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Growth and volatility of tax revenues in Latin America

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**Growth and Volatility of Tax Revenues
in Latin America**

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Growth and Volatility of Tax Revenues in Latin America

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Abstract. Against the backdrop of high macroeconomic instability and the need to meet the demands of public spending, we analyze the trade-off between growth and volatility of tax revenues in Latin America. Short-run and long-run elasticities for a sample of eleven economies are estimated accounting for state-dependent asymmetric reactions. Controlling for composition of revenue sources and other idiosyncrasies, we find revenues above (below) its long-run equilibrium to react stronger (weaker) to business cycle dynamics. Our detailed elasticity estimates can give some orientation on how to stably reach higher tax levels on the way to develop an adequate internal tax system.

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1 INTRODUCTION AND MOTIVATION

(a) Motivation

In general, collecting taxes is justified by the generation of revenue to finance public goods and services like infrastructure, education, health and other social programs. Providing these prerequisites for economic performance is crucial, especially in developing economies, to foster growth and to reduce inequality and poverty (Székely 2003, Gordon & Li 2009, Cornia 2010). Given a notoriously high macroeconomic instability of Latin American economies (Neumeyer & Perri 2005, Catão 2007, Lama 2011), the dependence on external financial factors and the presence of capital market constraints (Mendoza & Smith 2002, Christiano *et al.* 2004) tax revenues need to be both stable and growing in order to meet these prerequisites. This need is all the more obvious given that many Latin American economies generally were and still are dependent on the shackles of commodities exploitation, which provides the livelihoods of their citizens but leaves their economies perennially susceptible to boom-bust cycles and currency fluctuations. The historical roots of this fact are outlined in Engerman & Sokoloff (2005). Nevertheless, commodity prices in the region have remained remarkably stable during what has become known as the period of the Great Recession that started in the last years of the preceding decade. Most countries seem to have coped relatively well with the global crisis. Accumulating international reserves at rates never seen before, domestic markets perform relatively better than in many other regions of the world. However, as Latin American economies still go through transition from an international trade taxes regime to raising revenues from other tax categories, there remains the question of an adequate structure: Given idiosyncrasies of a country in the region, how responsive are the different categories to economic fluctuations? Are there differences in their potential to generate revenue in the long run?

As state governments in the U.S. are also constrained in their external financing and habitually tend to suffer from cyclical budget contractions, the vast majority of the existing literature on tax revenue growth and volatility is concerned with U.S. federal states. It dates back to the seminal study by Groves & Kahn (1952). Early studies that followed (e.g., Wilford 1965, Legler & Shapiro 1968) analyzed state and local tax revenue, conditioning revenues on income using standard OLS and not distinguishing between the long and short run. By the early 1970s, Williams *et al.* (1973) demonstrated that two taxes can follow the same growth trend while experiencing a distinct

variability around it. Their findings suggest that a single statistic for revenue elasticity can not be used to analyze growth and variability at the same time and that a possible trade-off between growth and stability exists. The succeeding studies by White (1983) and Fox & Campbell (1984), therefore, considered different taxes and tax structures, confirming this trade-off and finding personal income tax (PIT) and corporate income tax (CIT) to be the fastest growing but also the most unstable taxes. While, for example, White (1983) restricted his analysis to one state, Dye & McGuire (1991) applied White's methodology to all federal states. Sobel & Holcombe (1996) further improved this methodology by accounting for problems of residual variability, serial correlation, and non-stationarity of revenue series. The latest development in this agenda is Bruce *et al.* (2006) who combine the structured approach of Fox & Campbell (1984) with the refined methodology proposed by Sobel & Holcombe (1996). For our estimates, we will widely adhere to their approach, which can be displayed as part of the more general class of nonlinear autoregressive distributed lag models (NARDL). In econometric terms, it uses short run partial sum decompositions in an ARDL framework to estimate asymmetric dynamic multipliers (Shin *et al.* 2011). To the best of our knowledge, these techniques by now have —besides for U.S. federal states— only been used to study a few other countries; see Wolswijk (2009) for the Netherlands and Acquaah & Gelardi (2008) for British Columbian revenues.

(b) Theoretical considerations

Although some tax revenue elasticity estimates for Latin American economies can be found in the literature (usually intended to calculate cyclically adjusted balances), the evidence remains scattered across the different nations and mostly stems from researchers located in governmental organizations in the region (e.g., Basso 2006, Cárdenas *et al.* 2008, De Mello & Moccero 2006, Rincón *et al.* 2003, Salazar & Prada 2003, Schenone & De la Torre 2005, Tapia 2003). With few exceptions (Antelo 2003, Fuentes & Tobar 2003) this literature is focused on a long-run relationship, i.e., the growth aspect of tax revenues. Neither is the issue of growth and stability of revenues analyzed jointly nor is a potential trade-off examined. However, such a trade-off is also an implication of theoretical models like the one recently proposed by Gordon & Li (2009) who argue that in the course of a developing financial sector more firms are pulled into using it, increasing CIT revenues in the long run. On the other hand, revenues from CIT will be volatile and as a share of GDP low in the short run. This is due to two reasons. In the short run domestic banks pass through business cycle volatility

in the form of cyclically varying loan conditions to capital-intensive firms. For the substantial contribution of real interest rates to output volatility in emerging economies see Neumeyer & Perri (2005). Additionally, some firms shift into the informal economy in order to evade the CIT (“threat of disintermediation”). Thus, CIT in the Gordon-Li model, though bearing a substantial growth potential of its revenues, is at the same time generating only relatively low and volatile revenues in the short and medium run. Hence, raising CIT revenues that were eventually also collected in the U.S. until the 1930s (Gordon & Li 2009, p. 856) theoretically implies a clear-cut growth-volatility trade-off for emerging economies. The results of the study by Keen & Lockwood (2010) also imply such a trade-off of growth and volatility for the value added tax (VAT), which started its spread in the second half of the 1960s, primarily amongst the initial members of the EU and in Latin America. Using an unbalanced panel of 143 countries with and without VAT adoption for the period 1975 to 2000, their IV estimates show that VAT implementation generated a “sizeable revenue gain” of 4.54 percent (compared to economies that did not implement a VAT) in the long run. Additionally, a robustly positive coefficient for the interaction term of VAT adaption and income per capita is estimated. The latter, of course, implies a certain volatility of VAT revenues at business cycle frequencies. Again, there seems to be a growth-volatility trade-off that is particularly pronounced for developing countries, where administration and compliance of the VAT can be affected by business fluctuations in the short and medium run.

