of GDP) 1/



Sources: Authors' calculations based on data from national authorities; World Bank, UNCOMTRADE database; and IMF *World Economic Outlook*.

1/ Cyclical adjustments based on HP-filtered output with smoothing parameter = 6.25

2/ Adjustment based on income elasticities of revenue estimated in Table 2.

3/ Fitted values from regressions reported in Table 2.

To see why a simple cyclical adjustment makes virtually no difference to the revenue ratio, recall that after dividing both sides of equation (2) by potential output, structural revenues in the standard approach are given by:

$$\frac{R_{s,t}^{nc}}{Y_t^*} = \frac{R_t^{nc}}{Y_t} g_t^{1-\hat{\epsilon}} \quad (8)$$

The extent of this cyclical adjustment will depend on two factors: the cyclical position—that is, whether the economy is deemed to be far away from a neutral cyclical state—and the income elasticity of revenue, which measures how much revenues tend to respond to changes in economic activity.

If the income elasticity of revenue is 1—that is, revenues respond proportionally to changes in output—then the economic cycle has no impact on the revenue-to-GDP ratio, and the reported ratio will be deemed entirely “structural.” Similarly, if the income elasticity of revenue is different from 1 but actual output is close to potential output, then any cyclical adjustment to the reported revenue ratio will also be very small.

As it turns out, for the eight countries whose revenues are analyzed in this section the cyclical adjustment is very small for one or the other of these reasons. For most countries, income elasticities underlying Figure 1 were close to 1 (between 0.96 and 1.11). For Colombia and El Salvador, the elasticities used were 1.21 and 1.36, respectively; and for Panama it was 0.8. However, the output gaps (deviations from neutral cyclical positions) for these countries are estimated to be relatively modest, namely, between 0 and 3.5 percent of GDP. As a result, any cyclical adjustment to revenue/GDP ratios is very minor, leading to virtually no difference between the red and black solid lines.<sup>9</sup> What turns out to matter much more is revenue buoyancy that is hard to attribute to *either* the business cycle or to changes in the tax system. Five of our eight countries exhibit positive residuals in 2007, in the range of 0.6–2.9 percentage points of GDP (see difference between broken green and solid black lines).

Which of the two approaches is closer to the truth? It depends on what drives “residual” revenues. These could reflect one-off increases or decreases in revenue that are likely to disappear over the medium term. But they could also reflect unaccounted for but nonetheless permanent structural changes, for example, unaccounted for improvements in tax administration. Table 2 indicates that for most countries, the null hypothesis that these residual revenues are stationary could not be rejected (see “KPSS test”); in this light, it is wise to treat residual revenue buoyancy as temporary rather than structural. The main exception is Argentina, where the KPSS test does reject. Figure 1 shows that Argentina experienced a large rise in the revenue ratio earlier than the other countries, with no tendency

---

<sup>9</sup>To give an example, suppose a country has an output gap of 3 percent (output is 3 percent above potential), which is at the high end of the 2007 output gap estimates shown in the appendix) and a noncommodity tax ratio of 10 percent of GDP. Assuming an elasticity of 1.1, cyclically revenue would be  $10 \cdot 1.03^{0.9} = 9.97$  percent of GDP, just three-hundreds percentage points lower than the headline tax ratio. Using the highest elasticity in the sample (1.36), the adjustment would be to 9.89 percent of GDP, just one tenth percent of GDP below.

to revert over time. Hence, its shift in revenue is at this point is most plausibly regarded as structural.

### C. Structural Commodity Revenues

As described in Section II, structural commodity revenues were computed in two steps. First, based on either IMF or World Bank price projections, country-specific indices of both actual and expected commodity prices—defined as five-year ahead expectations at the time of the actual prices—were constructed for nine major commodity producers in the LAC region.<sup>10</sup>

Next, for each country, actual commodity revenues were multiplied by the ratio of actual and expected prices in each year. Hence, structural commodity revenues were computed as actual revenues valued at medium term expected prices. We do this using two alternative sets of commodity price forecasts based on different methodologies, from the World Bank and from the IMF, respectively (Figure 2).

