FISCAL POLICY IN LATIN AMERICA: COUNTERCYCLICAL AND SUSTAINABLE AT LAST?

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This paper analyses fiscal policy for several economies in Latin America, from the early-Nineties to the 2009 crisis. We present original estimates of cyclically-adjusted public revenues for Argentina, Brazil, Chile, Colombia, Costa Rica, Mexico, Peru and Uruguay implementing the standardised OECD methodology and extending it to include commodity cycles, which have a direct and significant effect on the fiscal balance of several Latin American countries. Based on these estimates, we evaluate the size of automatic tax stabilisers and the cyclicality of discretionary fiscal policy. Additionally, we highlight the uncertainty stemming from the estimation of the output gap, due to large and simultaneous cyclical, temporary and permanent shocks in several Latin American economies.

1 Introduction

In reaction to the 2009 global financial crisis, most industrialised and several emerging economies enacted Keynesian-type fiscal packages (from personal income tax cuts and indirect taxes reductions, to higher infrastructure spending and transfers to local governments, families, and firms) to mitigate the collapse of domestic demand.

Several Latin American economies faced the international crisis on relatively solid domestic macroeconomic grounds, both monetary and fiscal. Monetary policy had gain credibility during the decade, as several independent Central Banks moved towards inflation targeting regimes. On the fiscal front, most countries in the region displayed higher budget surpluses and lower debt-to-GDP levels, giving them apparently unprecedented fiscal margins to pursue sustainable counter-cyclical fiscal policies, of a similar size of those in OECD countries (see Figure 1 and OECD, 2009b).[1]

But, is Latin America's resilience in 2009 a permanent change in paradigm? The success of these counter-cyclical fiscal policy responses in Latin American economies is still unclear, and will largely depend on both the size of the programmes actually implemented (generally smaller and with greater lags than announced) and their effective impact (opening, once again, the debate on multipliers). Besides, at the wake of the international financial crisis there was no consensus on the cyclical or structural nature of still recent fiscal improvements.[2]

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[1] This strength was in stark contrast with previous episodes. See Gavin and Perotti (1997) and Gavin and Hausmann (1008) for Latin America, and Talvi and Vegh (2005), Kaminsky *et al.* (2006), and Ilzetzki and Vegh (2008) for emerging markets in general.

[2] Izquierdo and Talvi (2008), from the Inter-American Development Bank, argued that if revenues from the seven largest economies in Latin America countries were adjusted using the implicit Hodrick-Prescott filter parameter for Chile (*i.e.*, the smoothing coefficient on revenues that would render a structural surplus of one per cent of GDP since 2001), structural fiscal balances in the region, with the exception of Chile, did not differ significantly from their situation at the onset of the 1998 Russian crisis. Using a

(continues)

Our paper joins the latter debate. In Section 2 we present updated original estimates of cyclically-adjusted fiscal balances for a number of Latin American countries: Argentina, Brazil, Chile, Colombia, Costa Rica, Mexico, Peru and Uruguay. We track these balances since the early-Nineties to 2009, implementing the standardised OECD methodology (Girouard and André, 2005, and Van den Noord, 2000), but adding the fiscal impact of commodity prices (following basically the IMF approach in Vladkova and Zettelmeyer, 2008). With these estimates, we can then measure the size of automatic stabilisation tax policies and the size and cyclicality of discretional fiscal policy. These measures are compared with those in OECD countries and used to discuss the cyclicality of discretionary fiscal policy in the region, differentiating countries and periods. Additionally, based on these numbers we perform standard debt sustainability exercises. The third section explains the methodology used to estimate the output gap. We opt for an unobserved components model to decompose shocks into permanent, cyclical and transitory. Section 4 concludes, underlining the importance of output gap estimates, the inclusion of commodity prices and the consideration of automatic fiscal responses in the design of sustainable fiscal policies over the business cycle in the region.

2 Cyclically-adjusted budget balances in Latin America

2.1 OECD approach to estimation of cyclically-adjusted fiscal revenues

As a starting point, we apply the OECD approach to account for the automatic impact of the business cycle on public accounts, as presented in detail by Girouard and André (2005) for OECD countries, and De Mello and Moccero (2006) for Brazil. This method computes separately the cyclical component of unemployment-related transfers and of public receipts from four types of taxes: personal income tax (PIT), social security contributions (SSC), and corporate income tax (CIT), and indirect taxes (IT), and of unemployment-related transfers.

Focusing on public revenues, the cyclical response of tax *i* to the business cycle (labelled $\varepsilon_{ti,y}$) is calculated as the product of two elasticities: the elasticity of tax receipts to the tax base (labelled $\varepsilon_{ti,tbi}$) and the elasticity of the tax base to the economic cycle (labelled $\varepsilon_{tbi,y}$):

$$\varepsilon_{ti,y} = \varepsilon_{ti,tbi} \times \varepsilon_{tbi,y} \tag{1}$$

where *i* covers the four taxes mentioned above (PIT, SSC, CIT or IT) or their respective tax bases (wage bill for the first two, corporate profits and consumption).

On the expenditure side, the adjustment is usually made at the level of total primary spending as time-series data on unemployment-related expenditure are not available across countries. Girouard and André (2005) use several OECD instruments, publications and databases, especially the *Annual National Accounts*, the *Economic Outlook* database, national *Labour Force Surveys*, the *Taxing Wages* model, and *Revenue Statistics*. Next, we describe the methodology more in depth while explaining the approach we follow for Latin American economies.

2.1.1 Personal income tax and social security contributions

To calculate the elasticity of income tax and social security contributions with respect to the tax base, the marginal and the average tax rates of a representative household are calculated for several points in the earnings distribution: from 0.5 to 3.0 times the average production worker in

different methodological approach, Vladkova-Hollar and Zettelmeyer (2008), from the International Monetary Fund, observed an improvement in structural balances in most countries, although they point out that commodity prices added a significant layer of uncertainty.

each OECD country. A representative household is defined as a full-time, two-earner married couple with two children, with the secondary earner receiving 50 per cent of the wage of the principal earner. Effective tax rates are computed using the OECD *Taxing Wages* simulator, while the distribution of tax payers across income levels in each country are based on labour market statistics (based on median, first and ninth deciles incomes taken from *Labour Force Surveys*). The overall elasticities of both PIT and SSC with respect to the tax base ($\varepsilon_{ti,tbi}$) are calculated as the weighted ratios of marginal and average tax rates:

$$\varepsilon_{t_i tb_i} = \left(\sum_{i=1}^{n} \gamma_i MA_i \right) \Big/ \left(\sum_{i=1}^{n} \gamma_i AV_i \right) \quad (2)$$

where γ_i is the share of earners i in the income distribution, MA_i is the marginal income tax rate or social security contribution rate at earning level i, and AVi stands for the corresponding average rate.

Due to the lack of comparable databases and instruments, this procedure poses significant challenges when applying them to Latin America. We proxy the distribution of potential tax payers using the latest available National Household Surveys[3] in Argentina (referred to 2006), Brazil (2006),[4] Chile (2006), Colombia (2008), Costa Rica (2006), Mexico (2006), Peru (2006), and Uruguay (2005). In particular, we calculate the "adjusted first earner income" distribution taking into account household composition (if two earners exist, the first earner is assigned two thirds of household income while second earner is assigned the rest). We restrict our analysis to labour income (dependent and self-employed workers),[5] and limit the sample to households with at least some labour income.[6] Given the high levels of informality and income inequality in the region, we analyze an extended income interval, covering from 0.05 times average income (*i.e.*, almost from the first peso/sol/real of labour income) to more than six times average income.

Figure 1 represents the average adjusted income level and those corresponding to the first and ninth deciles, corrected by purchasing power parities. Average annual labour income level ranges from 7,700 $ PPP in Peru, to nearly 14,600 $ PPP in Chile. Workers in the ninth decile earn more than twice the average in all countries, while low earners vary significantly (in Peru, those in the first decile earn 20 times less than the average income, while only five times less in Costa Rica).

Focusing on the distribution of labour income earners, the analysis shows a high concentration of workers below the average labour income: between 60 and 70 per cent of labour income earners earn less than the national average (Figure 3). The Peruvian income distribution represents an outlier, given the concentration of income earners at lower levels. This fact has a very significant impact on the number of effective tax payers and fiscal revenues.

These national labour income distributions provide the weighs (γ_i) to compute the overall average and marginal personal income and social security tax rates. We calculate the effective tax burden for representative households, assuming they only differ in their income level (from 0.05 to

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3 *Encuesta Permanente de Hogares* in Argentina, *Pesquisa Nacional por Amostra de Domicilios* in Brazil, *Encuesta de Caracterización Socioeconómica Nacional* in Chile, *Gran Encuesta Integrada de Hogares* in Colombia, *Encuesta de Hogares y Propósitos Múltiples* in Costa Rica, *Encuesta Nacional de Ocupación y Empleo* in Mexico, *Encuesta Nacional de Hogares* in Peru and *Encuesta Contínua de Hogares* in Uruguay. We are aware of the potential limitations from using survey data, in contrast to administrative records, but, on the other hand, household surveys are more generally available. As a future extension of this research, we will test the robustness of the results using alternative income distribution sources.

4 Brazil is included to establish a link between previous OECD research and our regional analysis. In the following sections we will report analysis based on elasticities calculated by De Mello and Moccero (2006).

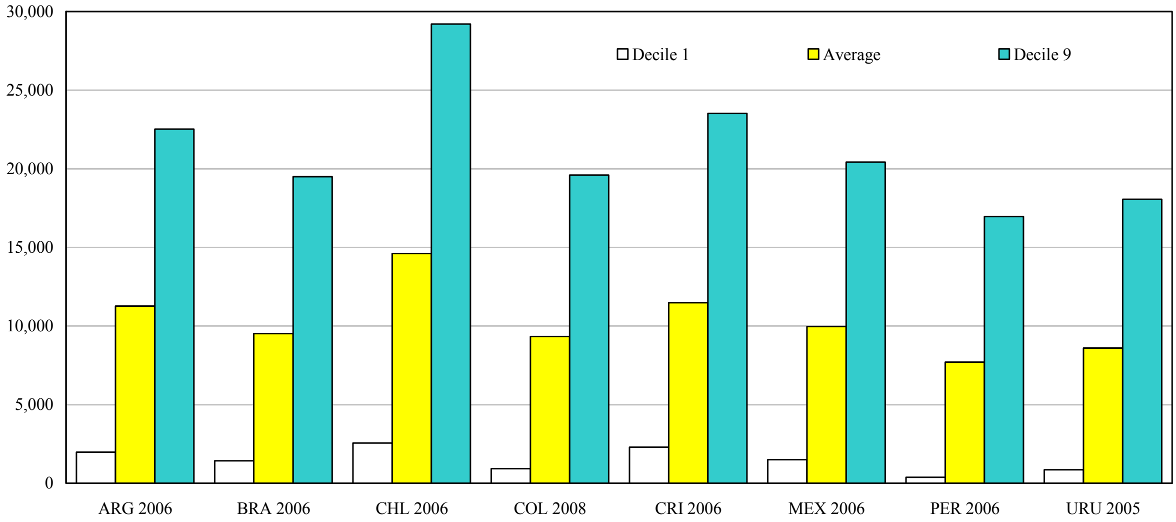
5 As already established in the OECD method, this does not represent a significant bias for Latin America, since capital income is usually not taxed by the personal income tax.

6 According to our calculations based on the National Household Surveys, between 8 and 26 per cent of households in the selected Latin American countries do report no labour income (26.1 in Argentina, 15.6 in Brazil, 11.4 in Chile, 11.5 in Colombia, 15.0 in Costa Rica, 7.7 in Mexico, 9.2 in Peru, and 22.0 in Uruguay).

Figure 1

Adjusted First Earner Annual Labour Income

(PPP dollars)

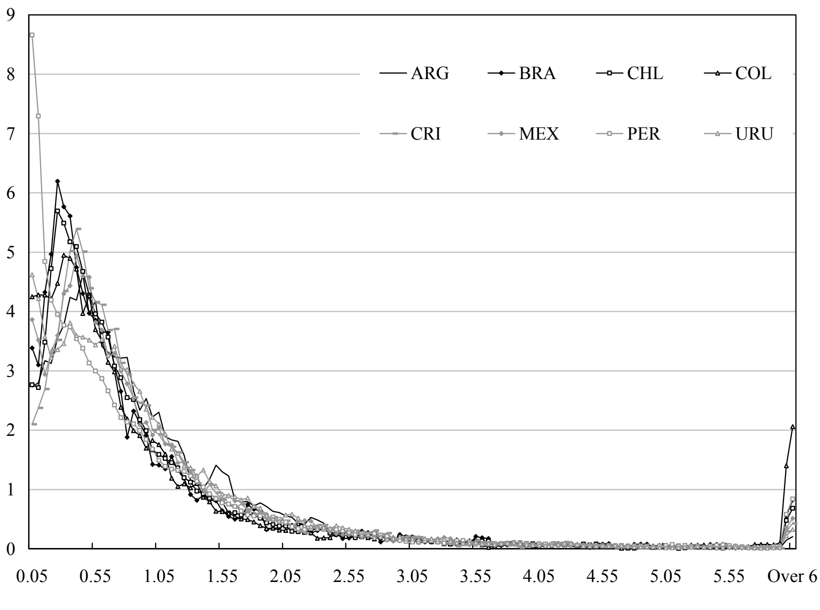


Source: Authors' calculations based on National Household Surveys.