The above reasoning can be summarized and briefly rationalized as follows. Let total welfare W in a developing economy depend on a series of revenue collections R_i from different sources, e.g., from IT, VAT or commodities. Considering a state having to choose a portfolio from N different revenue sources in order to maximize welfare, we may summarize its objective as

$$\max_{S_i} W = \int F\left(\sum_i^N R_i(t)\right) dt, \text{ where } i = 1, \dots, N; S_i = \frac{R_i}{\sum_i^N R_i} \text{ and } \sum_i^N S_i = 1,$$

i.e. S_i representing the share of revenue instrument i in the portfolio. If we disregard the time dimension for notational ease and introduce the volatility-growth trade-off described in the above sketched literature, the state objective function becomes

$$\max_{S_i} \tilde{W} = F\left(R_i; C_i = \mu_{\Delta R_i} / \sigma_{\Delta R_i}\right) \text{ with } \frac{\partial F}{\partial R_i} > 0 \text{ and } \frac{\partial F}{\partial C_i} > 0 \text{ and}$$

$C_i = \mu_{\Delta R_i} / \sigma_{\Delta R_i}$ denoting the inverse of the coefficient of variation of growth rates ΔR_i of revenue component R_i . What makes this problem a non-trivial task and formally reflects potential volatility-growth trade-offs is the uncertainty about the sign of the cross-differentiation of the arguments in \tilde{W} , i.e.

$$\frac{\partial^2 F}{\partial R_i \partial C_i} > 0 \text{ or } < 0.$$

Reconsidering time, this sign might not only depend on more or less time-invariant idiosyncratic characteristics of a country but also on the phase of the business cycle it is facing. Households, firms, or, in general, economic actors might change their behavior depending on different phases of the cycle. For example, households might under-proportionally cut down consumption of basic needs goods during recessions, while spending proportionally more (less) on other goods during expansions (contractions). Under these circumstances, overall VAT revenues react less pronounced to changes in GDP during downturn phases than during expansion. Likewise if labor market turnover increases more during periods of acceleration than it is slowing down in downturns, the short-run elasticity of PIT is likely to be higher in boom than in bust.

The present study contributes to the literature by applying recently developed econometric techniques to estimate short-run and long-run elasticities of tax revenues in Latin America, accounting for asymmetric reactions of short-run elasticities over the business cycle. Considering the composition of revenues of PIT, CIT, VAT, social security contributions, and revenues from commodities exploitation, we find revenues above (below) its long-run equilibrium to react stronger (weaker) to business cycle dynamics. Our detailed elasticity estimates can give some orientation on how to reach necessary higher tax levels evading sudden stops in revenues due to business cycle instabilities on the way to develop an adequate internal tax system.

The remainder of the paper is organized as follows. Section 2 describes the recent development of tax collection in Latin American economies. Section 3 gives an outline of the data and methodology we use. In Section 4 we present and discuss our findings. Finally, Section 5 concludes.

2 SOME RECENT DEVELOPMENT IN TAX COLLECTION ACROSS LATIN AMERICA

Throughout Latin America the tax burden has been relatively low. In 2008, central governments on average collected only 17.9% of gross domestic product (GDP).¹ Even though this amount is a considerable increase over the 12.5% collected in 1990, it remains well under revenues collected in developed countries: The OECD reports a corresponding 35.2% on average in 2008.² Similarly, Tanzi & Zee (2000) and Bahl & Bird (2006) document a level of taxation in industrialized countries by the end of the 20th century that was about twice that in developing countries. Historically, this rather small amount of tax revenues proved insufficient to meet the demands of public spending in the region. Only in 2006 and 2007 did revenues exceed spending (Carnio 2010), making it look like governments are now more “fiscally conservative” and suggesting “strongly that on the whole this is a good thing for their people;” see Bahl & Bird (2008, p. 295). This period, however, came to a sudden end in 2008 when the international financial crisis began to hit the region.

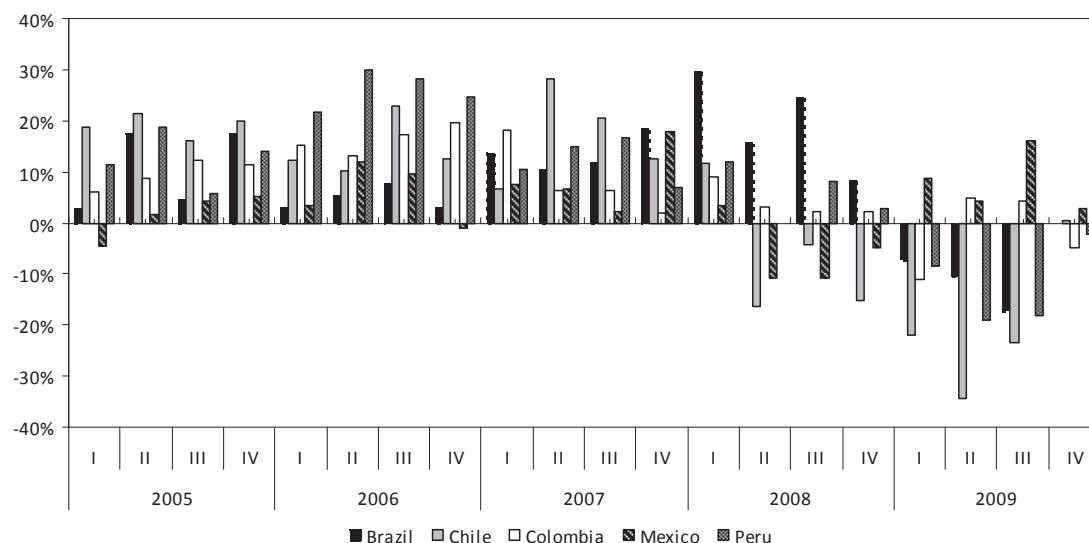
Besides comparably low levels of taxation, macroeconomic volatility in Latin America has been higher than in developed countries and in emerging economies in Asia and East Europe (Catão 2007). Fluctuations in macroeconomic activity have caused major losses in tax revenues. The recent crisis has demonstrated how vulnerable these revenues are to contractions in economic activity (Figure 1). As shown in Figure 1, from 2005 up to the year 2008 all shown countries experienced a more or less steady increase in quarterly tax revenues due to good economic performance but also due to increasing commodity prices. Tax revenues for the majority of considered economies sharply fell at the end of 2008 and during 2009.³ For example, in the second quarter of 2009 Chilean revenues decreased by as much as 34.6% in comparison to the previous year. While this drop was not as pronounced as in other countries, it was still severe.