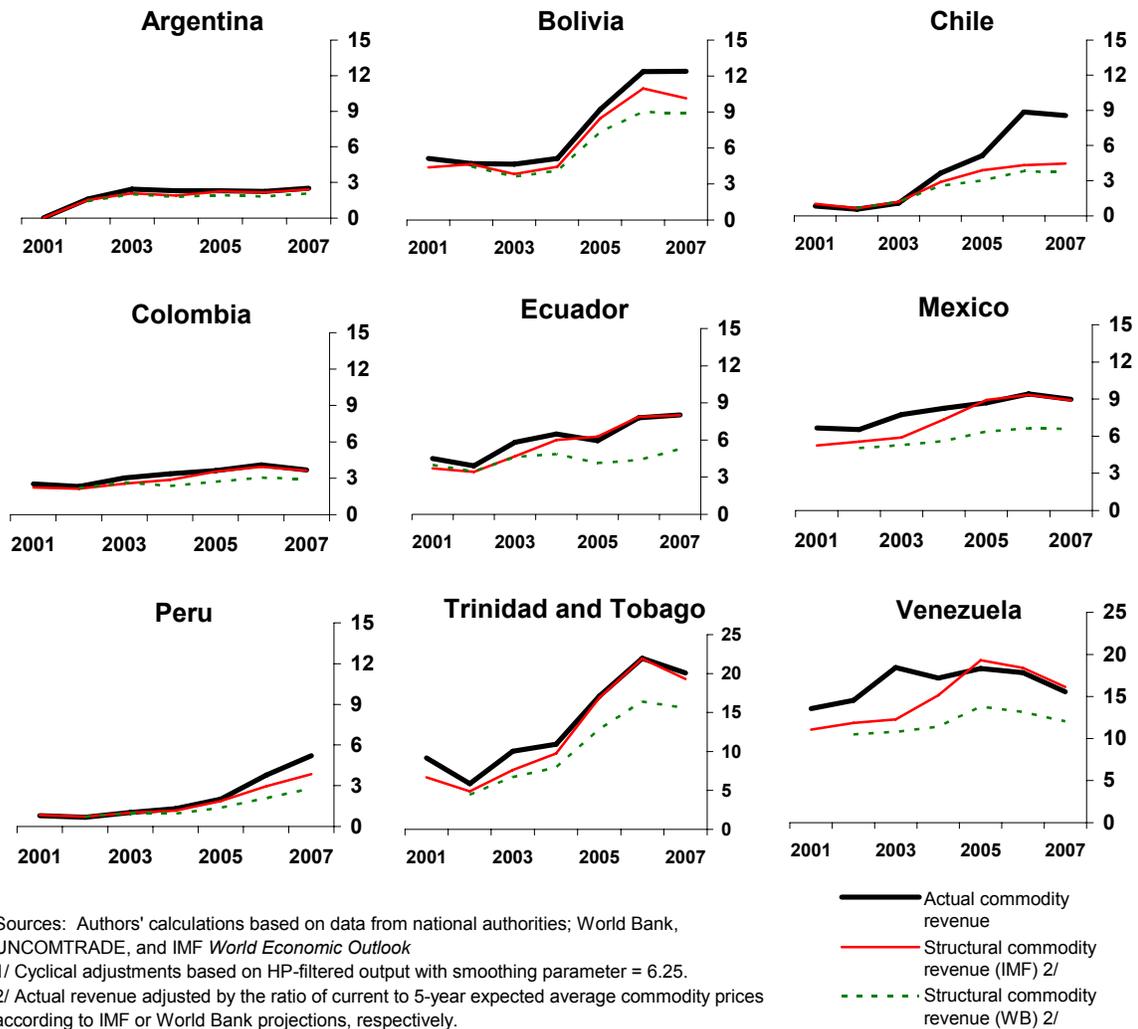
Figure 2 shows that in most countries, structural commodity revenues have been following more roughly the same trend as actual revenue, namely, upward. This said, the rise in structural commodity revenues has been slower for some countries. For Chile, in particular, there is a very large difference between actual and structural commodity revenues, in the order of 4–5 percent of GDP, regardless of whether World Bank or IMF commodity price forecasts are used. In most other cases, the results are fairly sensitive to the set of commodity price projection that is used. IMF commodity price forecasts imply a fairly high persistence of recent commodity price indices, implying that structural commodity revenues for these countries have been rising significantly. In contrast, the World Bank projects lower medium-term prices for most commodities exported from Latin American countries, including energy (see appendix 3); this translates into a generally more pessimistic view of underlying structural commodity revenues.

The two sets of estimates diverge particularly in the case of the large oil producers (Ecuador, Mexico, Trinidad and Tobago, and Venezuela). IMF projections, based on futures markets, forecast continued high oil prices in the medium term. But the model-based projections by the World Bank envisage a significant decline in oil prices (on the order of 25 percent) over the next five years, with an even bigger drop by 2015. As a result, structural commodity revenues estimated using these price projections are currently below actual commodity revenues by 3–4 percent of GDP in Venezuela and Trinidad and Tobago, and by around 2 percent in Ecuador and Mexico. In contrast, estimates based on the IMF price projections imply that current revenue levels will be sustained over the medium term, provided that production volumes are maintained.

---

<sup>10</sup>Namely, countries with at least 2 percent of GDP commodity revenue, on average, over the 2002–2007 period: Argentina, Bolivia, Chile, Colombia, Ecuador, Mexico, Peru, Trinidad and Tobago, and Venezuela.

**Figure 2. Actual and Structural Commodity Revenues**  
(In percent of GDP) 1/



#### D. Structural Primary Balances

Combining the structural revenue estimates presented so far with noninterest expenditure data, we now present a set of estimates of structural primary balances. These give a sense of the overall strength of the fiscal position in the countries analyzed. Depending on which concept is used to compute noncommodity structural revenues, they are constructed using either equation (6) or (7). To overcome data difficulties, two additional assumptions were needed:

- Since commodity revenues often accrue to public enterprises, we focus here on overall *public sector* structural balances. This requires taking a view on structural, or permanent, noncommodity revenues outside the central government. For lack of a feasible alternative, we use the “conventional” approach to structurally adjust this portion of

revenues, i.e. we assume that all noncyclical changes in noncommodity revenues outside the central government revenues are structural.

- For noncommodity producers whose noncommodity structural revenues could not be analyzed in detail due to lack of data, the standard methodology for calculating cyclically adjusted revenues is applied using the average revenue elasticity estimated for the other countries in the region (about 1.1).

Figure 3 shows the results. Reflecting the fact that we have two alternative estimates for commodity structural revenues and up to two estimates for non-commodity structural revenues, the figure plots up to four alternative structural balance paths for each country. Together, these give a sense of the range covered by alternative point estimates.