Figure 2

Labour Income Distribution in Latin American Countries

(percent)



Note: Percentage of people by household labour income level.
1 represents the national average.
Source: Authors' calculations based on National Household Surveys.

more than 6 times the national average).[7] Chilean and Uruguayan figures were provided by the respective Ministries of Finance, while Mexican rates were calculating using the OECD *Taxing Wages* simulator. For other countries, we calculated the fiscal figures based on the legislation in place during the corresponding fiscal year.

Calculations are referred to 2006, because several of the household surveys available are from that year, and as it corresponds to a rela tively neutral year in cyclical terms (in the case of Colombia, we

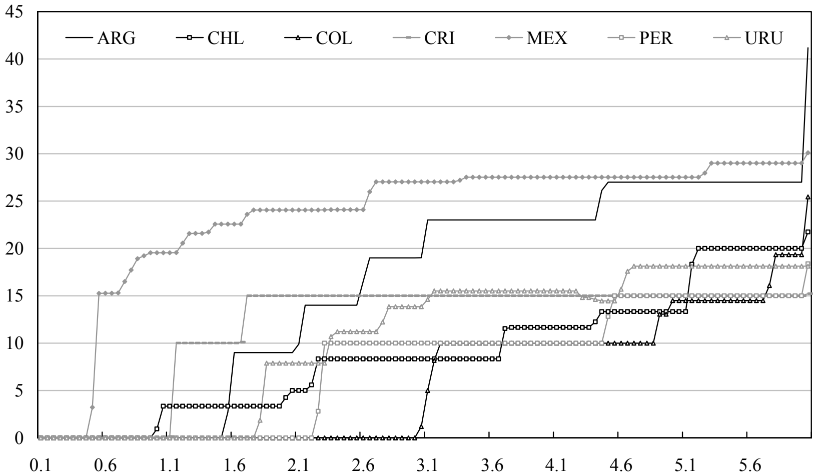
[7] To be precise, we liquidate these two taxes for 121 levels of income (so *i*=1…121). We grouped all households that earn more than six times the national average (this last bracket earns between eight times the average in Uruguay, to 11 times in Chile).

deflated the data referred to 2008 with the national CPI). The only exception is Uruguay, in which we updated survey figures with observed CPI up to 2009 to incorporate the new personal income tax established in 2008. In those cases where fiscal legislation allows individual and household declaration, we chose the one more beneficial to tax payers, including allowances for both spouse and children, if existing.[8] Figures 3 and 4 show the effective marginal and average personal income tax rates by income levels.

As shown in Figure 4, the personal income tax in all these Latin American countries is formally progressive, since average tax rates increase with income levels. Second, with the exception of Mexico (due to the interaction of exempted income, individual declarations and tax credits), labour income earners are net payers of the PIT starting at levels ranging from the average income in Chile to three times the average income in Colombia. Together with informality, these high levels imply that only a small share of households with labour income is a net PIT payer.

Figure 3

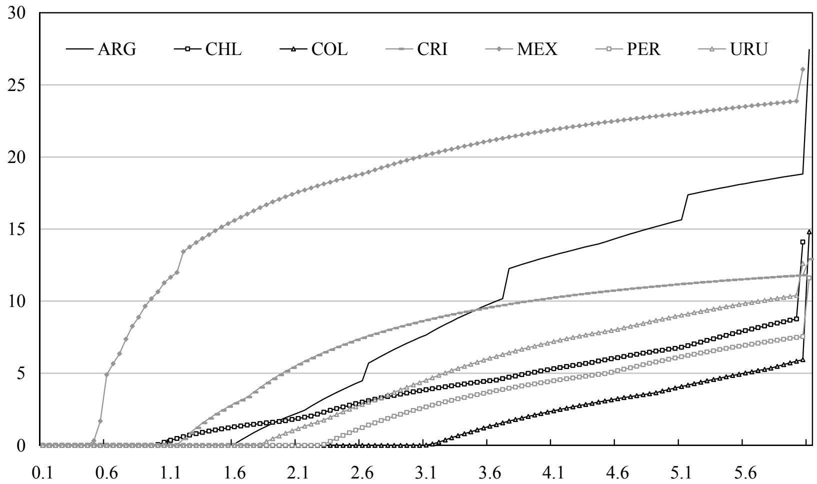
Marginal Personal Income Tax by Income Levels
(percent)



Note: Marginal tax rate by household labour income level.
1 represents the national average.
Source: Authors' calculations based on OECD's *Taxing Wages* (Mexico), Ministries of Finance (Chile and Uruguay) and own elaboration (Argentina, Colombia, Costa Rica and Peru).

Figure 4

Average Personal Income Tax by Income Levels
(percent)

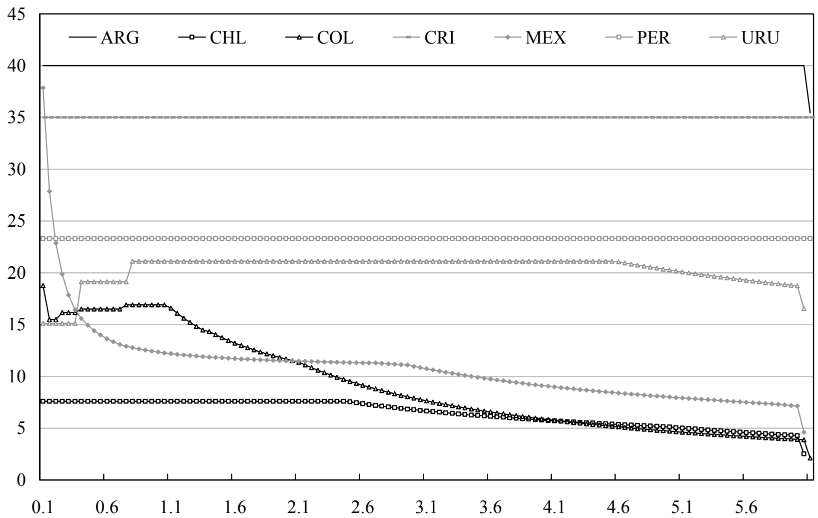


Note: Average tax rate by household labour income level.
1 represents the national average.
Source: Authors' calculations based on OECD's *Taxing Wages* (Mexico), Ministries of Finance (Chile and Uruguay) and own elaboration (Argentina, Colombia, Costa Rica and Peru).

[8] Tax declarations are at the individual level in Chile, Colombia, Peru and Uruguay, and by households in Argentina, Costa Rica and Mexico. Argentina and Mexico figures incorporate spouse and children allowances. Brazilian figures, taken from De Mello and Moccero (2006), are on an individual basis. Therefore, we fix both income distribution and tax legislation, as stated in the OECD methodology. As a future extension, we plan to test the effects on tax elasticities of changes in the tax code, and of variations of income distribution.

Figure 5

Average Social Security Contributions by Income Levels
(percent)



Note: Average tax rate by household labour income level.
1 represents the national average.
Source: Authors' calculations based on OECD Taxing Wages (Mexico), Ministries of Finance (Chile and Uruguay) and own elaboration (Argentina, Colombia, Costa Rica and Peru).

By contrast, as shown in Figure 5, social security contributions tend to be flat taxes, or even slightly regressive given the existence of minimum contributions in Mexico. Chile and Mexico are the only two countries with a fully privatized pension system, where social contributions mainly finance health benefits.[9]

As defined in equation (2), the wage elasticity of PIT and SSC is calculated as the ratio between the weighted marginal tax rate, and the weighted average tax rate (included in fifth and sixth columns in Table 1). With the exception of Mexico, PIT elasticities are between 2.5 and 3.3. These levels are higher than those observed in OECD countries, and slightly lower than the 3.4 found for Brazil in De Mello and Moccero (2006). In other words, formal progressivity of the PIT is higher in Latin America. On the other hand, SSC elasticities are very much in line with OECD estimates, except Mexico and Colombia, where they are significantly lower.

To calculate the overall elasticities, the second step involves the econometric estimation of the sensitivity of the relevant tax bases with respect to the output gap ($\varepsilon_{tbi,y}$). As in Girouard and André (2005), the cyclical sensitivity of the wage base (PIT and SSC tax base) has been estimated using an equation that links directly the cyclical component of the wage bill to the output gap. We regress the share of the real wage bill in potential GDP (constructed with active population from the *Penn World* tables, and unemployment and urban workers wages from ECLAC) on the output gap (estimated using unobserved components model on real chained GDP series from *Penn World* tables as described in Section 3) and a constant, in logs with annual data from 1981 to 2007 (see details in Annex 1).

$$\Delta \ln(W_t L_t / Y_t^*) = \alpha + \varepsilon_{twl_t, y_t} \times \Delta \ln(Y_t / Y_t^*) + \mu_t \qquad (3)$$

The estimated responsiveness of the wage bill for Uruguay, Colombia (taken from Lozano and Toro, 2007) and Argentina (around 1.0) are slightly above the OECD average (0.7 according to Girouard and André, 2005), and Brazil (0.8 reported by De Mello and Moccero, 2006), while elasticities for the rest are significantly above previous estimates (up to 2.0 in Peru). Details on the estimations are also included in Annex 2.

9 Mexican contributions cover sickness, disability and nursery, while Chilean rates cover health and unemployment. In the other cases contributions finance both health and pensions. In the case of parallel public-private compulsory pension systems (Argentina, Colombia, Peru and Uruguay), we assumed that the worker is affiliated to the public scheme.

Table 1

Marginal and Average Tax Rates

Country	Marginal Tax Rate PIT	Marginal Tax Rate SSC	Average Tax Rate PIT	Average Tax Rate SSC	Real Wage Elasticity of PIT	Real Wage Elasticity of SSC
	X		*Y*		*Z = X / Y*	
Argentina	**2.9**	**39.3**	**0.9**	**40.0**	**3.3**	**1.0**
Brazil	**-**	**-**	**-**	**-**	**3.4**	**1.8**
Chile	**1.7**	**6.9**	**0.7**	**7.5**	**2.5**	**0.9**
Colombia	**0.9**	**5.7**	**0.3**	**10.9**	**2.5**	**0.5**
Costa Rica	**3.4**	**34.3**	**1.3**	**35.0**	**2.6**	**1.0**
Mexico	**13.7**	**8.8**	**7.0**	**17.5**	**2.0**	**0.5**
Peru	**1.1**	**22.6**	**0.4**	**23.3**	**2.7**	**1.0**
Uruguay	**1.6**	**20.0**	**0.5**	**19.0**	**3.2**	**1.1**
Canada	28.6	7.8	18.3	9.7	1.6	0.8
France	13.9	34.9	8.2	30.7	1.7	1.1
Germany	26.2	23.9	11.4	31.1	2.3	0.8
Italy	26.3	26.5	13.2	27.6	2.0	1.0
Japan	9.6	18.7	4.9	20.5	1.9	0.9
Korea	8.5	11.2	3.6	13.1	2.3	0.9
Spain	20.2	18.3	9.5	24.1	2.1	0.8
United Kingdom	22.8	13.6	13.5	10.4	1.7	1.3
United States	19.1	11.6	10.3	12.8	1.9	0.9
OECD	21.8	19.0	12.7	18.8	1.7	1.0

Notes: Marginal and average rates are weighted by the distribution of tax payers across income levels. OECD unweighted average, excluding Chile and Mexico.
Source: Authors' calculations for Argentina, Chile, Colombia, Costa Rica, Mexico, Peru and Uruguay, De Mello and Moccero (2006) for Brazil, and Girouard and André (2005) for the rest.

Finally, we multiply both elasticities to obtain the overall tax elasticities. Table 2 collects the output elasticity of PIT and SSC in our selected Latin American countries, compared to those in selected OECD economies and Brazil. Given the higher elasticities of the wage bill to output gap, output elasticities of PIT are much larger in Latin America than those observed in OECD countries (3.5 on average vs. 1.2), and less in the case of SSC elasticities (1.2 on average vs. 0.7).

2.1.2 Corporate income tax

Concerning corporate taxes, we strictly apply the OECD methodology. Therefore, the cyclical sensitivity of the corporate tax base (proxied by corporate profits) is also a function of the elasticity of the wage bill relative to the output.

$$\varepsilon_{CIT,y} = (1-(1-PS)\,\varepsilon_{wl,y})PS \qquad (4)$$

where *PS* is the profit share in output proxied by the ratio of the gross operating surplus over GDP, and $\varepsilon_{wl,y}$ is the elasticity of the wage bill to the output gap. Profit shares over GDP are taken from OECD *Annual National Accounts* in the case of Chile, from the national central banks in Costa

Table 2

Elasticities of Personal Income Tax and Social Security Contributions

Country	Real Wage Elasticity of PIT	Real Wage Elasticity of SSC	Output Elasticity of Wages	Output Elasticity of PIT	Output Elasticity of SSC
	A		*B*	*C = A × B*	
Argentina	**3.3**	**1.0**	**1.1**	**3.6**	**1.1**
Brazil	**3.4**	**1.8**	**0.8**	**2.7**	**1.4**
Chile	**2.5**	**0.9**	**1.4**	**3.5**	**1.3**
Colombia	**2.5**	**0.5**	**1.1**	**2.6**	**0.6**
Costa Rica	**2.6**	**1.0**	**1.7**	**4.5**	**1.7**
Mexico	**2.0**	**0.5**	**1.5**	**3.0**	**0.8**
Peru	**2.7**	**1.0**	**2.0**	**5.3**	**1.9**
Uruguay	**3.2**	**1.1**	**0.9**	**2.8**	**0.9**
Canada	1.6	0.8	0.7	1.1	0.6
France	1.7	1.1	0.7	1.2	0.8
Germany	2.3	0.8	0.7	1.6	0.6
Italy	2.0	1.0	0.9	1.8	0.9
Japan	1.9	0.9	0.6	1.2	0.5
Korea	2.3	0.9	0.6	1.4	0.5
Spain	2.1	0.8	0.9	1.9	0.7
United Kingdom	1.7	1.3	0.7	1.2	0.9
United States	1.9	0.9	0.7	1.3	0.6
OECD	1.7	1.0	0.7	1.2	0.7

Notes: Change in tax revenues as a per cent of GDP for a 1 percentage-point change in the output gap. Based on weights for 2003 for OECD, and 2005-06 in Latin America. OECD unweighted average, excluding Chile and Mexico.
Source: Authors' calculations for Argentina, Chile, Costa Rica, Mexico, Peru and Uruguay, De Mello and Moccero (2006) for Brazil, and Girouard and André (2005) for the rest. Output elasticity of wages in Colombia is taken from Lozano and Toro (2007).