The interplay between structurally low tax burden and temporary busts in tax revenues has forced several governments in the region to cut down on public services and fall back on external financing in unfavorable conditions or seignorage financing. The margin for counter-cyclical policies narrowed for some countries (ECLAC 2008, Fanelli 2009). Hence, a tax structure with positive revenue growth is not sufficient to ensure solvency each year. Transitory fluctuations can lead to resource shortages even though tax revenues grow in the long run, rendering accurate year-to-year budget

planning a most difficult task. Among other factors such as poor tax administration (cf. Bahl & Bird 2008) this makes tax policy in developing countries in general “the art of the possible rather than the pursuit of the optimal” (Tanzi & Zee 2000, p. 300).

Figure 1: Evolution of Tax Collection during the Recent Crisis^{a)}

(constant values, $[t-(t-4)]/(t-4)$ variation)



Source: own calculations based on data obtained from ECLAC

a) Without social security contributions; data refer to central governments

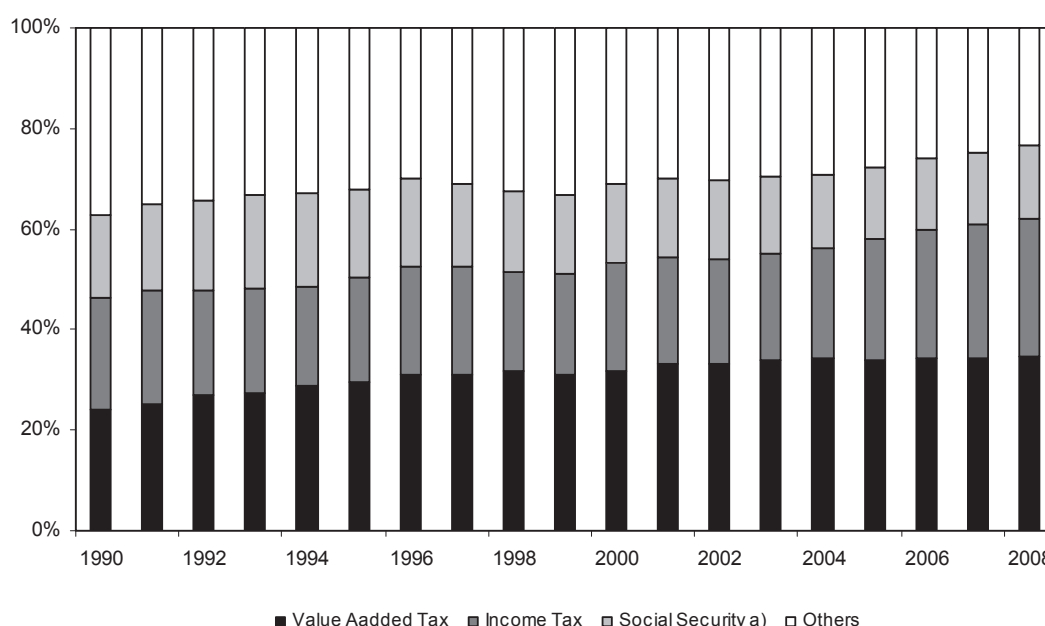
Under the presumption that the Latin American economies seek to become fully integrated with the world economy like countries such as Canada and Australia that were seen as “regions of recent settlement” a century ago and succeeded in installing an adequate internal tax system (Bahl & Bird 2008, p. 279) they will as Tanzi & Zee (2000, p. 320) put it in the *long run* “probably need a higher tax level, because of the need to pursue a government role closer to that of industrial countries.” *Long-run* elasticity estimates capture tax revenue growth, as they measure the relationship between the cumulative development of tax revenues and aggregate income or the respective commodity price for the total period of observation. Short-run elasticity estimates give an answer to the question of how revenues respond to the ups and downs of the business cycle or of commodity prices. In this sense, they capture the volatility of revenues. However, there might be a trade-off, inasmuch as faster growing tax revenue sources might react more strongly to macroeconomic fluctuations and, thus,

prove to be less stable. If this is the case, policy makers face the problem of finding a balance between policy goals of revenue expansion and maintaining revenue stability.

Our analysis will focus on major sources of revenues in Latin America: VAT, income tax (IT), social security contributions, and revenue from commodities. In 2008, IT, VAT, and social security contributions make up 76.8% of total tax revenues. As shown in Figure 2, VAT is the fastest growing tax (cf. Keen & Lockwood 2010). IT revenue grows more moderately over the last two decades. Social security contributions have decreased slightly from 16.6% to 14.8% with a minor increase in the first half of the 1990s. It is noteworthy, however, that there are considerable differences in the composition of these revenue sources across countries in the region. For example, in Bolivia VAT accounts for 46.2% of total tax revenues in 2008, while in Panama it amounts to only 13.8%. For year-over-year growth rates for the major tax sources see Appendix C.

Figure 2: Major Tax Revenue Sources in Latin America

(% of total tax revenue, 19 countries)



Source: own calculations based on data obtained from ECLAC

a) Average for social security contributions does not include Haiti.

Going further into detail, we differentiate (i) personal income tax (PIT) from corporate income tax (CIT) and (ii) external VAT from domestic VAT. Figure 3 and Figure 4 show the sample variation of PIT and CIT as well as the one of the two VAT components for the Peruvian economy during the financial crisis. Obviously, PIT revenue growth slowed gradually until revenue fell slightly in the second quarter of 2009 and only recovered slowly afterwards. Ups and downs of CIT revenues are more pronounced and somewhat lag the cycle. In fact, CIT revenue growth actually accelerated at the end of 2008 before falling in 2009. Possible explanations for the differences include the fact that wages are usually more stable in the short-run due to labor market frictions, while companies face a profound negative impact on profits during a trough.

In the case of domestic and external VAT the difference is even more pronounced. While domestic VAT revenue is only slightly affected by the drop in economic activity, external VAT revenue grew much faster during 2008 but fell by as much as 34.9% in the third quarter of 2009. Imports in the region mainly consist of durable (and luxury) goods, while domestic production satisfies basic consumer needs, which are generally less elastic. Therefore, a contraction of national income will likely be reflected in a decreased demand for imported goods and, consequently, a drop in revenue from taxes levied on imports. In the Peruvian case, domestic VAT (PIT) seems to react less to changes in economic activity than external VAT (CIT).