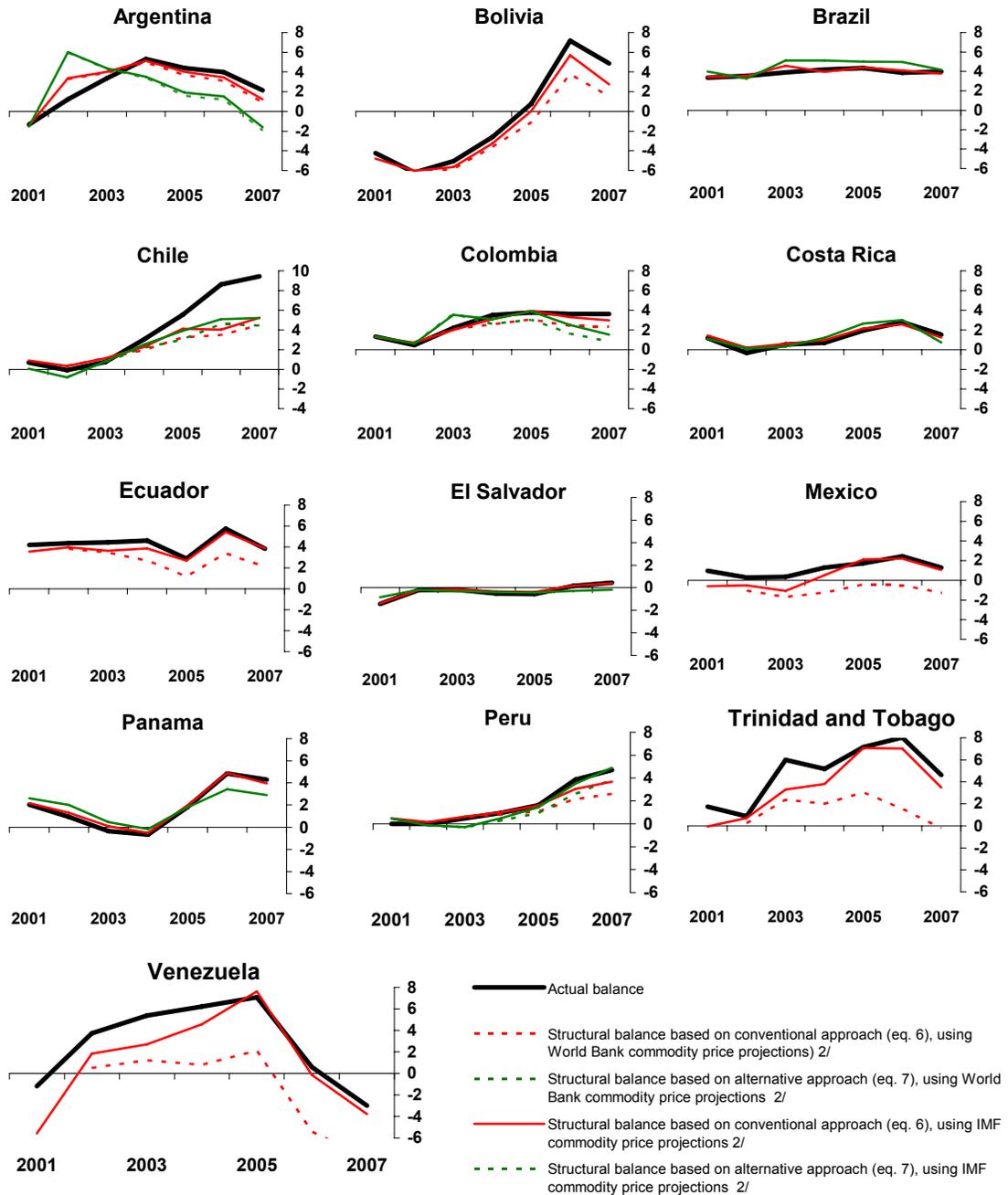
The main result is that structural primary balances—and, by implication, structural overall balances, since interest payments have declined—have indeed improved significantly in Latin American countries relative to the beginning of the decade. Although structural primary balances peaked in 2006, they appear to have remained in surplus in most countries in 2007.

This said, there are large differences across countries, ranging from a large 2007 public sector primary surplus in Chile to a substantial deficit in Venezuela.<sup>11</sup> Furthermore, for some countries, the structural balance estimates plotted in Figure 3 describe wide ranges, driven by conflicting commodity price projections—particularly for oil—and, in some cases, discrepancies between alternative approaches for estimating noncommodity structural revenue. In some cases, we can narrow these ranges using statistical criteria, as described earlier. This leads us to conclude that the more pessimistic approach for estimating noncommodity structural revenues (green lines, where any “residual” increase is viewed as temporary) should be preferred in all cases except Argentina. However, there remains significant uncertainty as to the true level of structural balances, particularly since these ranges described in Figure 3 do not reflect parameter uncertainty, and only give a limited sense of forecast uncertainty with regard to commodity prices.

---

<sup>11</sup>Note our calculations refer to the structural *public sector primary* balance, while the Chilean government’s structural surplus target refers to the *overall* structural balance of the *central government*. Our calculations for Chile are consistent with the government’s structural surplus target when similar commodity price projections are used.

**Figure 3. Actual and Estimated Structural Primary Balances**  
(In percent of GDP)<sup>1/</sup>



Sources: Authors' calculations based on data from national authorities; World Bank; UNCOMTRADE database; and IMF *World Economic Outlook*.

<sup>1/</sup> Cyclical adjustments based on HP-filtered trend output with smoothing parameter = 6.25

<sup>2/</sup> "Conventional" estimates view all noncyclical revenues as structural and use IMF commodity price projections; "alternative" excludes regression residual from definition of noncommodity structural revenues and uses World Bank projections.

#### IV. CONCLUSION

Many Latin American countries made impressive improvements in fiscal positions between 2002 and 2007. Following an initial period of expenditure restraint earlier in this decade, these fiscal improvements have recently come from the revenue side, and have occurred under exceptionally favorable external conditions, and in the context of a cyclical upswing. This justifies a dose of healthy skepticism regarding the sustainability of these fiscal improvements. To paraphrase the title of a recent IADB report on Latin America, when so much glitters at the same time, not all that glitters may be gold.

Based on a country-by-country analysis that sought to disentangle temporary and structural improvements, this paper concludes that although structural fiscal balances generally improved *less* than actual balances between 2002 and 2007, they nonetheless improved—significantly so in many cases. While most of these improvements occurred between 2003 and 2005, it continued even after 2005 in some cases—for the most part, until 2006. Between 2006 and 2007, structural balances generally deteriorated—driven by high expenditure growth—but not by very much: in part, because they were bolstered by further commodity price increases, which raised not only actual but also medium term expected prices, benefiting structural commodity revenues.

Hence, while fiscal positions in Latin America today may not be “gold,” they seem to be of fairly solid material, certainly when compared to the region’s history of fiscal weakness. However, this conclusion needs to be accompanied by several caveats.

First, although the skeptics are wrong in claiming that Latin America’s “headline” fiscal improvements mask a deterioration in fiscal fundamentals, they are right in observing that a large portion of the headline improvement is due to commodity prices, and hence good luck. Though this should have mostly permanent effects, it is also possible that there is a speculative element—a bubble—behind some of the most recent run-ups in commodity prices. If this bubble bursts, it would hurt the fiscal position of Latin American commodity producers.<sup>12</sup>

Second, there are large margins of uncertainty in our structural balance estimates, in addition to competing and uncertain commodity price forecasts, these derive from the fact that in some countries, a portion of the recent increases in revenue is hard to “explain” at all, in the sense that it cannot be easily traced to either identifiable changes in the tax system, or commodity prices, or growth in non-commodity tax bases. For the most part, the conclusions of this paper hold even if these “residual increases” are viewed as transitory, but as is clear from Figure 3, there are exceptions.