Rica and Uruguay, and from national statistics institutes in Argentina (INDEC), Colombia (DANE), Mexico (INEGI) and Peru (INEI). As shown in Table 3, output elasticities of CIT vary from 0.3 in Costa Rica to 1.2 in Uruguay, therefore lower than in OECD countries.

2.1.3 Other revenues, expenditures and overall balance

The output elasticity of the indirect tax base with respect to the economic cycle is set to unity for all countries, as in Girouard and André (2005). Finally, due to the lack of data and given the absence of unemployment benefits in many countries in the region, we suppose that current expenditures do not respond automatically to the cycle at all.

The cyclical budget response, as a share of GDP, can be expressed as the weighted sum of the four different tax revenues elasticities (based on the tax structure in 2006; see Table 8 in Annex 2). According to our calculations, the sensitivity (semi elasticity in GDP percentage points) of government budget balances to a 1 percentage point change in the output gap is 0.21

Table 3

Elasticities of Corporate Income Tax

Country	Profits Elasticity of CIT	Profit Share in GDP	Output Elasticity of Wages	Output Elasticity of Profits	Output Elasticity of of CIT
	A	*B*	*C*	*E = (1 – (1 – B) C) / B*	*F = A x E*
Argentina	**1.0**	**0.38**	**1.1**	**0.8**	**0.8**
Brazil	**1.0**	**0.54**	**0.8**	**1.2**	**1.2**
Chile	**1.0**	**0.54**	**1.4**	**0.7**	**0.7**
Colombia	**1.0**	**0.59**	**1.1**	**1.0**	**1.0**
Costa Rica	**1.0**	**0.49**	**1.7**	**0.3**	**0.3**
Mexico	**1.0**	**0.62**	**1.5**	**0.7**	**0.7**
Peru	**1.0**	**0.62**	**2.0**	**0.4**	**0.4**
Uruguay	**1.0**	**0.36**	**0.9**	**1.2**	**1.2**
Canada	1.0	0.35	0.7	1.5	1.5
France	1.0	0.34	0.7	1.6	1.6
Germany	1.0	0.36	0.7	1.5	1.5
Italy	1.0	0.45	0.9	1.1	1.1
Japan	1.0	0.38	0.6	1.6	1.6
Korea	1.0	0.43	0.6	1.5	1.5
Spain	1.0	0.40	0.9	1.2	1.2
United Kingdom	1.0	0.31	0.7	1.7	1.7
United States	1.0	0.36	0.7	1.5	1.5
OECD	1.0	0.39	0.7	1.5	1.5

Notes: Change in tax revenues as a per cent of GDP for a 1 percentage-point change in the output gap. Based on weights for 2003 for OECD, and 2005-06 in Latin America. OECD unweighted average, excluding Chile and Mexico.
Source: Authors' calculations for Argentina, Chile, Costa Rica, Mexico, Peru and Uruguay, De Mello and Moccero (2006) for Brazil, and Girouard and André (2005) for the rest. Output elasticity of wages in Colombia is taken from Lozano and Toro (2007).

(unweighted average of the six Latin American economies), ranging from 0.12 in Mexico and 0.14 in Colombia, to 0.24 in Argentina and Uruguay, 0.25 in Brazil (De Mello and Moccero, 2006), and 0.26 in Costa Rica. This regional average is almost half the OECD average, and is explained by significantly lower automatic stabilization from PIT (Figure 6).

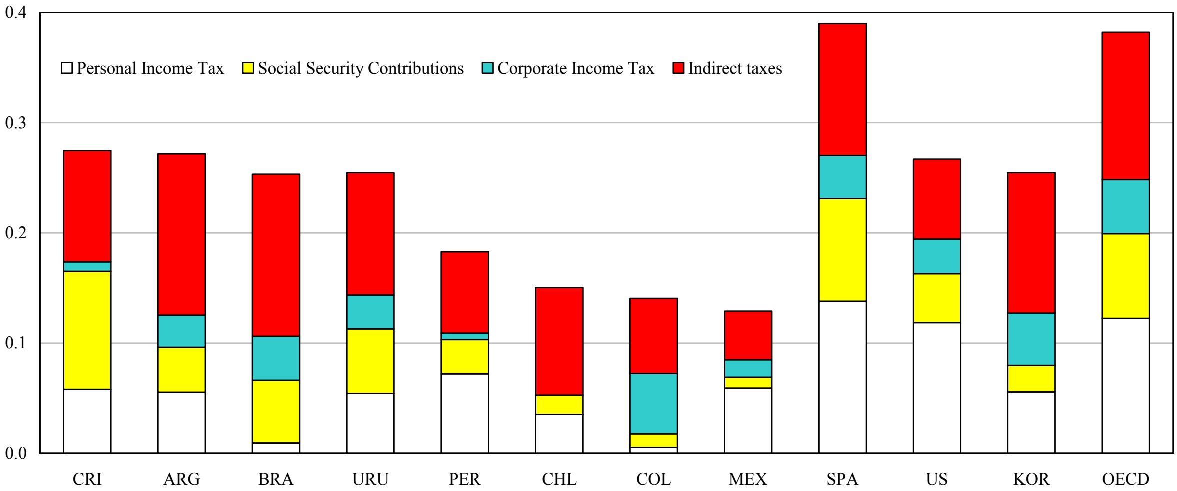
These estimates of the cyclical response of budget balance are positively correlated with the size of the government, as stated in the literature on fiscal macroeconomic stability in industrialized economies (see for instance Galí, 1994 and Fatás and Mihov, 2001). Nonetheless, as shown in Figure 7, some of the biggest economies in Latin America (notably Brazil, Colombia and Mexico) deviate significantly from their "expected" trends as automatic stabilisers are significantly lower than the government size (in part due to the high non-tax revenues).

2.2 *Adjustment of tax and non-tax revenues for commodity prices*

A special feature of several Latin American countries is the importance of commodity prices

Figure 6

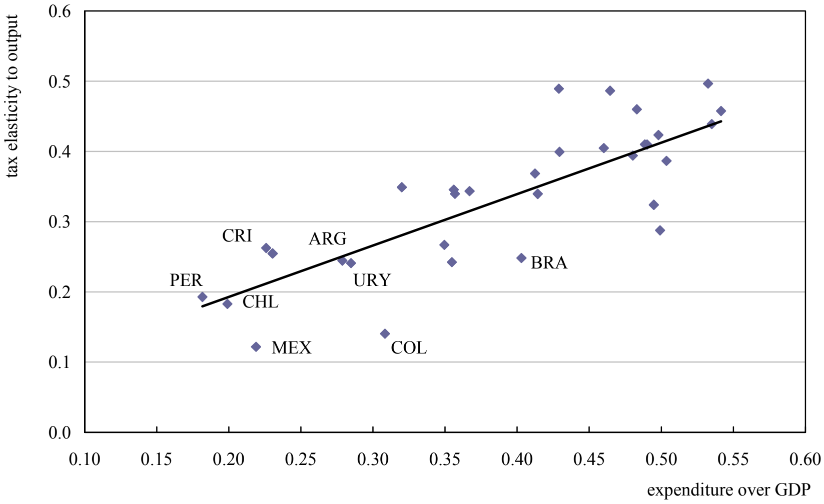
Tax Semi-elasticities to Output
(percent of GDP)



Note: OECD unweighted average, excluding Chile and Mexico.
Source: Authors' calculations for Argentina, Chile, Colombia, Costa Rica, Mexico, Peru and Uruguay, De Mello and Moccero (2006) for Brazil, and Girouard and André (2005) for the rest.

Figure 7

Government Size and Tax Automatic Stabilisers in OECD and Latin America
(percent of GDP)



Source: Authors' calculations for Argentina, Chile, Colombia, Costa Rica, Mexico, Peru and Uruguay, De Mello and Moccero (2006) for Brazil, and Girouard and André (2005) for the rest.

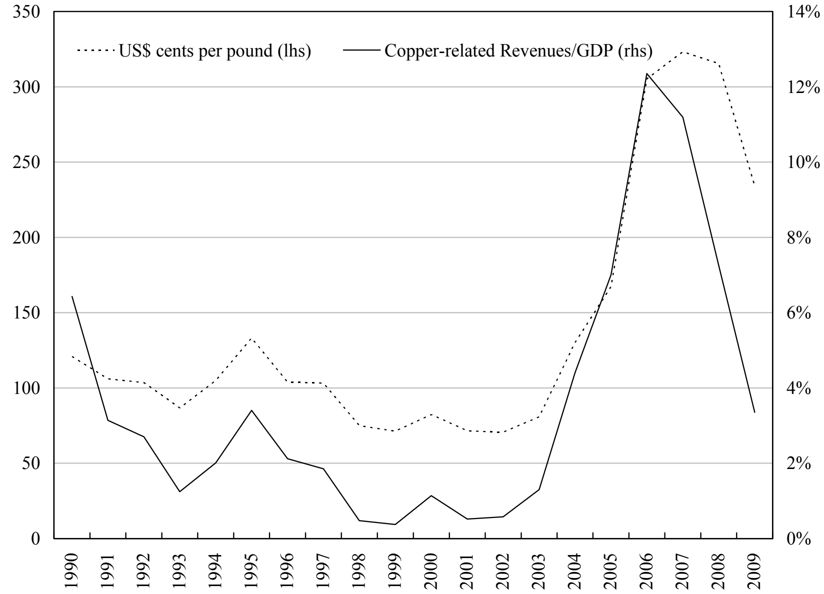
for its fiscal accounts, whether it is due to a significant share of taxation linked to rents in natural resource extraction, or the utilities of state-owned enterprises in these sectors. Not only are commodity-linked revenues important as a source of revenue, but they also tend to be very volatile, primarily due to large fluctuations in prices. Therefore, they are also relevant for fiscal sustainability and macroeconomic stability (Avendaño *et al.*, 2008).[10]

[10] These authors show that the macroeconomic response to the latest Asian-driven commodity boom of exporting countries in Africa and Latin America has been fairly positive. In contrast to the Nineties, during 2000-05 African commodity-exporters have shown a more counter-cyclical fiscal stance, displaying various positive macroeconomic developments (notably, reserves accumulation, exports diversification, and improved credit profile). Results are more modest in Latin America.

Figure 8

Copper Revenues as Share of GDP and the Price of Copper

(US dollars cents/pound)



Source: Authors' calculations based on DIPRES and COCHILCO data.

Figure 8 shows copper revenues as a share of GDP in Chile from 1990 to 2009. Copper revenues during this period have risen from less than 0.5 per cent of GDP in 1999 up to more than 12 per cent of GDP in 2006. Compared with total revenues, these revenues are more than five times more volatile (copper revenues have a coefficient of variation of 1.01 versus 0.18 for total revenues). Thus, it is necessary to separate this source of income in countries where commodities are important for fiscal revenues and perform a special adjustment for commodity price fluctuations.

Unfortunately, the OECD methodology is silent regarding this issue.[11] Therefore, we follow a similar methodology to the Chilean fiscal rule (see Marcel *et al.*, 2001 and Rodríguez *et al.*, 2007) and recent IMF work on this topic in Latin America and the Caribbean (e.g., Vladkova-Hollar and Zettelmeyer, 2008). The adjustment is made for Argentina, Chile, Mexico and Peru.[12] In Argentina, we consider export taxes on agricultural goods introduced in 2002. For Chile, we consider revenues transferred to the central government from the public copper company (CODELCO) and revenues from specific taxes on private mining firms.[13] In the case of Mexico, we use international oil price data to adjust the value of transfers from the public oil firm (PEMEX) to the federal government, royalties and revenues of specific taxes on oil and petrol derivatives. It is important to point out that there are differences – due to data availability restrictions – between how we treat public enterprises in the commodity sector for Chile and Mexico. While for Chile we consider the general government, which implies that we do consider only the transfers and income taxes paid by CODELCO, for Mexico we used the non-financial public sector. Finally, in the case of Peru, we consider royalties and income taxes of the mining and fishing industries, adjusted by a weighted average (according to their share in revenues) of international copper, gold and fishmeal prices. In Annex 3 we present more details on the series and data sources.

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11 For Norway, OECD exercises are carried out using Norway-mainland fiscal and national accounts that exclude the oil and natural gas sector in a consistent way. There is no such information available for Mexico or Chile.

12 Commodity prices are also important in the other countries studied here, but their impact on the fiscal accounts is mainly through the business cycle rather than an autonomous effect for these economies. For the case of Colombia, it is important to point out that energy and mining related revenues represent close to 1 per cent of GDP, but are expected to play an important role in the near future (see Comité Técnico Interinstitucional, 2010).

13 Although other metals like molybdenum, gold and silver are also produced in Chile, copper remains by far the most important source of revenues.