Figure 3: Variation of PIT and CIT in Peru

($[(t-t-4)]/(t-4)$ variation, constant values)

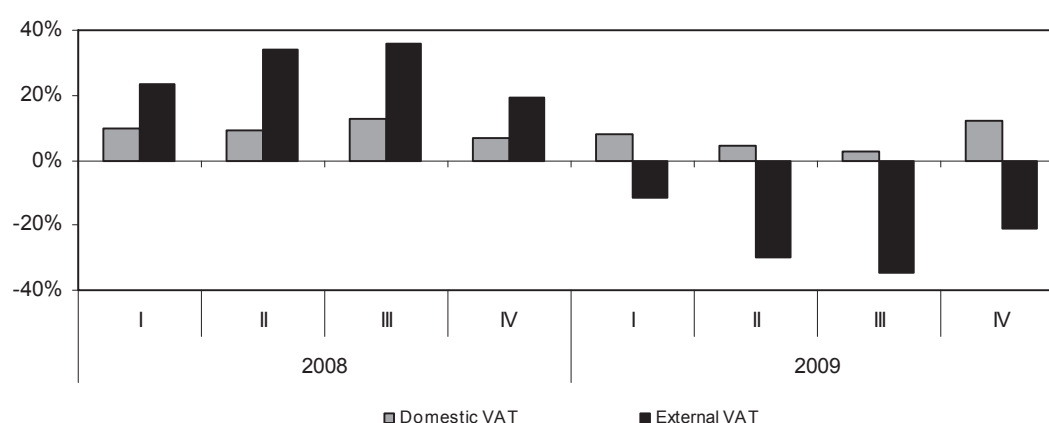


Source: own calculations based on data obtained from ECLAC

As argued above, a peculiarity of most Latin American economies lies in their dependence on commodities exploitation. In Venezuela, Bolivia, Chile, Colombia, Ecuador, and Mexico⁴ non-renewable commodities and natural resources account for over 20% of exports. Considering exports of renewable commodities, the list also includes Argentina as well as several other countries in Central America. In these economies, tax revenues and non-tax revenues from these sectors generate a sizable share of total fiscal revenue. During 2008, shares of revenue from commodities in total revenue ranged from 11.3% in Peru to 49.6% in Venezuela.

Figure 4: Variation of Domestic and External VAT in Peru

($[(t-t-4)]/(t-4)$ variation, constant values)



Source: own calculations based on data obtained from ECLAC

As commodity sectors mainly produce for exports, revenues are crucially dependent on the price of the commodities in question. Moreover, tax and non-tax revenue are usually linked to the performance of the sector and as a result depend on the commodity's price.⁵ Jiménez & Tromben (2006) find that revenues from commodities, in general, show a higher standard deviation than non-commodity revenue series. For this reason, we will analyze revenue from commodities and non-commodity revenue separately: the first with respect to the particular commodity price and the latter with respect to GDP as a measure for aggregate income. The existing literature is fo-

cused on measuring the long-run responses of tax revenues, whereas the short-run has been widely neglected. Most of the estimates stem from cyclical adjusted balances (CAB) and thus are not estimated to explicitly analyze growth or volatility. Existing studies so far also have concentrated either on one country or, if they considered several countries, on total tax revenues only. Two recent exceptions are the seminal studies by Aizenman & Jinjara (2009) and Keen & Lockwood (2010), where the focus of the latter study is on VAT adoption and revenue for a comprehensive panel of 143 countries for 2.5 decades, while Aizenman & Jinjara consider “easy to collect” and “hard to collect” taxes. The present study will be the first to estimate long-run elasticities but at the time also to consider asymmetric short-run elasticities of the most important tax revenue sources for Argentina, Bolivia, Brazil, Chile, Colombia, the Dominican Republic, Ecuador, Mexico, Peru, Uruguay, and Venezuela.

3 DATA AND METHODOLOGY

(a) Data

Our choice of countries and time periods (see Appendix A for detail) is dictated by data availability. Although it covers the larger countries of the region, the sample is certainly not an exhaustive list. About 80 percent of our sample is made of South American economies. Summary statistics of (log first) differences of series is given in Appendix C.

In principle there are two options when quantifying the responsiveness of taxation to changes in national income: either to use tax base (cf. Dye & McGuire 1991, Sobel & Holcombe 1996, Nichols & Tosun 2008) or tax revenue (cf. Bruce *et al.* 2006, Acquaaah & Gelardi 2008, Felix 2008) data. If the relationship between the two is proportional then tax base and tax revenue elasticities would be equivalent. However, due to progressivity of the tax schedule, tax exemptions, or tax evasion, there usually is no such equivalence. In practice, both approaches have advantages and disadvantages. Estimates of tax revenue elasticities can be biased if tax code changes altering the definition of tax base or tax rates are not controlled for in the empirical model’s specification.⁶ Tax base based estimates do not suffer from this bias. Tax base data, however, is in general not readily available and has to be hypothetically constructed with the help of proxies (Dye & McGuire 1991, Sobel & Holcombe 1996), which do not necessarily coincide with the legal tax base definition (Dye 2004). In fact, we know only about one study, Nichols & Tosun (2008), where the au-

thors use exact tax base data by analyzing gambling taxes, for which gross casino revenues represent the actual tax base.

Due to data limitations and for the sake of comparability, we follow the recent studies of Bruce *et al.* (2006), Acquaah & Gelardi (2008), and Felix (2008) by relying on tax revenue data and by controlling for policy changes like tax rate or tax base changes (Appendix B) in our empirical model. As not for all Latin American economies disaggregate data on revenues is available, we have to limit our analysis in these cases to aggregate data on IT and VAT. Our series are of quarterly frequency and range for most of the series from the first quarter of 1990 to the first quarter of 2009. Longer series are unfortunately not available. To deflate the revenue series we employ a corresponding GDP deflator. If the latter is not available, we resort to the respective CPI. To express commodity prices in real terms, we use the U.S. Producer Price Index (PPI).⁷ All series were deseasonalized applying the standard ARIMA X-12 method. Detail along with data sources is given in Appendix A.

With regard to revenues from commodities we consider tax as well as non-tax revenues. Non-tax revenues from commodities, such as transfers, are usually linked to sector performance. The latter rather depends on commodity prices than on economic activity. As a result, we expect non-tax revenues from commodities to react to changes in the commodity price. In the case of Peru and Argentina, revenue from commodities is, in contrast to the other economies in the region, not primarily raised from a single good. We, therefore, construct Peruvian and Argentinean price indices as weighted averages of prices for commodities with a substantial share in exports.⁸ Argentinean taxes on basic goods exports are considered commodity revenues rather than taxes. As each product is taxed with a different rate, an approximation of the share in total export tax revenue is used as weight instead of the share in export volume.

(b) Methodology

Following the method proposed in Sobel & Holcombe (1996), we estimate long-run elasticities relying on dynamic OLS (DOLS) techniques (Stock & Watson 1993). A standard error correction model (ECM) is used to estimate short-run elasticities (Engle & Granger 1987). Additionally, we allow short-run elasticities to vary for different states of economic conditions. Following Bruce *et al.* (2006), state-dependent asymmetry is taken into account according to the position of actual revenue to respective long-run value. Tax revenue measures and cyclical variables are analyzed in natural

log expression. To control for changes in legislation, tax rates are included in the empirical models as independents. They capture variations in the schedule and have been considered for IT (PIT, CIT) and VAT (domestic VAT, external VAT) series. Other changes in the tax code like changes in the definition of legal tax bases are controlled for by use of dummy variables.