Finally, while Latin America is in much better fiscal shape than it was in 2002 or 2003, these gains could be frittered away quickly if expenditures continue to grow at the high rates experienced in the last two years, namely, 8-10 percent on average in *real* terms. While the

---

<sup>12</sup>As a caveat to the caveat, however, note that the analysis for 2007 in this paper is based on commodity price data and expectations as of October 2007, that is, prior to the drastic jump in oil and food prices in early 2008.

effect of rapid expenditure growth has so far been fully (in 2006) or partly (in 2007) offset by continued revenue growth, this is not a trend that can be expected to continue.

Hence, if Latin America is to avoid returning to primary deficits and new debt problems, curtailing expenditure growth will need to be a top priority. In some countries, better control of expenditures may require institutional or structural reforms. Depending on country circumstances, such reforms could include reducing budgetary rigidities (Alier, forthcoming), increasing expenditure efficiency and flexibility, and strengthening public financial management systems.

## REFERENCES

- Alier, Max, "Measuring Budget Rigidities in Latin America," IMF Working Paper (unpublished; Washington: International Monetary Fund).
- Alberola, Enrique, and José Manuel Montero, 2007, "Debt Sustainability and Procyclical Fiscal Policies in Latin America," *Economía*, Vol. 7, No. 1 (Fall 2006 Issue), pp. 157–84.
- Baxter, Marianne, and Robert King, 1999, "Measuring Business Cycles: Approximate Band-Pass Filters for Economic Time Series," *Review of Economics and Statistics*, Vol. 81, No. 4, pp. 575–93.
- Chalk, Nigel, 2002, "Structural Balances and All That: Which Indicators to Use in Assessing Fiscal Policy," IMF Working Paper 02/101 (Washington: International Monetary Fund).
- Coelho, Isaias, Liam Ebril, and Victoria Summers, "Bank Debit Taxes in Latin America: An Analysis of Recent Trends," IMF Working Paper WP/01/67 (Washington: International Monetary Fund).
- Contraloría General de la República de Costa Rica, 2002, *El Sistema Tributario Costarricense: Contribuciones al Debate Nacional* (San José: Costa Rica).
- Corbae, Dean, and Sam Ouliaris, 2002, "Band Spectral Regression with Trending Data," *Econometrica*, Vol. 70, No. 3, pp. 1067–1109.
- , 2006, "Extracting Cycles from Nonstationary Data," *Econometric Theory and Practice: Frontiers of Analysis and Applied Research* (Cambridge and New York: Cambridge University Press), pp. 167–77.
- Cubero, Rodrigo, and Rhiannon Sowerbutts, "Actual vs. Structural Fiscal Balances: Evidence from Costa Rica," IMF Working Paper (unpublished; Washington: International Monetary Fund).
- De Mello, Luiz, and Diego Moccero, 2006, "Brazil's Fiscal Stance During 1995–2005: The Effect of Indebtedness on Fiscal Policy over the Business Cycle," Economics Department Working Paper No. 485 (Paris, France: OECD).
- Duarte Lledo, Victor, 2005, "Tax Systems under Fiscal Adjustment: a Dynamic CGE Analysis of the Brazilian Tax Reform," IMF Working Paper 05/142 (Washington: International Monetary Fund).
- Hagemann, Robert, 1999, "The Structural Budget Balance: The IMF's Methodology," IMF Working Paper 99/95 (Washington: International Monetary Fund).

- Hodrick, Robert J., and Edward C. Prescott, 1997, "Postwar U.S. Business Cycles: An Empirical Investigation," *Journal of Money, Credit and Banking*, Vol. 29 (February), pp. 1–16.
- Izquierdo, Alejandro, Pablo Ottonello, and Ernesto Talvi, "If Latin America Were Chile: A Comment on Structural Fiscal Balances and Public Debt" (unpublished; IADB Research Department and CERES).
- Inter-American Development Bank, 2008, "All That Glitters May Not Be Gold: Assessing Latin America's Recent Macroeconomic Performance," (Washington: Inter-American Development Bank).
- International Monetary Fund, 2006, *Regional Economic Outlook: Western Hemisphere*, November 2006 (Washington).
- , 2007, *Regional Economic Outlook: Western Hemisphere*, November 2007 (Washington).
- Lozano, Ignacio, and Jorge Toro, 2007, "Fiscal Policy Throughout the Cycle: the Colombian Experience," *Borradores de Economía*, No. 34 (Colombia: Banco de la Republica).
- Marcel, Mario C., Marcelo Tokman, Rodrigo Valdés, and Paula Benavides, 2001, "Balance Estructural del Gobierno Central Metodología y Estimaciones para Chile: 1987–2000," *Estudios de Finanzas Publicas*, September (Santiago de Chile: Direccion de Presupuestos, Ministerio de Hacienda, Government of Chile).
- Martner, Ricardo, and Varinia Tromben, 2004, "Tax Reforms and Fiscal Stabilization in Latin American Countries," *Serie Gestión Pública*, No. 45, CEPAL, Santiago, Chile.
- Ravn, Morten O., and Harald Uhlig, 2002, "On Adjusting the Hodrick-Prescott Filter for the Frequency of Observations," *Review of Economics and Statistics*, Vol. 84, No. 2, pp. 371–76.
- Rico Torres, Cecilia, 2006, "Recursos Fiscales Para el Restablecimiento del Orden Publico en Colombia: 1991–2006," *Direccion de Impuestos y Aduanas Nacionales, Oficina de Estudios Economicos*, Documento Web 013.
- Rodríguez Arosemena, Nicolás, 2007, "Incidencia de la Política Fiscal en Panamá" (Washington: Banco Interamericano de Desarrollo).
- Swiston, Andrew, Martin Mühleisen, and Koshy Mathai, "U.S. Revenue Surprises: Are Happy Days Here to Stay?" IMF Working Paper 07/143 (Washington: International Monetary Fund).
- Werneck, Rogerio, 2004, "An Evaluation of the 2003 Tax Reform Effort in Brazil," *Discussion Paper No. 488*, PUC-Rio.