In terms of the adjustment, we first separate revenues (tax and non-tax) into revenues related to commodities and non-commodity revenues. The latter are adjusted as indicated in the Section 2.1 by the business cycle. For commodity-related revenues, we proceed as follows. Considering a spot price of p and a long-run price of the relevant commodity price p^*, structural commodity-linked revenues at time t are given by:

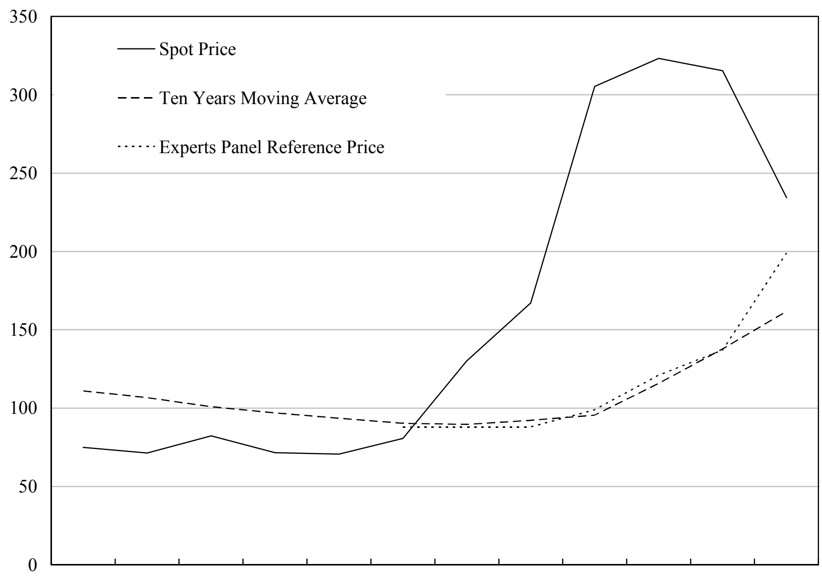
$$R_{s,t}^{c} = R_{t}^{c}\left(\frac{p_t^*}{p_t}\right)^{\gamma} \tag{5}$$

As Marcel *et al.* (2001) and Vladkova-Hollar and Zettelmeyer (2008), we consider a unitary elasticity, such that $\gamma = 1$. For p^*, we considered four different options, depending on available information: future prices, five-year-ahead forecasts, a 10-year moving average or a reference price set by a panel of experts (the case of copper in Chile). As shown in Figure 9 for the case of copper, a 10-year moving average coincides roughly with the forecasts of the experts' panel, with the exception of 2009. For the latest year, it seems that experts consider a larger fraction of the recent rise in copper prices to be persistent. We discard future markets, as they prove to be relatively small and shallow (probably with the exception of oil futures), and prices tend to be very volatile. In what follows, we report our results based on the 10-year moving average price. Commodity revenues are not separately adjusted by the output gap, given that commodity prices are already significantly linked to the business cycle.

As shown in Table 4, as of 2007 a large fraction of observed revenues linked to commodities were likely to be transitory. For Chile, around two thirds of the 11.2 percentage points of GDP linked to copper revenues were due to copper prices above its long-run price. The results for Argentina and Peru indicate that around half of commodity revenues could be considered transitory in 2007, although the absolute magnitudes are smaller than for Chile or Mexico. For the case of Mexico, it would be around one third of the oil revenues that are linked to the oil price cycle (almost 4 per cent of GDP). This table also shows that the global economic crisis, and the consequent decline in commodity prices due to the collapse of global demand, had an important effect on some of the commodity-linked revenues in the region, but the effect is not homogenous. In fact, while in 2009 commodity revenues in Chile declined significantly, in the other three countries the effect was considerably milder.

Figure 9

Copper Prices
(US dollars cents/pound)



Source: Authors' calculations based on data from Cochilco and London Metal Exchange.

Table 4

Commodity-linked Revenues

	Argentina	Chile	Mexico	Peru
Percent of GDP (1)				
1998	0.0	0.5	6.1	2.1
2003	2.5	1.3	7.4	2.5
2007	2.5	11.2	7.9	5.0
2009	2.9	3.4	7.4	3.8
Percent of total revenues (2)				
1998	0.0	2.1	29.8	11.1
2003	10.3	5.7	33.3	14.0
2007	8.6	37.9	35.4	23.7
2009	9.0	11.4	31.0	18.2
Structural commodity revenues (*percent of GDP*) (3)				
1998	0.0	0.7	9.9	3.4
2003	2.3	1.5	5.7	2.3
2007	1.5	4.0	3.9	2.5
2009	2.1	2.3	5.9	2.6
Difference (3)–(1)				
1998	0.0	0.2	3.8	1.3
2003	–0.1	0.2	–1.7	–0.2
2007	–1.0	–7.2	–4.0	–2.5
2009	–0.8	–1.0	–1.5	–1.2

Source: Authors' calculations based on national sources, IMF and ECLAC-ILPES and IDB data.

2.3 Main results

Including all these elements and using the share of each tax on GDP for general governments from ELAC-ILPES and IDB public sector databases of 2006 (except for Colombia and Uruguay, where we used central government data for 2006 and 2008 respectively), we can derive the adjusted balance b^* (as a share on potential output) as:

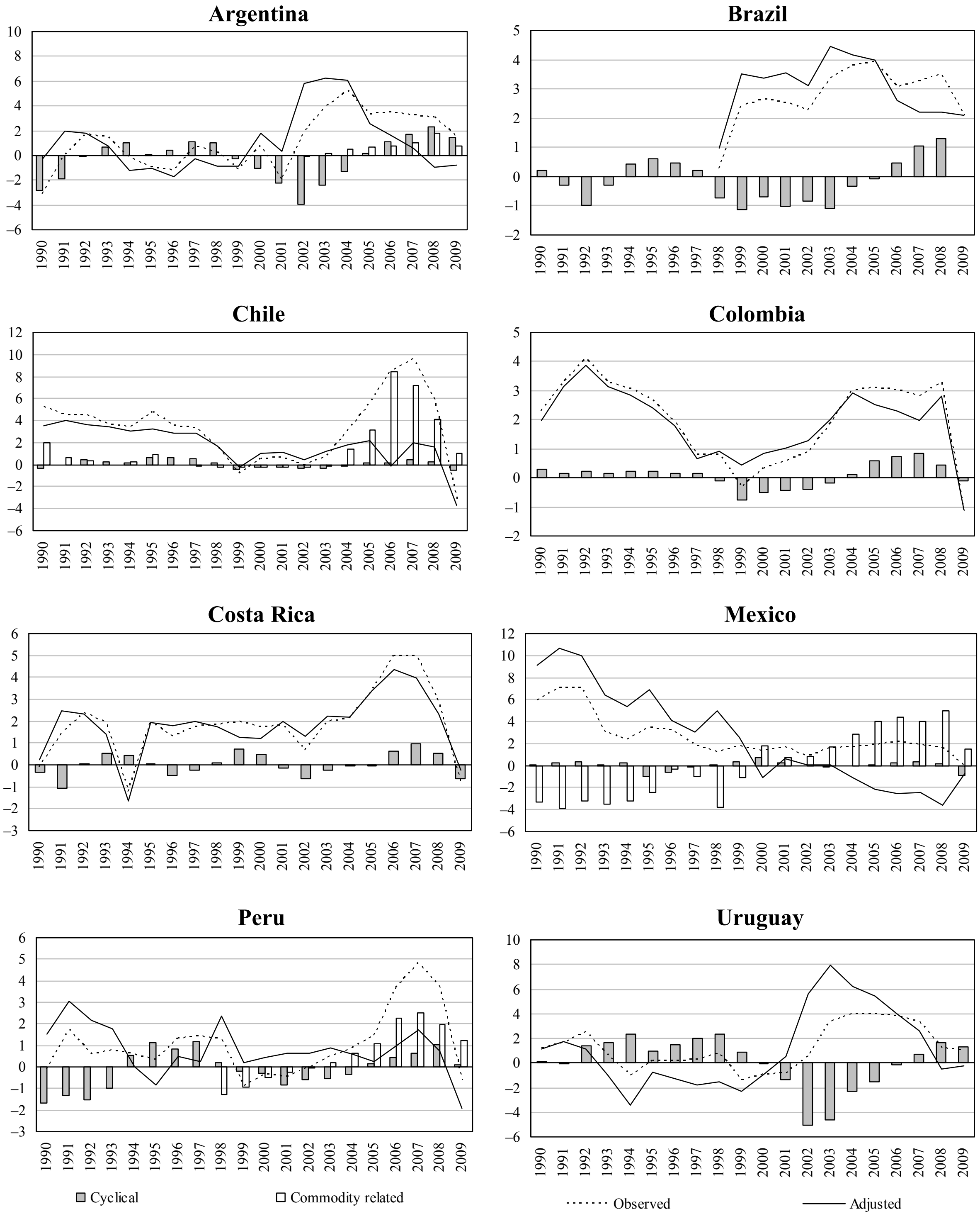
$$b^* = \frac{\left(\sum_{i=1}^{4} T_i (Y^* / Y)^{\alpha_i, y}\right) - G + X}{Y^*} + R_c^s \tag{6}$$

where G are current primary government expenditures, the expression in parenthesis is the cyclically-adjusted receipts from taxes excluding those directly related to commodities, X are non-tax revenues not related to commodities minus capital and net interest spending, Y^* is the level of potential output, and R_c^s are the structural revenues related to commodities from equation (5).

Figure 10 shows the evolution of the primary budget balance (excluding interests) in the selected Latin American economies, the estimated impact of the economic cycle on revenues (automatic stabilization) with the price of commodities (for Argentina, Chile, Mexico and Peru), and the resulting "adjusted primary balance".

Figure 10

Adjusted Primary Budget Balance
(percent of GDP)

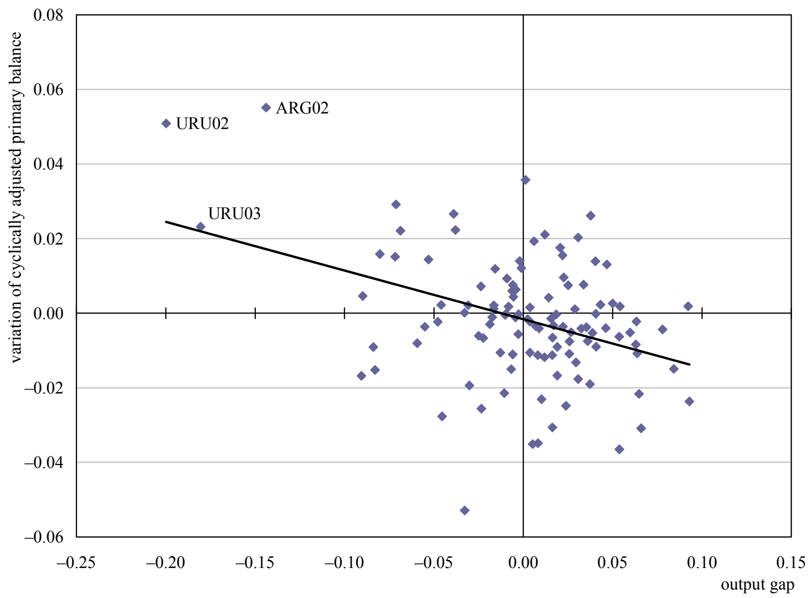


Notes: Primary budget balance is adjusted for deviations of GDP and commodity prices (for Argentina, Chile, Mexico and Peru) around their trends, as explained in Sections 2.1 and 2.2. Non-financial public sector figures in Argentina, Colombia, Mexico and Uruguay, and general government figures for Brazil, Chile, Costa Rica and Peru, from ECLAC-ILPES and IDB databases.
Source: Authors' calculations.

Figure 11

Output Gap and Change in Adjusted Budget Balance

(percent of GDP)



Source: Authors' calculations.

According to our estimates, at the onset of the crisis, adjusted primary balances were in equilibrium or surplus in a majority of countries (1 p.p. of GDP in Peru, 2 p.p. in Uruguay, 2.5 p.p. in Brazil, almost 3 p.p. in Chile and Colombia, and 5 p.p. in Costa Rica; –1.0 p.p. in Argentina and –3.6 p.p. in Mexico). So, even taking into account the positive economic and commodity price cycles, these figures confirm that the region faced the crisis in relatively good shape. The figure also highlights the significant impact of the economic cycle; especially in Argentina and Uruguay (automatic stabilizers via revenue contributed more than 4 per cent of GDP to sustain aggregate demand). Finally, commodity prices (copper, gold and oil) contributed significantly to improve fiscal positions in latest years (around 1 p.p. in Argentina, 2 p.p. in Mexico, 3 p.p. in Peru and over 6 p.p. in Chile). Obviously, 2009 figures reflect a generalized deterioration, driven by cyclical, commodity related and discretionary factors.[14]

Next, we explore the pro-cyclicality of discretionary fiscal policy in the standard way, comparing the variation of the adjusted primary balance and the output gap level. Fiscal policy is defined as counter-cyclical if the surplus increases (deficit decreases) in a year with positive output gap, or if the deficit increases (surplus decreases) when the output gap is negative. As represented in Figure 11, in the last two decades discretionary fiscal policy in Latin America has tended to be pro-cyclical (the correlation coefficient is –0.37 and in more than 60 per cent of cases, 53 out of the 144 cases, discretionary fiscal policy was not stabilizing).