As we presume the existence of a long-run equilibrium in order to quantify the long-run relationship between revenue and macroeconomic conditions, the two variables must be cointegrated and trending together, in the sense of following a common stochastic trend. This implies that for the two non-stationary series a linear combination exists that is $I(0)$. To assess these technical conditions, we conduct standard ADF and PP tests for the series in levels, first differences, and for the residuals from regressing revenue on the cyclical variable, respectively. Several of the revenue series are found to be trend stationary, while the vast majority of cyclical variables is found to be stationary in first differences (detailed ADF and PP test results are available on request).⁹ Thus, we decided to follow a two-track strategy. First, we interpret these test results as being the product of small sample bias and notoriously low power of unit root tests and treat the trend stationary series as sharing a stochastic trend with the business cycle. This part of our strategy corresponds for example to the approach followed by Wolswijk (2009).

Additionally, we also considered another strategy for series tested to be trend stationary by estimating a deterministic trend instead of a long-run multiplier in the first step of our analysis (White 1983). It measures, how much tax revenue grows each period without considering a relation to a particular macroeconomic base. In a second step, symmetric short-run elasticities are estimated using standard OLS in differences without including an error correction term. In the final step, asymmetric reactions are taken into account by allowing short-run elasticities to vary according to the position of current revenue relative to deterministic trend. Using White's approach, estimates do not substantially differ from the results we would have obtained by treating the trend stationary tested series as sharing a stochastic trend with the business cycle (cf. Wolswijk 2009) and applying the methods proposed by Bruce *et al.* (2006) to estimate elasticities. If we center the elasticity estimates obtained from the respective method and regress them on each other, we find reasonably high correlation coefficients for the long-run elasticity estimates as well as for short-run elasticities. Throughout, these correlations are significant at all conventional levels of signifi-

cance. This finding leads us to abstract in the following from discussing estimates resultant from the method proposed by White (1983). Detailed estimates based on White's approach for all trend stationary tested series are available on request from the authors. Therefore, in what follows, we report results obtained from the method of Bruce *et al.* (2006) throughout.

In our baseline regressions, the DOLS-model is used to estimate the long-term elasticity β_1 from single equation cointegration relationships of the following form for every economy

$$\ln T_t^i = \beta_0^i + \beta_1^i \ln Y_t + \sum_{g=-j}^j \gamma_g \Delta \ln Y_{t+g} + (X_t^i)' \alpha + \eta_t^i \quad (1)$$

$$\ln R_t = \beta_0 + \beta_1 \ln P_t + \beta_2 \ln E_t + \sum_{g=-j}^j \sum_{h=-s}^s (\gamma_g \Delta \ln P_{t+g} + \phi_h \Delta \ln E_{t+h}) + X_t' \alpha + v_t, \quad (2)$$

where T^i denotes revenues from tax i and Y real GDP, respectively. Covariates contained in X^i are tax rates¹⁰ as well as dummy variables indicating changes in the tax code for respective tax i (Appendix B). The lag- and lead-operator, i.e., the summation of first order differences Δ for different forward and backward shifts of Y (as well as of P and E), is employed to adjust for problems of endogeneity and autocorrelation. Length j (s) of this operator is chosen by means of the Schwarz-Bayesian information criterion (BIC), where we allow for a maximum length $j = 3$ ($s = 3$) except for series of less than 50 observations, for which the maximum length is set to one. In equation (2),¹¹ R denotes revenues from commodities, P the commodity price in US Dollars, and E the respective exchange rate. Long-run elasticities of revenues from tax i are given by estimates of β_1^i – long-run elasticities of commodity revenues by estimates of β_1 . Errors η^i and v are assumed to represent i.i.d. normal random shocks. Note, leads of the first differences of national income are explicitly included. At first sight, this seems at odds with desired and habitually required exogeneity as future national income seems to be naturally related to today's tax revenues and, hence, endogenous. Yet, this is intentionally permitted for different reasons: Using OLS to estimate the first stage in a standard Engle & Granger (1987) routine is on the one hand consistent in the presence of serial correlation in the error term and also of correlation in regressors and cointegration errors. However, on the other hand it can be shown to be not asymptotically efficient in the sense of Saikkonen (1991) and Phillips (1991), i.e. suffering from a so-called “second-order bias.” DOLS factors the likelihood of the

triangular ARDL representation such that the relationship between revenues and income is “ancillary” or in the terminology of Engle *et al.* (1983) “weakly exogenous,” extended to permit conditioning on both leads and lags of first differences in income. See Stock & Watson (1993, pp. 783-786) for detail. In this sense the included lead-lag polynomial of first log differences of GDP in the long-run equation deals with endogeneity issues.

Two short-term effects can occur in each period: Revenues may react to changes in real GDP (or, in case of commodity revenues, to commodity prices) and/or may adjust towards their long-term equilibrium level, based on the assumption that a disequilibrium (ε) exists at the beginning of a period, where

$$\varepsilon_t^i = \ln T_t^i - \beta_0^i - \beta_1^i \ln Y_t - (X_t^i)' \alpha \quad (3)$$

$$\varepsilon_t = \ln R_t - \beta_0 - \beta_1 \ln P_t - \beta_2 \ln E_t - X_t' \alpha. \quad (4)$$

These effects can be considered in terms of an error correction model (ECM), which represents a basic re-parameterization of an autoregressive distributed lag model of first order, i.e. an ARDL(1, 1) model,¹²

$$\Delta \ln T_t^i = \theta_0^i + \theta_1^i (y_t - y_{t-1}) + \theta_2^i \varepsilon_{t-1}^i + \varepsilon_t^i \quad (5)$$

$$\Delta \ln R_t = \theta_0 + \theta_1 (p_t - p_{t-1}) + \theta_2 (e_t - e_{t-1}) + \theta_3 \varepsilon_{t-1} + \varepsilon_t \quad (6)$$

where (dummy-type) covariate expressions have been dropped for reasons of notational convenience; although not shown, they are included above and in the following; lower case letters denote variables in natural log; ε_t^i and ε_t represent i.i.d. random variables. Coefficients θ_1^i and θ_1 indicate intra-period effects, i.e., short-term adjustment effects to changes in real GDP and commodity prices, respectively. Thus, they can be interpreted as measures of short-run elasticities. A major concern of our study is to unravel differences between short-term and long-term effects of GDP (and commodity prices) on revenues. The selected econometric specification allows a direct comparison of both effects. The short-term reaction of revenues to income (or, in case of commodity revenues, to commodity prices) is smaller or larger than the long-term reaction, depending on whether the respective θ_1 is smaller or larger than the respective β_1 . A further interesting question is how fast revenues move to their (new) long-run equilibrium, which may result due to the changes in real GDP (or, in case of

commodity revenues, in commodity prices). Coefficients θ_2^i , θ_3 assess the speed of adjustment of revenues towards their long-term level, i.e., the proportion of disequilibrium, which is reduced in each period. Thus, the larger the absolute value of θ_2^i (in case of commodity revenues, θ_3) is, the faster revenues equilibrate to the new conditions and move to their long-term equilibrium level, respectively.