## APPENDIX

### 1. Revenue Data and Changes in Tax Structure

#### Argentina

**Data:** Tax revenues at the federal government level, 1980–2007. It is difficult to separate out commodity-related tax revenues from the available fiscal data. For the purposes of this study, we used export taxes as a proxy for commodity-related revenues, because of their direct link to commodity exports.

**Tax structure changes:**

While accounting for all of the tax system changes that have occurred in Argentina over the last three decades is infeasible, we attempted to capture the main events that had a notable impact on the tax structure.

- A financial transactions tax was introduced for the period 1988–1992, with various rate changes throughout period. We adjusted the tax revenues series for the nominal yield of this measure.
- A number of changes were introduced in 1989, including, in December 1989, a broadening of the VAT base to include virtually all goods. As the nominal impact is difficult to estimate, this change in the tax structure was controlled for by using a step dummy starting in 1990.
- The VAT rate was raised from 16 percent in 1980 to 18 percent in 1991 and 21 percent in 1995. An adjustment was made to the nominal series to account for the effect of the rate changes.
- Financial transactions taxes were re-introduced in 2001. The tax revenue series was adjusted by the nominal yield of this tax.

#### Brazil

**Data:** Tax revenue at the federal government level, 1992–2007. A series for commodity-related revenue is not available, however, this revenue was estimated to be relatively small at the federal government level (about 2 percent of GDP or less over the sample period). Thus, the original tax revenue series was not adjusted for commodity-related revenues.

**Tax structure changes:**

- A financial transactions tax (CPMF) was introduced in February 1997. The nominal revenue yield of the financial transactions tax is available, and was used to adjust the revenue series.

- A fiscal package, containing both revenue and expenditure measures, was announced by the government on November 10, 1997. At the federal level, the revenue measures included a personal income tax surcharge of 10 percent for all taxpayers in the upper 25 percent tax bracket, limits on deductions from taxable income, a 25 percent reduction in regional fiscal incentives for 1998, an increase in the industrial products tax (IPI) for automobiles, beverages, and temporary increases in the prices of petroleum derivatives and alcohol. As neither ex-ante nor ex-post estimates of the nominal impact of these measures are available, they were controlled for through a step dummy, beginning in 1998.
- A major tax reform took place in 2003, with its main impact beginning in 2004. The main measure of the 2003 tax reform was the conversion of the Cofins from a turnover tax into a non-cumulative tax. The financial transaction tax (CPMF) was also extended. Initial (ex-ante) impact estimates for 2004 were released by the Ministry of Finance at the time of the introduction of the reform<sup>13</sup>, but the nominal revenue series was adjusted by the actual size of the impact (ex-post) observed for that revenue item.

## Chile

**Data:** Tax revenue at the central government level, 1993–2007. Commodity revenues accrue to state enterprises and the central government. Central government commodity tax revenues include income and VAT payments by the private mining companies. Thus, the central government tax revenue series was adjusted by the available series on such payments.

### *Tax Structure Changes:*

- In Chile, major reforms of the tax system happened relatively early, before the time period under consideration. In the early 1980s, the VAT rate fluctuated between 20 and 16 percent, depending on perceived revenue needs. In 1984, the government lowered the income tax, reducing the marginal tax rate and widening the tax brackets. In 1990, the government raised the VAT rate from 16 to 18 percent and reversed some of the more regressive changes in the income tax that had been implemented in 1984. It also closed some loopholes in corporate taxation and imposed taxes on all business profits, raising the rate for 1991–1993 from 10 to 15 percent.
- The only changes made to the tax system since 1993 were changes in the tax rates for various categories of the income tax (*Impuesto a la Renta de Primera Categoría* and *Impuesto Global Complementario*). The personal income tax rate was raised from 15 percent to 16 percent and 16.5 percent, respectively, in 2002 and 2003. As of January 1, 2004, the rate was raised to and has remained at 17 percent. The maximum marginal tax rate for the *Impuesto Global Complementario* fell from 45 percent in 2001,

---

<sup>13</sup>See “*Impactos da Mudança do Regime de Tributação de Cofins*,” Ministry of Finance, Brazil.

to 43 percent in January 2002, and 40 percent in 2003. Given detailed information on the base, a nominal impact was calculated to adjust the tax revenue series.

## Colombia

**Data:** Tax revenue at the central government level, 1993–2007. Most of commodity revenues accrue to state enterprises, and do not affect central government revenues substantively. Thus, no adjustment was made to the central government revenue series.

### *Tax structure changes:*

- A financial transactions tax was introduced in 1999. The tax revenue series was adjusted to exclude the nominal impact of the financial transactions tax.
- A wealth tax was introduced in August 2002 (Decree No. 1838). The tax is assessed on net assets, and is assessed on payers of income tax at a rate of 1.2 percent. The tax revenue series is adjusted to exclude the nominal impact of this wealth tax. Estimates of the nominal impact of this tax are presented in Rico Torres (2006). However, these estimates differ substantially from the nominal collections for this tax reported to IMF staff. The latter series was used in adjusting overall tax revenues.<sup>14</sup>
- The VAT rate was increased from 15 to 16 percent in January 2001, together with some additional tax measures, including changes to the income tax. Two adjustments were made: a nominal adjustment of the tax revenue series to account for the rate change (which keeps the VAT structure unchanged at 15 percent), and a step dummy for 2001, to allow for the potential impact of the additional tax structure changes, for which a nominal estimate cannot be made.
- There was a broadening of the VAT base in 2003. Since neither ex-post nor ex-ante estimates are available, this change was controlled for with a step dummy for the 2003–2007 period.

## Costa Rica

**Data:** Tax revenue at the central government level, 1991–2007. Commodity-related revenues are economically insignificant.