From a national perspective, no country has benefited from sustained countercyclical discretionary fiscal policy, and in all cases, countries show a majority of pro-cyclical fiscal impulses (the most favourable cases are Brazil and Mexico, with 46 and 47 per cent of stabilizing episodes, respectively). In spite of that, based on the correlations of the variation of the adjusted budget balance and output gap level, Chile shows to some extent a countercyclical patter (0.35),

[14] 2009 budget figures are preliminary for many economies. Data for Argentina, Costa Rica, Colombia and Peru where taken from the respective Central Bank databases, for Mexico and Uruguay from Ministry of Finance databases, and Brazil and Chile from OECD *Economic Outlook* projections (May 2010). Access to stable funding (both internal and external) determined the size of announced fiscal packages in the region. Chile and Peru were the top performers in the "fiscal resilience index"constructed by the OECD (2009b); an index that takes into account the external debt to exports ratio (a standard fiscal solvency indicator), the financing cost of fiscal expansions (proxied by the JP Morgan's EMBI Global spreads), and the government's pre-crisis budget balance with respect to GDP. Not coincidentally, these two countries announced and implemented the biggest fiscal stimuli for 2009.

while in Colombia and Peru discretionary fiscal policy has been fairly neutral (coefficients of correlation of 0.01 and –0.07 respectively). Argentina and Uruguay show the highest pro-cyclically, driven mainly by the impact and policy response to the 2002 crisis (if this episode is excluded, Uruguayan fiscal policy has been fairly neutral). Additionally, we find no clear progress in this field in the last decade. From 2000, fiscal policy has been more pro-cyclical (–0.49 from 2000 vs. –0.22 from 1990 to 1999) or as pro-cyclical at best (–0.18 when controlling for the 2002 crisis). With these criteria, good practices stem again from Costa Rica, where discretionary fiscal policy has turned counter-cyclical, and Chile (where it was maintained throughout the period analysed).

We also test whether these results are symmetric along the economic cycle. Using this simplified approach, discretionary fiscal policy seems to be more pro-cyclical in the crisis, when output gap remains negative (correlation of –0.44) than in booms (–0.15). So, apparently, the pro-cyclicality of fiscal policy in the region is not explained by the existence of profligate governments, but with either internally or externally credit rationed countries, as dramatically shown in 2002 crisis, where a huge fiscal adjustment was implemented in a deep crisis environment in Argentina and Uruguay. Excluding this big shock, no significant difference remains between booms and (regular) busts, an issue that should be borne in mind when setting fiscal rules and institutions. Of course, if the fiscal authorities in the country are aware of the potential impact of such large negative shocks, one could still make the argument that it would be optimal to save more during the good times. However, when it comes to design fiscal rules, it is important to take into account that emerging markets might lose exogenously access to finance during times of turmoil.

While the main focus of this paper is on the cyclicality of fiscal policy in Latin America and the estimation of structural balances, the issue of fiscal sustainability has been of importance for the region, given its recurrent debt problems. Overall, in recent times there has been a reduction of debt-to-GDP levels in the region. However, there are considerable differences within the region. On the one hand, Chile, Costa Rica, Mexico (after the "tequila crisis"), and Peru reduced their debt-to-GDP levels over the last decade and more. Peru and Chile had debt levels of almost 80 per cent of GDP in the early 1990s, while nowadays exhibit levels around 25 per cent of GDP. Less pronounced, but still significant, has been the debt burden reductions in Costa Rica and Mexico from close to 50 per cent of GDP in the mid-1990s to less than 30 per cent in 2008. On the other hand, Argentina and Uruguay have suffered both a debt crisis during the collapse of their fixed exchange rate regimes and associated banking crises in 2001-02. Since then, in part due to debt restructuring, but also due to economic growth and fiscal surpluses they have reduced their debt levels down to around 50 per cent of GDP, which are higher levels than ten years ago. Brazil is closer to the case of Argentina and Uruguay, with still high levels of debt (at least in gross terms) and a somewhat slower reduction than the first group.

Debt sustainability depends on a series of factors such as long-term economic growth perspectives, the cost of funds (interest rate), and the composition of debt; but also things much harder to measure such as expectations (Calvo, 1988) and institutional/political characteristics affecting a country's ability and willingness to service its sovereign debt. Furthermore, exogenous shocks to each of these variables are hard to identify, making debt sustainability analysis a challenging topic. Therefore, in this section we explore some aspects of debt dynamics in the region using standard techniques in the literature, rather than making a precise judgement regarding the need and size of fiscal adjustment in each country.

Although it is not obvious how to establish a benchmark for safe debt levels, one way to approach this issue is to compute the primary surplus required to stabilize debt-to-GDP ratios at their current level, and compare this required surplus with both actual and structural balances.

Given the government budget dynamics in equation (7), fiscal policy is considered sustainable if the primary surplus (S) is greater than the primary surplus required to stabilize the debt level (*D*) relative to GDP (*Y*):

$$D_{t+1} = (1 + r_{t+1})D_t - S_{t+1} \tag{7}$$

where debt levels are end-of-period and r_{t+1} is the average real interest rate during period t+1. Assuming that GDP (*Y*) grows at a rate g_t , dividing equation (7) by Y_{t+1} yields:

$$d_{t+1} = \frac{1 + r_{t+1}}{1 + g_{t+1}} d_t - s_{t+1} \tag{8}$$

where all lower case variables refer now to GDP ratios.

Thus, for a given interest rate and GDP growth rate (assuming that they are constant over time), the primary surplus that stabilizes the current debt-to-GDP level is given by:

$$\bar{s} = \frac{r - g}{1 + r} \bar{d} \tag{9}$$

It should be recognised that this definition has some limitations. First, it does not say anything regarding the initial debt-to-GDP ratio, which might be too high and therefore an additional fiscal effort to reduce it to a safe level would be required. Second, this "accounting approach" does not consider underlying correlations and endogeneity of variables. For instance, in the presence of default risk, interest rates would increase with the debt burden and with net financing needs if liquidity risks are also present. Growth could in turn depend negatively on the cost of funding (*r*) and the debt burden (if there is a debt overhang problem, where private investment is lower because economic agents incorporate the prospects of higher future taxes to service the debt).

In addition, valuation effects can have very important quantitative effects, as most countries in the region have painfully learnt during the 1980s and 1990s (debt dollarization). In particular, swings in the real exchange rate often imply large fluctuations in the debt-to-GDP ratio, if the fraction of dollarized debt is different from the share of tradable goods in GDP.[15] Observe that the steady-state debt-to-GDP ratio can be written as:

$$\bar{d} = \frac{B + eD^*}{Y} \tag{10}$$

where e is the relative price of tradable goods in terms of one unit of output, D^* is debt denominated in tradables (dollars) and B in output units. The right-hand-side of equation (10) can be written as:

$$\frac{B}{Y} + \phi \frac{D}{Y} \tag{11}$$

with $\phi = \dfrac{eD^*}{D}$ representing the share of foreign-currency denominated debt.

The valuation-corrected debt-to-GDP ratio for a given equilibrium exchange rate $\tilde{e}$ is:

$$\tilde{d} = \frac{B}{Y} + \tilde{\phi}\bar{d} \tag{12}$$

15 In addition, the remaining fraction of debt in general is often not nominal debt, but indexed to CPI inflation or short-term interest rates, which move often in tandem with the exchange rate.

where $\tilde{\phi} = \frac{\tilde{e}D^*}{D}$.

Thus, under an appreciated real exchange rate ($e < \tilde{e}$), the valuation-corrected debt ratio will be greater than the observed ratio. This implies that the required primary surplus, shown in equation (13), will also be higher, given that a depreciation of the currency *vis-à-vis* the dollar would be expected in the transition to the steady state. Vice versa, if the currency is depreciated (above the equilibrium exchange rate), the adjusted debt level will be less than the observed one.

$$\tilde{s} = \frac{r-g}{1+r}\tilde{d} \tag{13}$$

In practical terms, we measure the equilibrium real exchange rate to be measured by the average bilateral real exchange rate *vis-à-vis* the US dollar, considering CPI prices over the period 1990-2008. Furthermore, as proxy for the share of foreign currency debt in total debt, we use data on the markets where debt was issued, assuming that all external debt is in US dollars and all domestic debt is indexed to the domestic price level (which we assume to equal the GDP deflator; this is the implicit assumption in equations 11-13).

A final adjustment refers to point in the cycle at which GDP stands, given that the debt-to-GDP ratio would be lower during a boom (holding constant the stock of debt), such that our preferred measure of sustainability is given by:

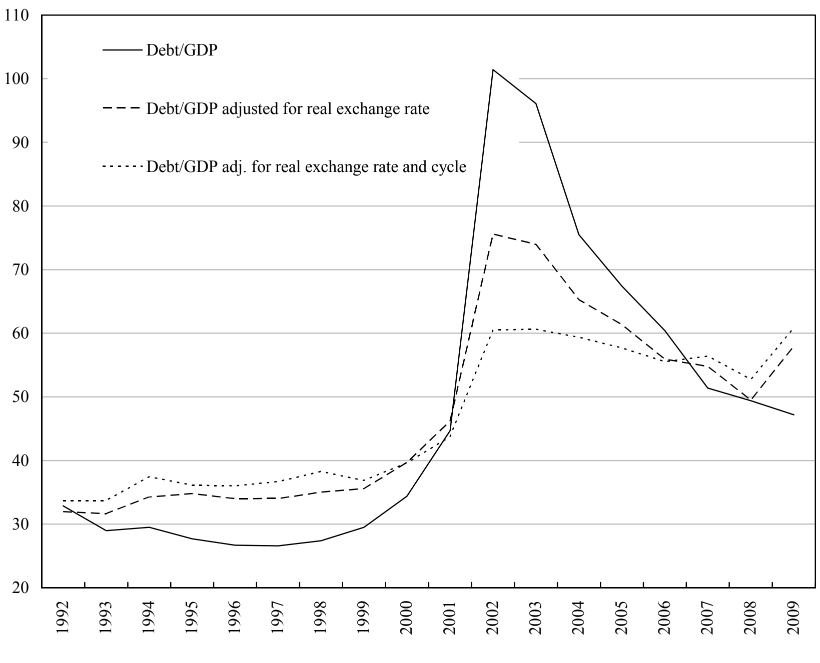
$$\hat{s} = \frac{r-g}{1+r}\tilde{d}\frac{Y}{Y^*} \tag{14}$$

where Y^* is potential output. In practical terms, we compute potential output jointly with the business cycle using the structural time series approach described below.

Before computing the required fiscal surpluses, it is useful to explore the relevance of these adjustments. Figure 12 shows the potential importance of these adjustments from a quantitative point of view for the case of Uruguay. Debt levels as a ratio of GDP in the late 1990s were slightly below 30 per cent of GDP. However, when taking into account the appreciation of the real exchange rate with respect to its

Figure 12

Debt Dynamics and the Real Exchange Rate in Uruguay
(percent of GDP)



Source: Authors' calculations based on ECLAC-ILPES database.

Table 5

Debt Sustainability Analysis
(percent of GDP)

Country	Adjusted Primary Balance (2009)	Observed Primary Balance (2000-09)	Required Surplus (Baseline)	Required Surplus (IMF Forecasts)
Argentina	–0.8	2.1	3.1	3.5
Brazil	2.0	3.0	1.3	1.0
Chile	–3.7	2.8	0.1	0.0
Colombia	–1.1	1.6	0.5	0.3
Costa Rica	–0.2	2.3	0.8	0.4
Mexico	–0.7	1.5	1.2	0.4
Peru	–1.9	1.2	-0.1	-0.1
Uruguay	–0.2	1.6	0.9	1.2

Notes: Required surplus corresponds to equation (14) with debt-to-GDP ratios adjusted by the real exchange rate and the business cycle. Observed primary balance is the average of observed fiscal balances as percentage of GDP over the last ten years. IMF forecasts refer to the WEO April 2010 forecast of real GDP growth in 2015.
Source: Authors' calculations.

long-term average, debt levels would have been ten percentage points of GDP higher. The opposite is true for 2002, where the observed debt-to-GDP ratio shot up to over 100 per cent of GDP, while it would have been around 76 per cent of GDP if debt was valued at the long-term real exchange rate, and almost 16 per cent of GDP less if it were taken into account that the Uruguayan economy was in a deep crisis with GDP far below its potential (almost 20 per cent, according to our estimates). Finally, regarding the large reduction in the debt-to-GDP ratio after the crisis of more than 50 percentage points of GDP between 2002 and 2009, our structural measure of debt was reduced by 7.7 percentage points until 2008, but increased in 2009 to reach similar levels as in 2002. Thus, most of the reduction in the debt-to-GDP ratio could be attributed to the rebound in economic growth and the appreciation of the real exchange rate in the aftermath of the devaluation of the currency.

The main results for the eight countries for 2009 are reported in Table 5.[16] As discussed above, in 2009, most countries present a considerably lower structural balance in 2009 than in previous years, given the automatic and discretionary fiscal expansion in response to the economic crisis. However, all countries (except Argentina) have been able during the last decade to exhibit fiscal balances above those required to sustain their current debt levels, such that they could be expected to reverse expansionary policies without major difficulties. In terms of the difference between the adjusted balance and the required balance to keep debt levels at their current values, while Brazil is the only country with a structural balance above the required surplus, for several countries the difference is below two percent (Costa Rica, Uruguay, Colombia, Mexico and Peru).

Argentina and Chile are the exceptions, with a difference of 3.9 and 3.7 per cent of GDP,

[16] For each country we considered the current yields (average 2010) on sovereign debt bonds (JP Morgan's EMBIG) as the relevant interest rate. Observed and trend growth rates in 2009 are estimated according to the methodology explained in Section 3.

respectively. However, Argentina and Chile are in very different situations. First, Chile took discretionary measures with a fiscal impulse of around 5.6 per cent of GDP (comparing 2007 with 2009), while the impulse in Argentina was much smaller (1.3 per cent of GDP). Thus, countercyclical fiscal policy was much stronger in Chile than Argentina. This impulse was taken from a very strong position (debt-to-GDP of only around 6 per cent of GDP) in Chile, which is also reflected in the low fiscal surplus required to balance debt levels at their current value; meanwhile Argentina requires a much higher fiscal primary surplus (and has higher levels of debt, 47.1 per cent of GDP, adjusting for the real exchange rate and the business cycle). In more general terms, the level of the structural balances (as well as the fiscal impulse during 2007-09) is highly correlated with the initial debt position. Countries with higher levels of debt were in a more solid position to have higher structural deficits and larger fiscal impulses (the correlation coefficients with the debt levels are 0.90 and 0.48, respectively).