In equations (5) and (6) the short-run elasticity of revenues with respect to changes in real GDP (in commodity prices) is the same regardless of whether revenues are above ($\varepsilon_t > 0$) or below ($\varepsilon_t < 0$) their long-term equilibrium level. A symmetric reaction is implicitly assumed. To allow the reaction to depend on the particular state of the business cycle, ARDL models (5) and (6) can be modified to account for possible asymmetries in the respective short run dynamics

$$\Delta \ln T_t^i = \theta_0^i + \theta_1^i \Delta y_t + \lambda_1^i (D_t^i \Delta y_t) + \theta_2^i \varepsilon_{t-1}^i + \lambda_2^i (D_{t-1}^i \varepsilon_{t-1}^i) + \nu_t^i \quad (7)$$

$$\Delta \ln R_t = \theta_0 + \theta_1 \Delta p_t + \lambda_1 (D_t \Delta p_t) + \theta_2 \Delta e_t + \theta_3 \varepsilon_{t-1} + \lambda_3 (D_{t-1} \varepsilon_{t-1}) + \nu_t, \quad (8)$$

where the ν vectors represent i.i.d. random variables, and D denote dummy variables, which indicate the respective position of revenues relative to their long-run equilibrium. These dummies will take on a zero value if revenues are below their steady state level and a value of one else. Additionally, we include several covariates in the estimation of equations (5) to (8) in order to isolate a cleaner effect of income elasticity. These other control variables, i.e. variables besides changes in tax rates and tax policy dummies, are (i) contemporaneous public expenditures, (ii) public expenditures lagged by one quarter, (iii) election year dummies, indicating each quarter of a respective election year,¹³ and (iv) three dummy variables marking different inflation regimes defined as intermediate inflation episodes for rates between 5 and 10 percent, high inflation episodes for the range from 10 to 20 percent, and finally hyperinflation periods indicating quarters, for which the inflation rate exceeds 20 percent.¹⁴

Note, the above reasoning on weak exogeneity for (1) and (2) does not extend to (5) to (8). Here, we implicitly and plausibly assume that changes in or first differences of GDP are weakly exogenous with regard to tax revenue changes, in particular for quarterly data, as tax revenues come into effect for growth the earliest when they turn into expenditures. However, the latter process takes time and becomes operative only after the parliament passed and possibly also amended a new budget.

It is more convenient (Shin *et al.* 2011) to write equations (7) and (8) as partial sum decompositions

$$\Delta \ln T_t^i = \theta_0^i + (\theta_1^i)^+ \Delta y_t^+ + (\theta_1^i)^- \Delta y_t^- + (\theta_1^i)^+ (\varepsilon_{t-1}^i)^+ + (\theta_1^i)^- (\varepsilon_{t-1}^i)^- + \nu_t^i \quad (9)$$

$$\Delta \ln R_t = \theta_0 + \theta_1^+ \Delta p_t + \theta_1^- \Delta p_t + \theta_2 \Delta e_t + \theta_3^+ \varepsilon_{t-1} + \theta_3^- \varepsilon_{t-1} + \nu_t, \quad (10)$$

where for $x_t = (\Delta y_t \mid \varepsilon_{t-1}^i \mid \Delta p_t \mid \varepsilon_{t-1})$

$$x_t^+ = \sum_{j=1}^t x_j^+ = \sum_{j=1}^t \max(x_j^+, 0); \quad x_t^- = \sum_{j=1}^t x_j^- = \sum_{j=1}^t \min(x_j^-, 0).$$

Similar specifications and estimation strategies have been used in widely different contexts; for example, by Webber (2000) studying the relationship between exchange rates and import prices, by Lee (2000) and Virén (2001) analyzing asymmetries in Okun's Law and by Borenstein *et al.* (1997) and Bachmeier & Griffin (2003) assessing the asymmetric response of gasoline prices to fluctuations in the price of crude oil.

4 FINDINGS AND DISCUSSION

Before going into detail of studying our findings, it is straightforward to sketch the status quo of tax collection in the region. During our period of observation, the composition of tax structures in Latin American economies was subject to quite some changes. For example, Bernardi *et al.* (2008) summarize the following stylized facts: The period is coined by decreasing revenues from external commerce (due to abolition of taxes on exports and cuts of nominal and effective tariffs on imports) paralleled by a substantial increase of VAT revenues. The latter became the main source of revenues in the region. VAT is both high on average, heterogeneous in terms of base and rates across countries,¹⁵ and of relatively low overall revenue potential. One reason for the latter can be seen in the increasing informality of markets during the observation period. Tax evasion rather than avoidance is particularly an issue regarding internal VAT revenues, as it is obviously more difficult to evade external VAT on imports than VAT on internal transactions. Additionally, tax expenditure, i.e. not collected revenue due to franchises or special tax regimes (exemptions, deductions, etc.) gained in weight. While in Argentina, Ecuador, Peru, and Uruguay incentives related to indirect taxes (especially VAT) prevailed, Chile turned its tax expenditure focus to IT. In general, the weight of IT categories, particularly CIT, increased recently across countries of the region, though less than for VAT. Hence, the scope for and potential