### *Tax Structure Changes:*

- In 1995, a 1 percent tax on companies' assets was created, creditable to the payment of corporate income tax, to reduce income tax evasion. However, in 1999, the Constitutional

---

<sup>14</sup>The tax rate was increased in 2007, but no further adjustment is required, as all collections from this tax are being removed from the “constant tax structure” series for the purposes of estimating the income elasticity of tax revenues.

Court declared the tax unconstitutional and it was repealed. We adjusted the tax revenue series by the nominal yield of the tax.

- A number of rate changes were made to the sales tax in the 1990s. The tax rate was increased from 10 to 13 percent in 1991, and then reduced by 1 pp each year to 10 percent in 1994. In September 1995, it was increased to 15 percent for 18 months, and then returned to 13 percent, its current rate. The sales tax series was adjusted to reflect the estimated nominal effects of the numerous rate changes.
- Important tax administration measures were phased in starting in 2005. Starting in July 2005, an automated customs reporting system (TICA) has been phased in. The concrete nature of this tax administration measure and the notable increase in revenues collected at the customs points where it was being introduced calls for modeling it as a structural change. The implementation of TICA was modeled as a step dummy starting in 2005.

### **El Salvador**

**Data:** Tax revenue at the central government level, 1992–2007. Commodity-related revenues are economically insignificant in size.

#### ***Tax Structure Changes:***

- Changes to the income tax and to the VAT were introduced in November 1994 and July 1995, respectively. In November 1994 the income tax was modified to increase withholding rates on professionals (from 2 to 10 percent), on corporations and individually owned enterprises (from 1.0 to 1.5 percent) and on coffee producers (establishing a scale of up to 15 percent according to the international price of coffee). The VAT rate was raised from 10 to 15 percent in July 1995. The effect of changes to both indirect and direct taxes was modeled using a step dummy starting in 1995.
- A second tax reform package was approved in the third quarter of 1999 and the first half of 2000. A partial revenue package was approved in September 1999, modifying the mechanism for taxation of dividends, limiting income tax deductions, and discontinuing VAT credits for certain expenses. In addition, the package included some administrative measures, with a law establishing new procedures to combat evasion. The rest of the VAT and income base-broadening measures were approved in mid-2000. While the overall impact of the revenue package was estimated at 0.8 percent of GDP, the effect of these structural changes was modeled with a step dummy starting in 2000.
- In 2005, the authorities broadened the income and value-added tax bases, raised excise taxes, and reinforced the tax office. The authorities' preliminary estimates suggest that about 0.5 percentage points of the increase in tax revenue in 2005 can be attributed to the tax reform, with a further 0.1 percent of GDP in 2006. The tax revenue series was adjusted to reflect these nominal impacts.

## Panama

*Data:* Tax revenue at the central government level, 1992–2007. Commodity-related revenues are economically insignificant in size. Tax revenues do not include revenue from canal operations.

### *Changes in Tax Structure*

- In June 1995, the Tax Incentives Harmonization Law was introduced. The law phased out or scaled back tax breaks and subsidies, reduced the maximum corporate income tax from 34 to 30 percent, increased the income tax for exporters in the Colon Free Zone from 2.5–8.5 to 15 percent, generalized a tax credit of up to 25 percent of income tax liabilities for investment in modernization or expansion of production until 2000, extended to the whole manufacturing sector a preferential import tariff of 3 percent on raw materials, and reduced home mortgage subsidies through better targeting to low income beneficiaries. While broad ex-ante estimates of the impact of the law are available, given the number of changes and the complexity of determining the yield, the reform was modeled using a step dummy starting in 1996.
- A rapid process of significant trade liberalization started in 1997 with the lowering of import tariffs on a range of goods and the phasing out of export taxes. The effects on trade tax revenue are seen notably starting in 2000. To account for the effects of the trade liberalization process, we excluded the trade tax revenue series from the overall tax revenue series.
- In December 2002 a number of further changes were made to both direct and indirect tax regimes. The reform increased annual exemption under the personal income tax, introduced a minimum tax on banks' income, phased out some fiscal incentives, scheduled a reduction in corporate income tax from 30 per cent to 29 percent in 2005 and 27 percent in 2007, widened the value-added tax base to include services, extended the consumption tax to luxury goods, and provided more autonomy for tax administration. No estimates of the nominal yield of the 2002 measures is available; therefore, this change in tax structure was modeled with a step dummy starting in 2003.
- In February 2005, the scheduled reduction in the corporate income tax rate was postponed, the maximum income tax rate on individuals was reduced from 30 percent to 27 percent, a minimum income tax on companies and individuals was introduced, and tax incentives for non-traditional exports were eliminated. Changes were also introduced to the tax regime for businesses in the Colon Free Trade Zone (CFZ). Sanctions for noncompliance with tax laws were increased. In addition, changes were introduced to the taxation of petroleum. Nominal estimates of the yield of the host of 2005 measures are available, and those were used to adjust the tax revenue series.
- The tax revenue series was also adjusted to account for one-off revenue in 2006, associated with the purchase of Banistmo by HSBC.

## Peru

**Data:** Tax revenue at the central government level, 1992–2007. Commodity-related revenue from mining and petroleum (amounting to about 5 ¼ percent of GDP in 2007) was removed from the tax revenue series.

### *Changes in Tax Structure*

- In 1994, a reduction in tax evasion and a broadening of the tax base led to a substantial increase in central government tax revenue. As an estimate of the nominal yield of changes in the tax structure is not available, the change was modeled with a step dummy starting in 1994.
- Several tax rate reductions were implemented starting in 1997. The rate of the payroll tax was reduced from 9 to 5 percent of gross wages in September 1997; excise rates on petroleum products were reduced in March and in August 1997, and the excise rate on fuel oil was eliminated in July 1998; the corporate minimum income tax rate was lowered from 2 percent to 0.5 percent in May 1997, and further to 0.2 percent in January 1999; and import tariffs were lowered in April 1997, reducing the average weighted tariff rate from 15.2 to 13.5 percent. The fiscal cost of tax measures introduced in 1997–1999 was estimated roughly at 1–1.5 percentage points of GDP, only partially compensated by improvements in tax administration. The effects of the tax rate reductions was modeled with a step dummy starting in 1997.
- In December 2002, a number of income tax exemptions were allowed to expire. No estimates of the fiscal impact are available, and the change was modeled with a step dummy starting in 2003.
- In 2004, a financial transactions tax (FTT) was introduced. The tax applied to both credit and debit operations, with exemptions on transfers between accounts of the same account holder. The tax rate was initially set at 0.1%, and reduced to 0.08 percent in 2005. The tax revenue series was adjusted for the nominal yield of the financial transactions tax.