3 Estimation of output gap

Many researchers have recognised and analysed aggregate cycles in production without reaching consensus on its causes.[17] Lack of consensus regarding the theory is accompanied by an empirical problem; measurement of economic cycles depends on the estimation of potential output, which is unobservable. OECD methodology decomposes production through classical Solow factor decomposition of capital constructed though perpetual inventory methods, labour (hours worked) and multifactor productivity (MFP). Potential output is then constructed as the counter-factual production arising from full capital utilization,[18] unemployment rate equal to the NAIRU, and MFP given by its long-run trend.

Although we follow the above criteria to construct potential output in the Latin American countries, we could not follow OECD methodology by further disaggregating factors by their specific types, by the sectors of the economy where they are being used, or by their rate of utilization. In particular, restrictions on data availability for several Latin American countries forced us to construct capital from aggregate investment figures, using the perpetual inventory method with infinite lifespan and a constant depreciation rate of eight percent. Real investment, real GDP and active population data are chained series[19] built from series in *Penn World* tables, which cover a span of nearly six decades, from 1950 to 2007. The series are extended up to 2013 using IMF's World Economic Outlook estimates and forecast as of April 2010.[20] The treatment of net exports, in real terms (volume) or in terms of its purchasing power (dollars), merits also some attention. While the first measure better reflects production dynamics, the latter better reflects change on income. We opt for the former measure of volume on two grounds: we keep consistency when we later decompose GDP using a production function, and we analyze the effect of terms of trade on fiscal balance separately from the effect of the business cycle. Initial capital stock in 1950 is assumed to be on a balanced growth path, thus approximated by:

$$K_{1950} = I_{1950} / [(1 + g)(1 + n) - (1 - \delta)] \tag{15}$$

where I_{1950} is initial investment expenditure (filtered by a linear interpolation of the log investment

17 This has lead economist to declare such aggregate behaviour dead in more than one occasion. The latest notable quote came in 2003 from Robert Lucas, who in his presidential address to the *American Economic Association* declared that "the central problem of depression-prevention has been solved, for all practical purposes, and has in fact been solved for many decades".

18 OECD latest revision to potential output uses total capital rather than a filtered series of such series (OECD, 2008).

19 See OECD (2001) for the benefit of chained indices with respect to other bases of conversion, especially when looking at higher frequency data and avoiding level comparison across countries.

20 Potential output is estimated up to 2009. But forecasts for years 2010 onwards are used as a way to circumvent well-known end point filter problems when estimating trends. GDP forecasts are provided by the IMF, while investment forecasts are estimated from those GDP forecasts, using simple regression of investment growth on GDP growth between 1990 and 2009.

throughout the 1950s), g is the average rate of technological progress on that same decade, and n is the corresponding average growth rate of active population.

For the implicit Cobb-Douglas production function we assume a capital share of 0.5 for all countries. This is significantly different from the standard approximation of one third, but closer to the average obtained in the literature that covers emerging markets (see, for example, Gollin, 2002, for country-specific measures of this parameter for a wide range of countries).

Given the broad level of aggregation, cyclical action will be centred in MFP. Several statistical studies have questioned the usual Hodrick-Prescott methodology to de-trend economic series, arguing that it is tailor-made for the output cycles in the US, but not necessarily optimal for any other type of economic series (see Harvey *et al.*, 2008). Furthermore, there is ample evidence that emerging markets have a very different cyclical behaviour than industrialized economies, with some authors putting into question even the existence of cyclical shocks (e.g., Aguiar and Gopinath, 2007).

To address some of these challenges posed in the literature, we de-trend the resulting MFP series using the unobserved components model suggested by Harvey (1998). We use this state-space estimation method to estimate unexpected shocks to the MFP series, decomposing these shocks into three components: shocks that have a permanent effect on MFP, cyclical shocks with an estimated frequency, and time decay, and transitory "white noise" shocks. Permanent shocks determine the trend while the two latter shocks determine the gap to potential output. Harvey (1989) shows that the Hodrick-Prescott filter can be obtained as a particular case of this method, by imposing two additional restrictions: no cyclical component and a predetermined ratio between the variance of transitory and permanent shocks (a ratio that coincides with the parameter lambda of HP filters).

We define the logarithm of multifactor productivity a, and use the state-space domain to decompose the series into three unobserved components: a trend t, a cycle c, and a transitory shock ξ_ι:

$$a = t + c + \xi\iota \qquad (16)$$

The trend component accounts for permanent changes in the growth rate of (log) MFP, and is thus interpreted as the "long run trend for multi factor productivity" in potential output. It is specified as growing with a stochastic drift μ:

$$t = t_{-1} + \gamma \Delta_{\text{crisis}} + \mu \qquad (17)$$

where t_{-1} is the trend in the previous period and Δ_{crisis} is a year dummy that account for large permanent MFP losses at the beginning of the 1980s debt crisis. The drift rate μ is assumed to follow a random walk:

$$\mu = \mu_{-1} + \beta \Delta_{\text{crisis}} + \xi_\mu \qquad (18)$$

where the same 1980s dummy Δ_{crisis} is used to account for any large permanent reduction in MFP's growth rates after the debt crisis. Thus, MFP trend grows at a rate that varies, but that at any time t, is best forecasted as remaining constant and equal to current rate μ. The large recession in the early 1980s and the prolonged low growth that resulted call for adding the Δ_{crisis} dummy, which proves to be significantly negative for both the level and rate of MFP trend. As countries felt the 1980s recession in different years (between 1981 and 1982), for each country we select the year dummy which maximizes the log likelihood (following the AIC criteria).

The cycle component c follows the autoregressive process:

$$c = \rho \cos(\lambda)\, c_{-1} + \rho \sin(\lambda)\, c^*_{-1} + \xi_\chi \qquad (19)$$

$$c^* = -\rho \sin(\lambda)\, c_{-1} + \rho \cos(\lambda)\, \tilde{c}^*_{-1} + \xi_{\chi^*} \quad (20)$$

where ξ_χ and ξ_{χ^*} are disturbances with equal variance. The period of the cycle is $2\pi/\lambda$. The damping factor ρ with $0 < \rho < 1$ ensures that c is a stationary ARMA (2, 1) process with complex roots in the autoregressive part. It is assumed that all disturbances are normally distributed and are independent of each other (usual assumption to assure the identification of the parameters). Initial values for the stationary cycle components are given by the unconditional distribution and for the non-stationary trend and drift components by a diffuse prior. The filtered and smoothed values of the unobserved components are generated by the Kalman filter.

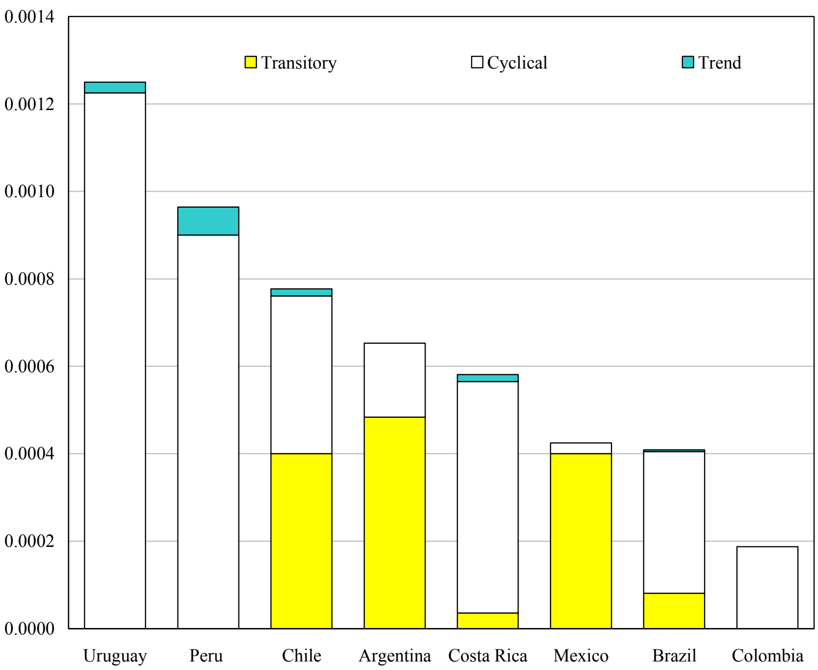
Estimated parameters for the temporary, cyclical and trend components vary significantly across countries. Figure 13 shows the variance decomposition of unexpected shocks in each period ($\xi_\mu + \xi_\chi + \xi_\iota$). While Uruguay has the largest estimated total variance, its shocks are mostly cyclical. The figure also shows that long term estimated shocks to the trend in Chile, Costa Rica, Peru and Uruguay have a statistically significant variance. As expected, even for these countries, this variance is significantly smaller than the estimated variance of the two stationary shocks; a fact that translates into a relatively smooth long-term trend. Though smaller in size than the stationary shocks, trend shocks follow a random walk. Thus their effect is cumulative and large after several periods.

For this reason, while estimated trends in Argentina, Brazil and Uruguay are close to (but different than) zero, growth rate of MFP, together with changes in capital formation, may accumulate and cause significant changes on long run GDP (as observed in Figure 14).

Table 6 shows the estimated damping factor ρ and the estimated period $2\pi/\lambda$ for the stochastic cycle component. Uruguay shows the longest stochastic cycles (averaging 15 years) while Mexico and Peru show the shortest cycles (averaging 9 years). Brazil's estimated cycles are the closest to the "biblical cycle" of 14 years. The damping factor for Costa Rica is the strongest with ρ equal to 0.24 (*i.e.*, the cyclical shock is dampened to a fourth of its size by the following year), while Mexico exhibits the weakest dampening effect with an estimated ρ equal to 0.93 (*i.e.*, it takes 19 years for the cyclical shock to be dampened to a fourth of its size). In Mexico, the high estimated value of ρ, combined with the low estimated variance of cyclical shocks, implies a very stable "almost non-stochastic" cycle.

Figure 13

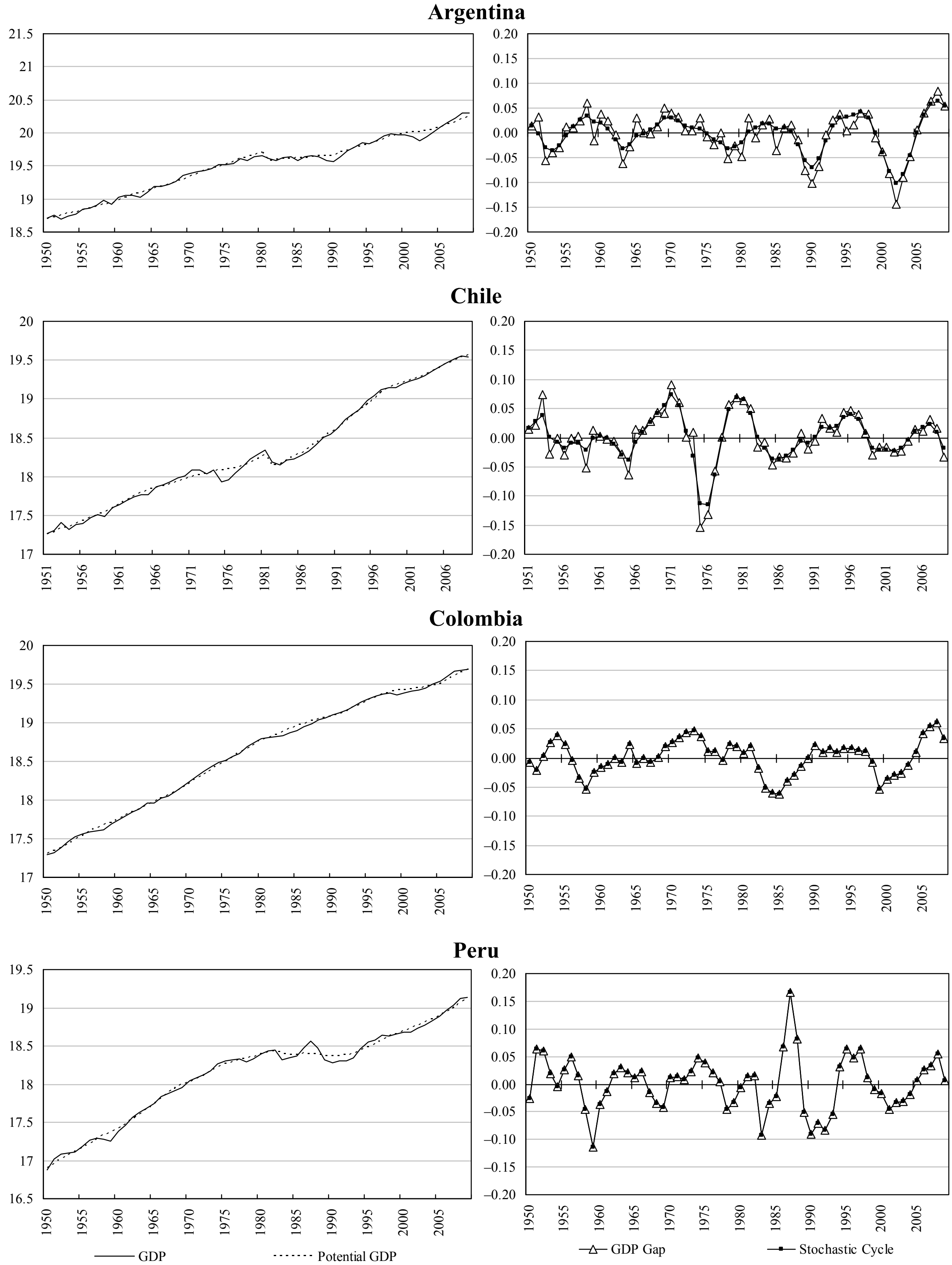
Estimated Variance Decomposition of Shocks to Log MFP



Source: Author's calculations.