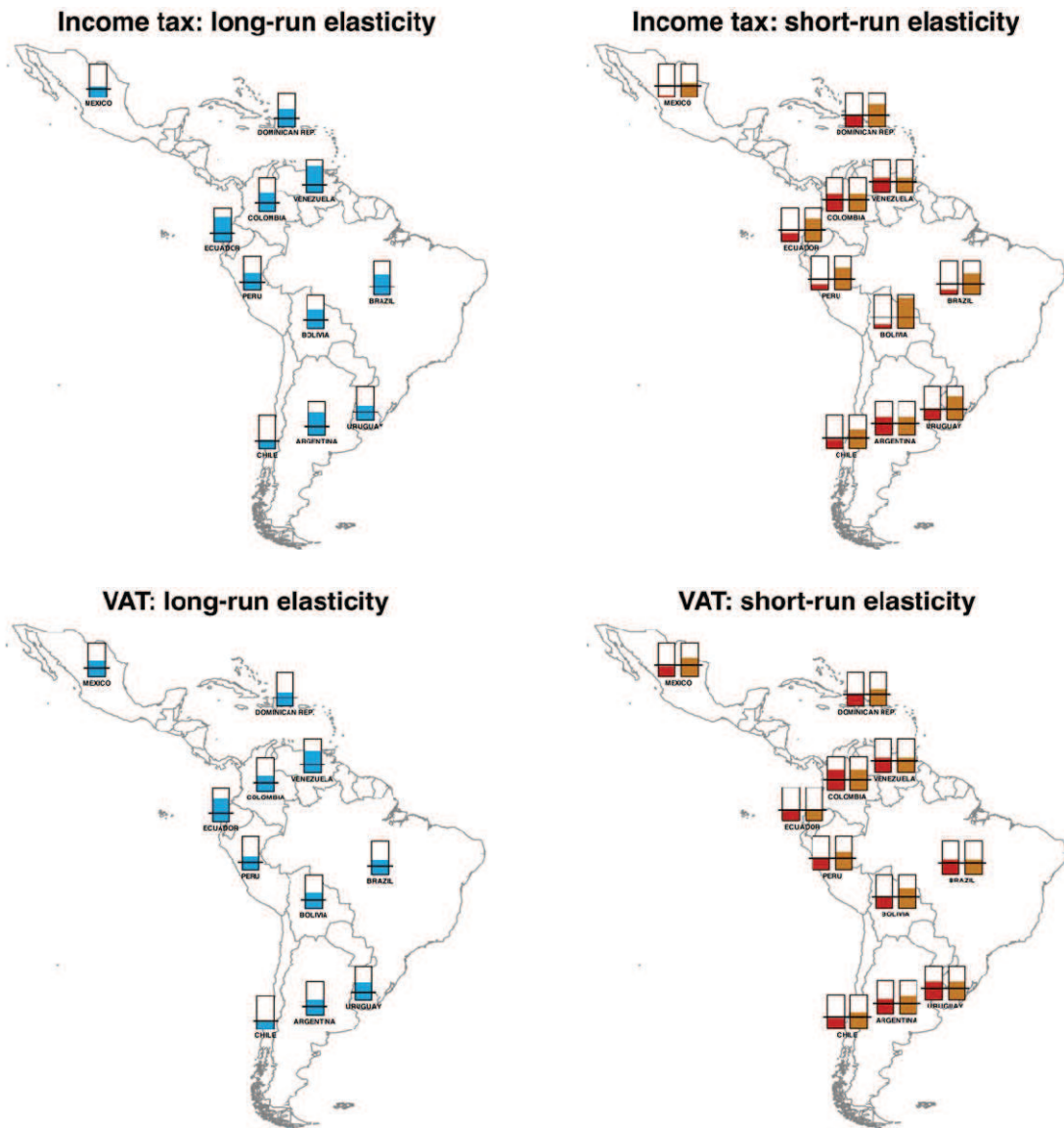
success of raising VAT might be slim and the leverage of other categories to raise revenue a priori more promising.

Figure 5 summarizes our long-run and short-run elasticity estimates of aggregate IT and VAT series in the region. The first row of maps visualizes our IT elasticity estimates for the long run and short run, respectively. The second row of maps does so for VAT elasticity estimates. The size of bars in the first column of maps visualizes the size of estimated long-run elasticities, which typically is larger than the corresponding elasticity estimates in the short run when revenues are below their long-run equilibrium level and smaller when above it (second column of maps). Note the reference line drawn in the bars is one for long-run and zero for short-run elasticity estimates, respectively. The latter are represented by a pair of bars, where the size of bars is identical for symmetric elasticity estimates (eq. 5 and 6) and differs for statistically significant asymmetric elasticity estimates (eq. 7 and 8).

Before actually interpreting our findings, let us briefly summarize why we expect asymmetric trade-offs in general: Households, firms, or generally economic actors might change their behavior depending on different phases of the cycle. For example, households might under-proportionally cut down consumption of basic needs goods during recessions, while spending proportionally more (less) on other goods during expansions (contractions). Under these circumstances, e.g., overall VAT revenues react less pronounced to changes in GDP during downturn phases than during expansion. Likewise if labor market turnover increases more during periods of acceleration than it is slowing down in downturns, the short-run elasticity of PIT is likely to be higher in boom than in bust. This reasoning also applies to the different sub-taxes at stake. For example, comparing PIT and CIT elasticities requires considering the fact that earnings are usually more stable in the short run due to rigidities in the labor market, while companies tend to face an immediate strain on profits during a contraction. Or in the case of external vs. internal VAT, we may argue that imports in the region mainly consist of durable and luxury goods, while domestic production satisfies basic consumer needs, which are generally found to be comparatively less elastic. Hence, a contraction of national income is likely to imply a decrease in demand for imported goods and, consequently, a drop in revenue from taxes levied on imports. Figure 6 and Figure 7 make the point. Figure 6 plots our short-term against long-term elasticity estimates for the different revenue sources. The left schedule refers to the below, the right schedule to the above long-term equilibrium situation, respectively.

While circles refer to symmetric estimates, grey dots mark asymmetric estimates. For the latter (former) the corresponding regression line is drawn solid (dashed).

Figure 5: Long-Run and Short-Run Elasticity Estimates: IT and VAT



Notes: For long-run elasticity estimates bars range from 0 to 4 with reference line at 1. For short-run elasticity estimates bars range from -4 to 8 with reference line at 0. For short-run elasticities left (right) bars correspond to below (above) long-run equilibrium responsiveness.

Based on own estimates; for detailed figures see Table 1; for data sources and detail on series see Appendix A.