## 2. Output Gap Estimates

Because this paper makes cross-country comparisons, we need to estimate output gaps using a consistent methodology. In view of data limitations (lack of reliable quarterly GDP data and/or lack of capital stock data in many countries), this leaves us with only one approach, namely, statistical filtering of annual data. To deal with the “end-point problem”, we filtered (log) real GDP series, for each country, ranging from 1970 until 2010 (source: IMF *World Economic Outlook* database). The last three values of this series are projections which reflect IMF staff’s views of GDP growth convergence to potential growth in each country.

To ensure that the results are not driven by a particular filter, we compared a variety of approaches, including: a Hodrick-Prescott filter with smoothing parameter equal to 6.25 as recommended by Ravner and Uhlig (2002); a Hodrick-Prescott filter with the traditional smoothing parameter equal to 100 (Hodrick and Prescott, 1997), a filter proposed by Baxter and King (1999), and finally, a frequency domain filter due to Corbae and Ouliaris (2002, 2006). The results indicate that most countries analyzed in this paper had positive, albeit small, output gaps in 2007 (output above potential), in the range of 0–3 percent. The standard deviation across filters is between about 0.2 and 1 percent of GDP. This implies that all conclusions in this papers are robust to the filter used. In the main text, we use the Hodrick-Prescott filter (with smoothing parameter = 6.25) only because it is the best known.

Table A1. LAC Countries: Filter-Based Output Gap Estimates for 2007  
(in percent of potential GDP)

Region	Country	HP(a)	HP(b)	BK	OC	Mean	Stan. Dev.
Caribbean	Jamaica	-0.4	0.0	-0.2	0.8	0.04	0.46
	Trinidad & Tobago	0.9	3.3	1.2	0.9	1.57	1.01
Central America	Costa Rica	1.2	1.4	1.0	1.0	1.16	0.18
	El Salvador	0.2	-0.6	0.0	-0.9	-0.32	0.47
	Guatemala	0.4	0.1	0.2	0.9	0.42	0.33
	Honduras	1.3	2.4	1.1	0.2	1.27	0.78
	Nicaragua	-0.3	-0.7	-0.5	-0.8	-0.56	0.21
	Panama	2.1	0.9	0.4	1.9	1.33	0.69
South America and Mexico	Argentina	2.7	4.1	1.7	2.2	2.69	0.89
	Bolivia	-0.4	-1.0	-0.7	-0.3	-0.62	0.28
	Brazil	0.4	0.6	0.2	0.5	0.44	0.14
	Chile	0.3	-0.2	0.0	-0.3	-0.03	0.23
	Colombia	1.7	1.9	1.0	0.8	1.33	0.45
	Ecuador	-0.2	1.0	-0.3	0.2	0.18	0.53
	Mexico	0.6	0.4	0.5	3.0	1.13	1.08
	Paraguay	1.2	1.3	0.8	1.0	1.04	0.19
	Peru	1.5	1.8	0.9	-0.8	0.87	1.03
	Uruguay	2.2	3.3	1.4	0.6	1.86	1.01
	Venezuela	3.5	5.8	2.3	2.1	3.43	1.46

Abbreviations used: HP(a) = Hodrick-Prescott with lambda = 6.25; HP(b) = Hodrick-Prescott with lambda = 100; BK = Baxter-King; OC = Ouliaris-Corbae. Output gaps defined as actual GDP in excess of potential, in percent. Estimates based on annual data, 1970-2010, using IMF *World Economic Outlook* projections for 2008-2010.

### 3. Commodity Price Indices and Projections

For each country classified as a “commodity revenue country,” a commodity price index was defined using 2005 commodity export shares and prices of all commodities that exceeded 5 percent of the country’s commodity exports. Export shares were obtained from the United Nations’ COMTRADE database. Two sources of prices and projections were used: from the IMF, and the World Bank.

Table A2 contains the list of commodities that enter the price indices for each country, with their shares in total commodity exports for 2005. In addition, the table indicates (in brackets below each country name) the 2007 percentage share of commodity revenue in total revenue, to give a sense of the fiscal importance of commodities.

The table shows that there are wide differences in the concentration of commodities exports across countries (i.e. the commodity export share accounted for by just one or two commodities), and in the importance of commodity exports for overall revenue. Commodity exports are *both* highly concentrated and significant, from a fiscal standpoint, in Bolivia, Chile, Ecuador, Mexico, Trinidad and Tobago, and Venezuela.

Table A3 shows the evolution of both actual commodity price indices and 5-year-ahead projections. Since about 2004, there have been large differences between IMF and World Bank projections particularly for the oil producers, with the World Bank generally projecting lower rises. In 2007, in particular, commodity price indices for these countries were projected to be about flat by the IMF, whereas the Bank projected a decline by about 25 percent.

There are also large differences in the expected persistence of commodity prices across countries. Commodity export prices for Chile, in particular, were projected to be much less persistent than those for other countries, with a projected decline by about 50 percent over the 5-year horizon by the IMF, and even more by the World Bank.