Figure 14

Evolution of Estimated Trend and Cycles for Argentina, Chile, Colombia and Peru



Source: Author's calculations.

4 Conclusions and policy implications

Table 6

Estimated Parameters for Cyclical Shocks

Country	Period	ρ
Argentina	11.4	0.84
Brazil	14.1	0.66
Chile	11.6	0.77
Colombia	14.3	0.74
Costa Rica	12.8	0.24
Mexico	8.6	0.93
Uruguay	15.3	0.72
Peru	8.9	0.67

Source: Author's calculations.

This paper aims to contribute to the debate on fiscal policy in Latin America by measuring cyclicality of fiscal balances using a common methodology. At the onset of the international financial crisis in 2008-09, many indicators suggested that Latin American economies were facing the crisis in a much better macroeconomic position that in the past; with positive budget surpluses, lower debt-to-GDP levels and a more credible monetary policy thanks to inflation targeting regimes. Solid macro balances were the new reality in a region where fiscal fragility had been at the root of past protracted crises, such as the dramatic debt crisis of the 1980s.

We track fiscal balances since the early-Nineties for a set of Latin American economies, implementing both standardised cyclical-adjustment OECD methodology and regional specific adjustments for the impact of commodity prices. These estimations allow measuring the size of automatic stabilisers embedded in tax policies, and the cyclicality of discretionary fiscal policy in the region as a whole. Additionally, we perform debt sustainability exercises to analyse how far from a potential benchmark current fiscal balances are.

Our main messages can be summarized as follow. First, there is a great degree of uncertainty concerning output gap estimates in Latin America. Compounded with highly volatile cyclical shocks, there is evidence of highly volatile trends for potential output. Second, commodity cycles may be as relevant to countercyclical policy as economic cycles, because of the former's significance in total fiscal revenues. Third, tax automatic stabilizers are significant, although fairly small. Primary budget balances respond automatically around 0.2 per cent for each percentage point of output gap in the region, half the OECD average (although with significant regional differences). Forth, since the early-Nineties, discretionary fiscal policy has been pro-cyclical in Argentina, Brazil, Costa Rica, Mexico and Uruguay, while neutral in Chile, Colombia and Peru. Fifth, pro-cyclicality of discretionary fiscal policy is probably explained by lack of access to credit during deep crises, rather than by profligate spending. And sixth, from a structural perspective, both cyclically-adjusted balances and debt sustainability analysis confirm the better position enjoyed by most countries in the region before the crisis.

Venues for continuing research include lifting restrictions and understanding the implications of distinguishing cyclical and trend volatility. In a first stage, some hard assumptions we made to apply the OECD methodology may be relaxed, in particular the unitary elasticity of consumption taxes to the cycle, and the consideration of automatic stabilization via expenditure. Additionally, alternative data sources of the distribution of tax payers (administrative data) may be used as a robustness check of the results. Finally, it would be interesting to identify in the tax revenues series the effects of tax and social security reforms implemented since 1990, and to estimate their impact on elasticities.

ANNEX 1
OUTPUT GAP AND WAGES

Table 7

Regressions of Income Growth to Growth of Output Gap

Country	sW	Coeff.	Std. Err.	*t*	*P*>|*t*|	(95% Conf. Interval)	
Argentina	sGap	1.052835	0.3538535	2.98	0.006	0.32406011	0.78161
	cons	–0.0010282	0.0146514	–0.07	0.945	–0.0312034	0.029147
Chile	sGap	0.696172	0.2313957	3.01	0.006	0.2196036	1.17274
	cons	–0.0014225	0.0055165	–0.26	0.799	–0.0127839	0.0099388
Costa Rica	sGap	1.729863	0.3118525	5.55	0.000	1.087591	2.372136
	cons	–0.0016511	0.0082065	–0.20	0.842	–0.0185527	0.0152505
Mexico	sGap	1.452921	0.3424351	4.24	0.000	0.7476625	2.158179
	cons	0.002872	0.0117638	0.24	0.809	–0.0213559	0.0270999
Peru	sGap	1.954151	0.4909695	3.98	0.001	0.9429808	2.965322
	cons	–0.01838	0.0258092	–0.71	0.483	–0.0715351	0.034775
Uruguay	sGap	0.8907144	0.2280803	3.91	0.001	0.4209743	1.360454
	cons	–0.0116578	0.012358	–0.94	0.355	–0.0371096	0.013794

Results of Unobserved Components Model Estimation for Potential Multi Factor Productivity

Argentina

Sample: 1950-2007 Number of obs = 58 Log likelihood = 105.73313

log MFP	Coeff.	Std. Err.	z	$P>\|z\|$	(95% Conf. Interval)	
γ1981	–0.1532983	0.0204885	–7.48	0.000	–0.193455	–0.1131416
β1981	–0.0011573	0.0011727	–0.99	0.324	–0.0034557	0.0011411
S.E. of ξ_μ	$5.45e^{-10}$	0.0002444	0.00	1.000	–0.0004791	0.0004791
$\rho\, cos(\lambda)$	0.7885919	$9.55e^{-06}$	$8.3e^{+04}$	0.000	0.7885732	0.7886106
$\rho\, sin(\lambda)$	–0.4852602	$4.16e^{-06}$	$-1.2e^{+05}$	0.000	–0.4852683	–0.485252
S.E. of ξ_χ	0.013292	0.0032897	4.04	0.000	0.0068444	0.0197397
S.E. of ξ_ι	–0.0221279	0.0035741	–6.19	0.000	–0.029133	–0.0151228

Brazil

Sample: 1950-2007 Number of obs = 58 Log likelihood = 118.84452

log MFP	Coeff.	Std. Err.	z	$P>\|z\|$	(95% Conf. Interval)	
γ1981	–0.1207987	0.0291704	–4.14	0.000	–0.1779716	–0.0636257
β1981	–0.0231028	0.0098635	–2.34	0.019	–0.042435	–0.0037707
S.E. of ξ_μ	0.0026364	0.0014108	1.87	0.062	–0.0001286	0.0054014
$\rho\, cos(\lambda)$	0.7330813	$4.68e^{-06}$	$1.6e^{+05}$	0.000	0.7330721	0.7330905
$\rho\, sin(\lambda)$	0.3568044	$1.44e^{-06}$	$2.5e^{+05}$	0.000	0.3568015	0.3568072
S.E. of ξ_χ	0.0181422	0.0035965	5.04	0.000	0.0110932	0.0251912
S.E. of ξ_ι	–0.0090068	0.0044601	–2.02	0.043	–0.0177485	–0.0002651

Chile

Sample: 1950-2007 Number of obs = 57 Log likelihood = 93.5357

log MFP	Coeff.	Std. Err.	z	$P>\|z\|$	(95% Conf. Interval)	
γ1982	–0.1585976	0.0411957	–3.85	0.000	–0.2393397	–0.0778556
β1982	0.06319	0.0140235	1.47	0.141	–0.0068536	0.0481175
S.E. of ξ_μ	0.0042634	0.0017336	2.46	0.014	0.0008655	0.0076612
$\rho\,cos(\lambda)$	0.7542281	$2.89e^{-06}$	$2.6e^{+05}$	0.000	0.7542225	0.7542338
$\rho\,sin(\lambda)$	0.4502893	$1.72e^{-06}$	$2.6e^{+05}$	0.000	0.4502859	0.4502927
S.E. of ξ_χ	0.0193095	0.0041932	4.60	0.000	0.011091	0.0275281
S.E. of ξ_ι	0.0203625	0.0039529	5.15	0.000	0.0126149	0.0281101

Colombia

Sample: 1950-2007 Number of obs = 58 Log likelihood = 168.231

log MFP	Coeff.	Std. Err.	z	$P>\|z\|$	(95% Conf. Interval)	
γ1982	–0.0589079	0.0163315	–3.61	0.000	–0.090917	–0.0268988
β1982	–0.0202486	0.0009121	–22.20	0.000	–0.0220363	–0.0184609
S.E. of ξ_μ	$3.78e^{-11}$	0.0001884	0.00	1.000	–0.0003692	0.0003692
$\rho\,cos(\lambda)$	0.7802297	0.052166	14.96	0.000	0.6779863	0.8824731
$\rho\,sin(\lambda)$	0.3666441	0.0603868	6.07	0.000	0.2482882	0.4850001
S.E. of ξ_χ	–0.0137002	0.0012958	–10.57	0.000	–0.0162398	–0.0111605
S.E. of ξ_ι	$-6.98e^{-10}$	0.0067861	–0.00	1.000	–0.0133004	0.0133004

Mexico

Sample: 1950-2007 Number of obs = 58 Log likelihood = 123.58014

log MFP	Coeff.	Std. Err.	*z*	*P*>|*z*|	(95% Conf. Interval)	
γ1982	–0.1558083	0.0115221	–13.52	0.000	–0.1783912	–0.1332254
β1982	–0.0150606	0.0007016	–21.46	0.000	–0.0164358	–0.0136854
S.E. of ξ_μ	$9.95e^{-12}$	0.0001558	0.00	1.000	–0.0003054	0.0003054
$\rho\, cos(\lambda)$	0.7152843	$2.40e^{-06}$	$3.0e^{+05}$	0.000	0.7152796	0.715289
$\rho\, sin(\lambda)$	0.6461949	$4.06e^{-06}$	$1.6e^{+05}$	0.000	0.6462028	0.6461869
S.E. of ξ_χ	0.0047896	0.0015288	3.13	0.002	0.0077859	0.0017933
S.E. of ξ_ι	–0.019532	0.002262	–8.63	0.000	–0.0239654	–0.0150986

Peru

Sample: 1950-2007 Number of obs = 58 Log likelihood = 89.85937

log MFP	Coeff.	Std. Err.	*z*	*P*>|*z*|	(95% Conf. Interval)	
γ1981	–0.0245013	0.0455782	–0.54	0.591	–0.1138329	0.0648302
β1981	–0.0336053	0.0225792	–1.49	0.137	–0.0778597	0.0106492
S.E. of ξ_μ	0.0076486	0.002554	2.99	0.003	0.0026427	0.0126544
$\rho\, cos(\lambda)$	0.6275314	$2.78e^{-06}$	$2.3e^{+05}$	0.000	0.6275259	0.6275368
$\rho\, sin(\lambda)$	0.5331292	$2.36e^{-06}$	$2.3e^{+05}$	0.000	0.5331246	0.5331338
S.E. of ξ_χ	0.0298896	0.0030726	9.73	0.000	0.0359118	0.0238673
S.E. of ξ_ι	$2.89e^{-32}$	0.0116013	0.00	1.000	–0.0227381	0.0227381

Uruguay

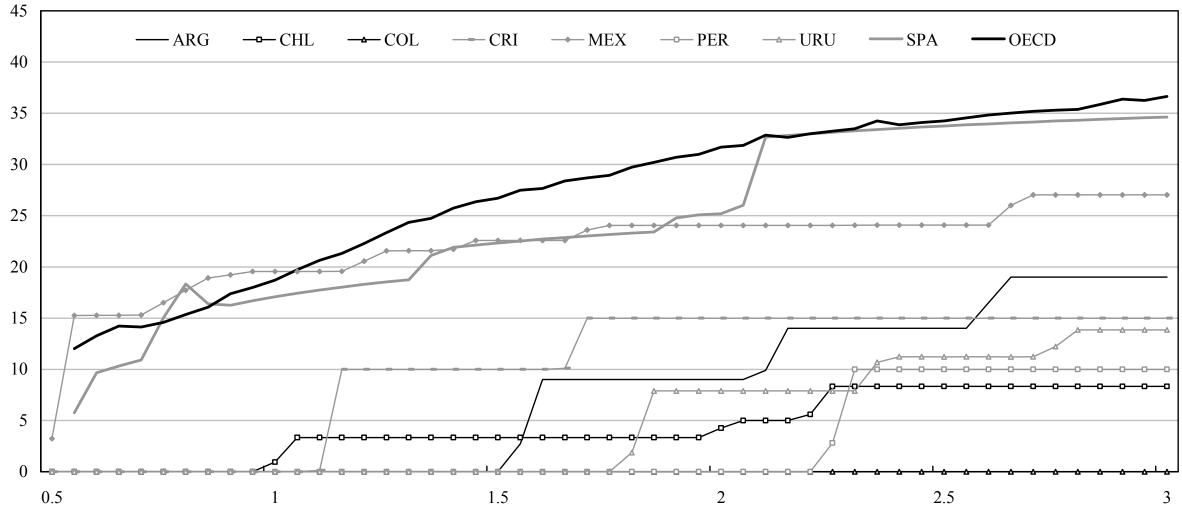
Sample: 1950-2007 Number of obs = 58 Log likelihood = 89.822777

log MFP	Coeff.	Std. Err.	z	$P>\|z\|$	(95% Conf. Interval)	
γ1982	–0.0956271	0.0450603	–2.12	0.034	–0.1839436	–0.0073105
β1982	0.0032569	0.0192269	0.17	0.865	–0.0344272	0.040941
S.E. of ξ_μ	0.0052465	0.0025954	2.02	0.043	0.0001596	0.0103334
$\rho\ cos(\lambda)$	0.7841392	$3.36e^{-06}$	$2.3e^{+05}$	0.000	0.7841326	0.7841458
$\rho\ sin(\lambda)$	0.3442606	$2.25e^{-06}$	$1.5e^{+05}$	0.000	0.3442562	0.344265
S.E. of ξ_χ	0.0352872	0.0035362	9.98	0.000	0.0283563	0.0422181
S.E. of ξ_ι	$2.72e^{-07}$	0.0103452	0.00	1.000	–0.020276	0.0202765