Table A2. Commodity Export Shares <sup>1/</sup>  
(in percent of total commodity exports, 2005)

Country	Commodity	Share
<b>Oil Exporters <sup>2/</sup></b>		
Colombia (11) <sup>3/</sup>	Crude Oil	47.4
	Coal	22.2
	Coffee	13.9
	Gold	5.4
Ecuador (28) <sup>3/</sup>	Crude Oil	73.9
	Bananas	13.6
	Shrimp	5.6
Mexico (35) <sup>3/</sup>	Crude Oil	88.7
Trinidad & Tobago (52) <sup>3/</sup>	Crude Oil	64.2
	Natural Gas	34.5
Venezuela (47) <sup>3/</sup>	Crude Oil	96.7
<b>Other</b>		
Argentina (8) <sup>3/</sup>	Soybean products <sup>4/</sup>	36.3
	Crude Oil	22.7
	Wheat	5.6
	Natural Gas	5.5
	Beef	5.1
Bolivia (34) <sup>3/</sup>	Natural Gas	44.3
	Crude Oil	15.9
	Soybean products <sup>4/</sup>	15.8
	Zinc	8.9
	Tin	5.7
Chile (29) <sup>3/</sup>	Copper	76.0
	Fish	8.5
Peru (21) <sup>3/</sup>	Copper	30.1
	Gold	26.1
	Crude Oil	12.8
	Fish meal	9.8
	Zinc	7.6

<sup>1/</sup> For countries in which commodity exports exceed 2 percent of GDP, on average, 2001-07.

<sup>2/</sup> Countries in which oil is the main commodity export.

<sup>3/</sup> Approximate share of commodity revenue in total public sector revenue, 2007.

<sup>4/</sup> Includes soybeans, soybean oil and soybean meal.

Table A3. Commodity Price Indices and Medium-Term Projections  
(2001 = 100, except for ratios)

Country	Based on IMF commodity price data and projections					Based on World Bank commodity price data and projections									
	2001	2002	2003	2004	2005	2006	2007	2001	2002	2003	2004	2005	2006	2007	
<b>Oil Exporters 1/</b>															
Colombia	actual	100.0	99.3	106.5	147.4	194.9	240.3	242.5	100.0	95.5	102.3	150.7	182.1	214.0	216.9
	5-year exp. 2/	88.9	93.0	90.7	125.5	192.3	230.0	234.9	...	91.2	90.3	106.8	136.4	158.5	170.9
	ratio 3/	0.89	0.94	0.85	0.85	0.99	0.96	0.97	...	0.95	0.88	0.71	0.75	0.74	0.79
Ecuador	actual	100.0	101.1	109.6	139.8	198.9	250.2	248.8	100.0	100.1	104.2	140.6	183.9	227.5	218.9
	5-year exp. 2/	82.7	89.3	89.8	127.9	205.3	247.7	247.8	...	84.4	82.3	103.6	143.3	167.4	170.4
	ratio 3/	0.83	0.88	0.82	0.92	1.03	0.99	1.00	...	0.84	0.79	0.74	0.78	0.74	0.78
Mexico	actual	100.0	103.2	116.0	150.8	217.8	279.4	277.9	100.0	101.9	114.8	157.7	216.2	276.2	266.2
	5-year exp. 2/	78.3	88.3	90.0	135.1	225.3	275.1	273.9	...	79.0	79.6	107.5	160.1	193.1	194.3
	ratio 3/	0.78	0.86	0.78	0.90	1.03	0.98	0.99	...	0.78	0.69	0.68	0.74	0.70	0.73
Trinidad & Tobago	actual	100.0	90.1	113.0	137.7	196.0	245.9	248.5	100.0	92.3	111.6	141.7	201.2	247.6	239.4
	5-year exp. 2/	74.5	77.3	85.0	121.8	194.5	238.9	236.5	...	71.9	73.8	102.3	151.8	180.0	184.1
	ratio 3/	0.75	0.86	0.75	0.88	0.99	0.97	0.95	...	0.78	0.66	0.72	0.75	0.73	0.77
Venezuela	actual	100.0	103.7	116.9	152.6	221.2	282.2	279.7	100.0	102.3	115.3	159.1	218.6	275.0	262.5
	5-year exp. 2/	76.8	87.0	88.8	136.1	230.0	281.5	279.9	...	76.2	77.0	106.8	162.3	196.0	196.4
	ratio 3/	0.77	0.84	0.76	0.89	1.04	1.00	1.00	...	0.74	0.67	0.67	0.74	0.71	0.75
<b>Other Commodity Exporters</b>															
Argentina	actual	100.0	98.9	113.4	143.1	162.0	187.5	203.7	100.0	104.0	117.5	144.2	156.3	180.2	202.1
	5-year exp. 2/	102.2	104.1	101.0	120.3	155.8	178.1	189.6	...	102.9	100.4	113.1	129.5	144.4	162.8
	ratio 3/	1.02	1.05	0.89	0.84	0.96	0.95	0.93	...	0.99	0.85	0.78	0.83	0.80	0.81
Bolivia	actual	100.0	81.3	108.1	127.6	161.6	201.8	220.5	100.0	88.6	110.0	132.2	168.8	208.4	226.6
	5-year exp. 2/	85.8	81.0	89.4	110.5	148.6	178.4	181.2	...	85.0	86.0	105.6	134.0	151.3	163.9
	ratio 3/	0.86	1.00	0.83	0.87	0.92	0.88	0.82	...	0.96	0.78	0.80	0.79	0.73	0.72
Chile	actual	100.0	103.7	106.5	156.0	200.1	326.0	348.1	100.0	98.4	110.7	175.8	224.9	384.8	425.8
	5-year exp. 2/	121.3	122.8	118.9	123.9	150.6	158.8	180.2	...	120.1	122.5	123.7	130.8	165.2	183.1
	ratio 3/	1.21	1.18	1.12	0.79	0.75	0.49	0.52	...	1.22	1.11	0.70	0.58	0.43	0.43
Peru	actual	100.0	108.3	112.3	150.4	185.2	273.4	306.4	100.0	102.6	115.7	158.0	194.5	295.7	335.2
	5-year exp. 2/	108.5	115.7	111.1	135.1	173.5	213.8	223.8	...	109.4	110.9	116.8	133.9	162.9	177.2
	ratio 3/	1.09	1.07	0.99	0.90	0.94	0.78	0.73	...	1.07	0.96	0.74	0.69	0.55	0.53

1/ Countries in which oil is the main commodity export.

2/ Price index expected for year t+5 from the perspective of year t. For example, 2001 entries refer to prices expected for 2006 in 2001.

3/ 5-year expected price index divided by actual price index.