ANNEX 2
TAX RATES

Figure 16

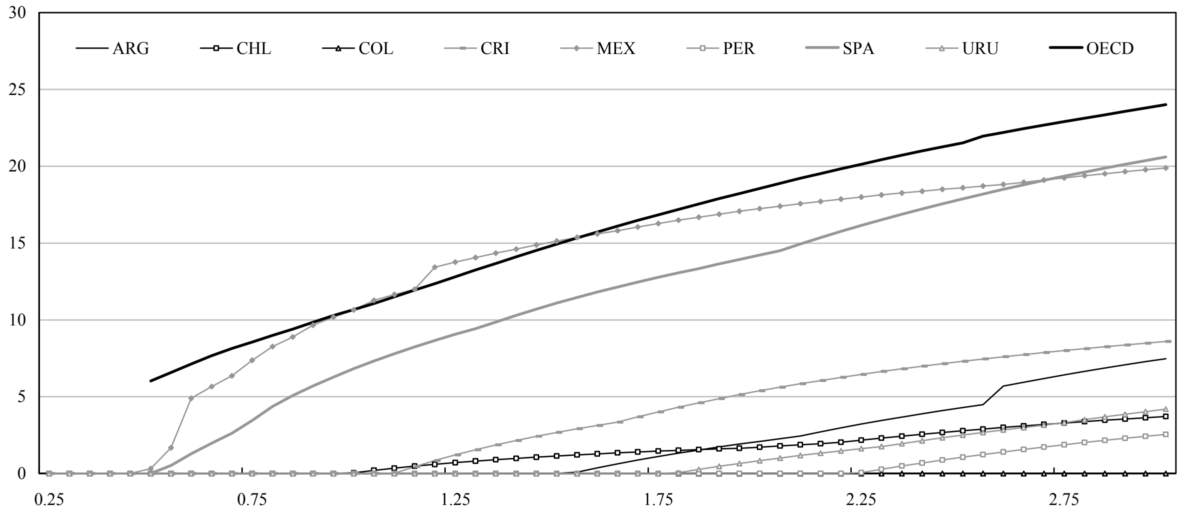
Marginal Personal Income Tax by Income Levels
(percent)



Note: Marginal tax rate by household labour income level.
1 represents the national average. OECD unweighted average, excluding Chile and Mexico.
Source: Authors' calculations based on OECD's *Taxing Wages* (Mexico), Ministries of Finance (Chile and Uruguay) and own elaboration (Argentina, Colombia, Costa Rica and Peru).

Figure 17

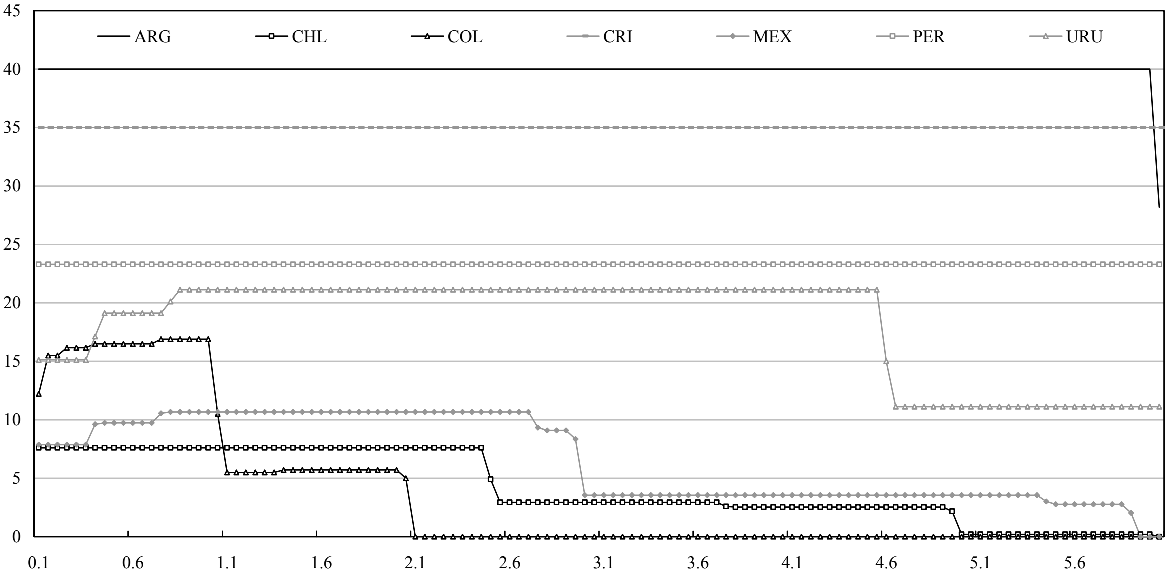
Average Personal Income Tax by Income Levels
(percent)



Note: Average tax rate by household labour income level.
1 represents the national average. OECD unweighted average, excluding Chile and Mexico.
Source: Authors' calculations based on OECD's *Taxing Wages* (Mexico), Ministries of Finance (Chile and Uruguay) and own elaboration (Argentina, Colombia, Costa Rica and Peru).

Figure 18

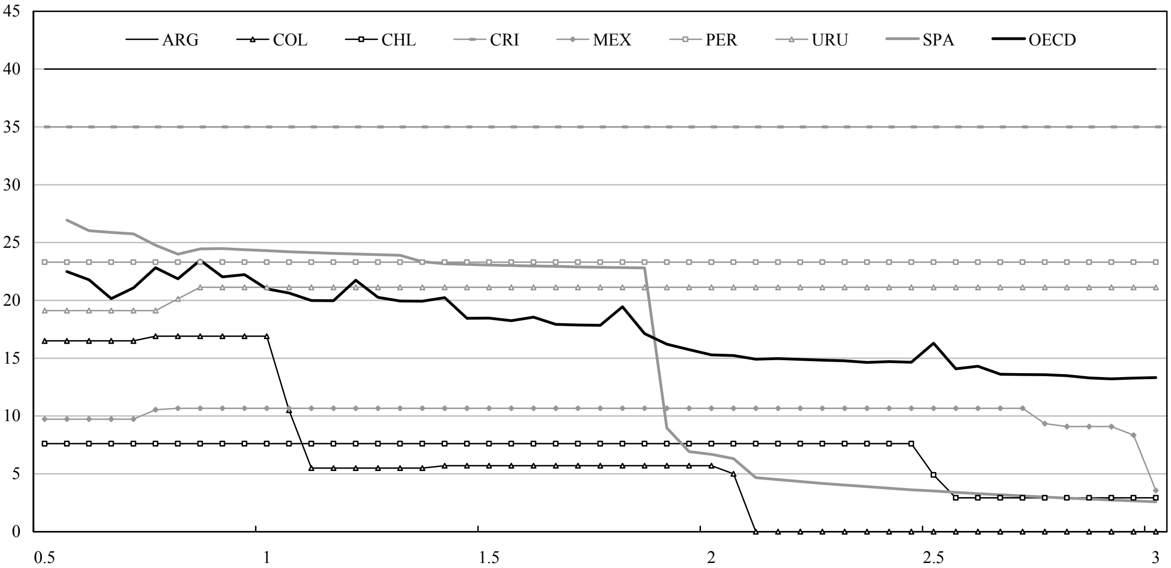
Marginal Social Contribution Tax by Income Levels
(percent)



Note: Marginal tax rate by household labour income level.
1 represents the national average.
Source: Authors' calculations based on OECD's *Taxing Wages* (Mexico), Ministries of Finance (Chile and Uruguay) and own elaboration (Argentina, Colombia, Costa Rica and Peru).

Figure 19

Average Social Contribution Tax by Income Levels
(percent)



Note: Average tax rate by household labour income level.
1 represents the national average. OECD unweighted average, excluding Chile and Mexico.
Source: Authors' calculations based on OECD's *Taxing Wages* (Mexico), Ministries of Finance (Chile and Uruguay) and own elaboration (Argentina, Colombia, Costa Rica and Peru).

Table 8

General Government Revenues
(percent of GDP)

Country	Tax					Current Primary Revenue	
	Corporate	Personal	Indirect	Social Security	Total	Non-tax Revenue	Total
Argentina	**3.5**	**1.5**	**11.6**	**3.8**	**20.4**	**2.8**	**23.2**
Brazil	**3.4**	**0.3**	**14.2**	**8.1**	**26.1**	**4.8**	**30.9**
Chile	**5.5**	**1.0**	**9.4**	**1.4**	**17.2**	**8.1**	**25.3**
Colombia	**5.7**	**0.2**	**5.6**	**2.2**	**15.6**	**12.6**	**28.2**
Costa Rica	**3.2**	**1.3**	**8.9**	**6.4**	**19.8**	**2.7**	**22.5**
Mexico	**2.3**	**2.0**	**3.7**	**1.3**	**9.3**	**13.3**	**22.6**
Peru	**5.2**	**1.4**	**7.0**	**1.6**	**15.1**	**3.1**	**18.2**
Uruguay	**2.6**	**1.9**	**10.1**	**6.2**	**20.8**	**6.2**	**27.0**
France	2.2	9.0	15.1	18.5	44.7	4.6	49.4
Germany	0.8	9.8	12.0	18.6	41.1	3.1	44.2
Italy	2.5	11.2	14.5	13.1	41.3	2.6	44.0
Japan	2.9	4.6	8.3	10.6	26.3	1.5	27.8
Korea	3.1	4.0	12.8	4.7	24.5	3.1	27.7
Spain	3.4	7.2	12.0	13.7	36.2	2.7	38.9
United Kingdom	2.9	12.5	13.3	7.8	36.4	3.0	39.4
United States	2.1	9.1	7.3	7.0	25.4	4.9	30.4

Note: Data is referred to 2003 for the OECD excluding Chile and Mexico, 2008 for Uruguay and 2006 for Latin America.
Source: ECLAC-ILPES and IDB databases, and Girouard and André (2005).

Table 9

Tax Elasticities

Country	Corporate Income Tax	Personal Income Tax	Indirect Taxes	Social Security Contributions	Total over Cycl-adj Taxes	Total over GDP
Argentina	**0.83**	**3.61**	**1.00**	**1.08**	**1.16**	**0.27**
Brazil	**1.17**	**2.72**	**1.00**	**1.44**	**0.95**	**0.25**
Chile	**0.66**	**3.51**	**1.00**	**1.30**	**1.30**	**0.14**
Colombia	**0.96**	**2.65**	**1.00**	**0.55**	**0.94**	**0.14**
Costa Rica	**0.27**	**4.49**	**1.00**	**1.67**	**1.31**	**0.27**
Mexico	**0.69**	**2.95**	**1.00**	**0.76**	**1.29**	**0.13**
Peru	**0.38**	**5.33**	**1.00**	**1.94**	**1.54**	**0.18**
Uruguay	**1.18**	**2.85**	**1.00**	**0.95**	**1.17**	**0.25**
LAC	**0.69**	**3.61**	**1.00**	**1.28**	**1.22**	**0.19**
Canada	1.55	1.10	1.00	0.56	1.03	0.34
France	1.59	1.18	1.00	0.79	0.98	0.49
Germany	1.53	1.61	1.00	0.57	0.96	0.44
Italy	1.12	1.79	1.00	0.86	1.18	0.40
Japan	1.65	1.17	1.00	0.55	0.92	0.39
Korea	1.52	1.40	1.00	0.51	1.04	0.25
Spain	1.15	1.92	1.00	0.68	1.08	0.39
United Kingdom	1.66	1.18	1.00	0.91	1.10	0.34
United States	1.53	1.30	1.00	0.64	1.05	0.24
OECD	1.47	1.21	1.00	0.71	1.02	0.40

Note: LAC unweighted average. OECD unweighted average, excluding Chile and Mexico.
Source: Authors' calculations for Argentina, Chile, Colombia, Costa Rica, Mexico and Uruguay, De Mello and Moccero (2006) for Brazil, and Girouard and André (2005) for the rest.

ANNEX 3
COMMODITY SERIES

Argentina

We consider export taxes introduced in 2002 ("Derechos de exportaciones"). All data are available at: http://www.mecon.gov.ar/sip/basehome/rectrib.htm

Prices come from the IMF commodity price database (food and energy indices) and are weighted according to their importance in exports.

Chile

- Corporate income tax paid by CODELCO
- Transfers from CODELCO to the central government
- Royalties paid by private mining firms

All these data come from DIPRES (www.dipres.cl). The price adjustment is based on a 10-year rolling window average of copper prices from COCHILO (refined copper prices BML/LME in US$).

Mexico

- PEMEX net income
- Royalties paid by private firms in the petrol sector to the federal government
- Special tax on petrol related income
- Specific net excise tax (IEPS)

All data come from the SHCP (www.apartados.hacienda.gob.mx). The price adjustment is based on a 10-year rolling window oil prices from the IMF commodity price database.

Peru

- Royalties paid by mining sector
- Corporate income tax paid by mining and hydrocarbon sector, petrol refinery, fishing sector, non-metal minerals
- General Internal Sales Tax of same sectors

Prices are taken from the IMF commodity prices database (copper, fishmeal, oil and gold), weighted by importance of sectors in revenues.

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