Figure 6: Long-Run vs. Short-Run Elasticity Estimates across Revenue Sources

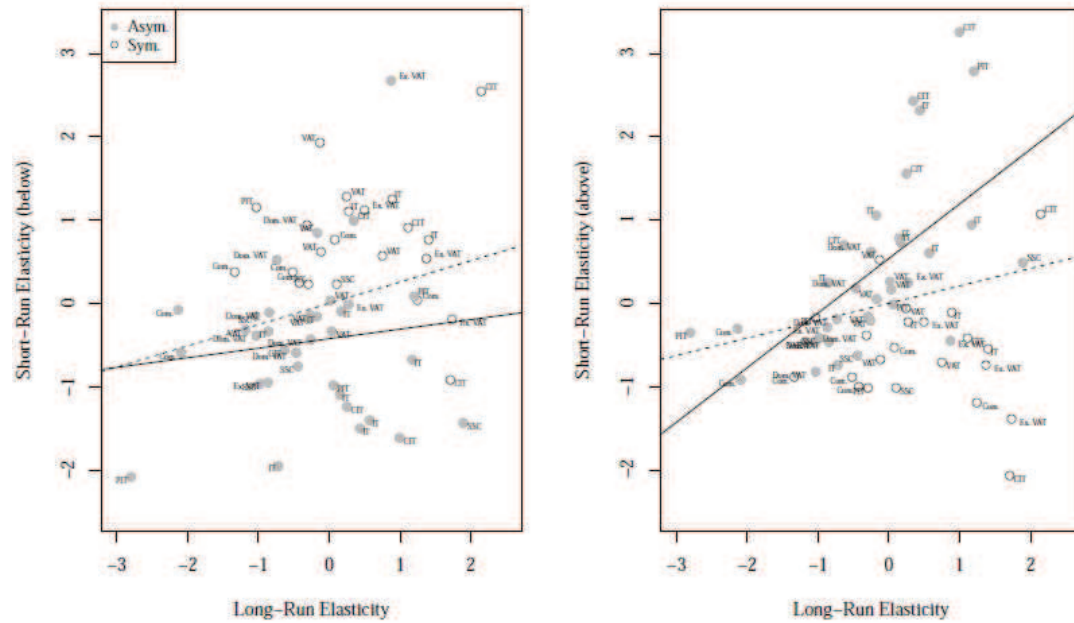
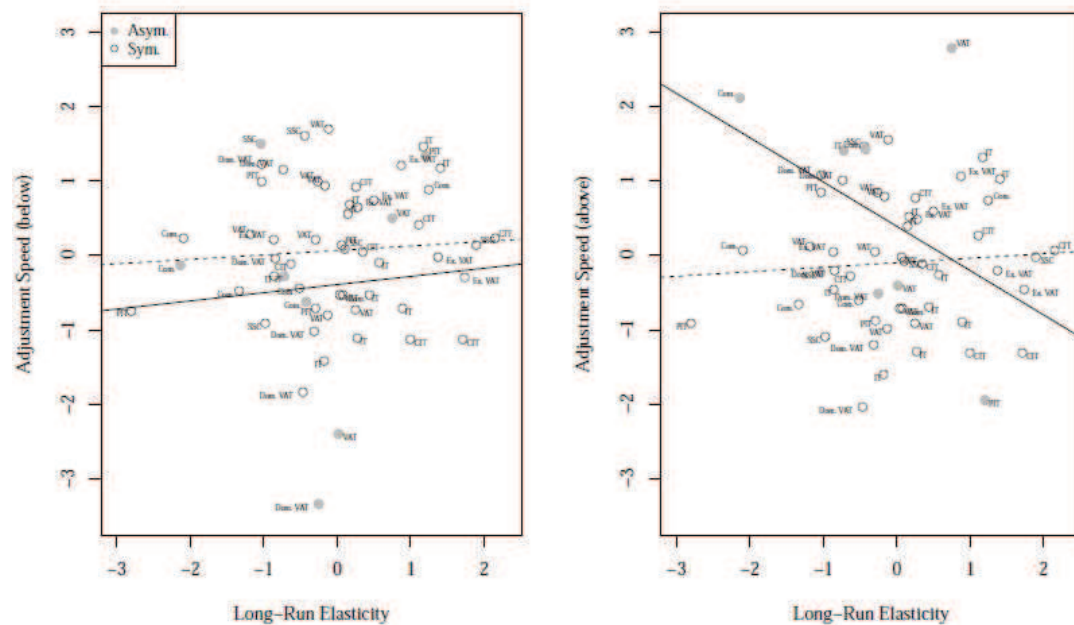


Figure 7: Long-Run Elasticity vs. Adjustment Speed Estimates across Revenue Sources



Obviously, while the trade-off, i.e. positive slope, between short-run and long-run elasticities is similar for the below long-run equilibrium case, it is markedly more profound allowing for asymmetric reactions in the above long-run equilibrium schedule.

For plotting adjustment speed estimates against long-term elasticities, the overall picture is less clear-cut (Figure 7). The impression that above the long-run growth trajectory, re-adjustments are the faster the lower the long-run elasticity is driven by a few observations only. Similarly, a trade-off is, at best, weakly given for below long-run equilibrium adjustments, in the sense that generally faster re-adjustment happens for revenues with lower growth potential.

Reconsidering our findings in Figure 5 and Table 1, we find for our IT short-run elasticities two out of ten estimates to be estimated as clearly asymmetric (Brazil and Peru), five out of ten show some weak asymmetry, while three out of ten show symmetry over the business cycle. In the case of VAT elasticity estimates, four out of nine are symmetric, while two out of nine show some weak asymmetry. Since the empirical models for long-run and short-run elasticities are not nested and standard bootstrap procedures are not readily applicable, we exploit the super-consistency property of the long-run equation (Lütkepohl 2005, p. 288) in order to obtain test statistics for a test on difference between long-run and respective short-run elasticity estimate. Bold figures in Table 1 denote estimates for which the respective short-run elasticity is estimated to be, at least at the 10% level of significance, statistically different from the respective long-run elasticity estimate. For the below long-run equilibrium scenarios this is for all tax categories the case for clearly more than half of the countries at stake. In the above long-run equilibrium cases, short-run elasticity estimates are only in the case of CIT and of revenues from commodities in the majority significantly different from their respective long-run counterparts. As regards adjustment speeds (ultimate and penultimate column of Table 1), we find them to be more stable when being estimated above and below the long-run equilibrium threshold than our short-run elasticities. In fact, they are different in the two scenarios only in slightly more than 12% of cases. Heterogeneity in re-adjustment speed seems to be an issue only for Brazilian PIT revenues, VAT revenues in Bolivia and Venezuela, Bolivian internal VAT revenues, social security contributions in Chile, and revenues from commodities in Argentina and Ecuador.

To highlight the strength of our single equation approach, let us consider the results country by country. The first thing to note is that we cannot estimate all four elasticities for Uruguay and Ecuador. Thus, we have to abstract from these economies in the detailed interpretation of our results, implying concrete policy recommendations. A second remarkable finding is that only Mexican IT revenues react stronger (in

absolute terms) when below their long-run equilibrium. For all other statistically significant asymmetric elasticity estimates the opposite applies, that is, revenues are found to be more elastic in the short run when above their long-run equilibrium level. Corresponding exact figures of our elasticity estimates can be found in Table 1.

Overall, the Mexican economy has clearly more growth potential in VAT than in IT revenues that could help to “strengthen the revenue raising capacity” (Dalsgaard 2000). Mexican revenues from VAT also adjust faster in the short run. However, there is some danger of “overheating” as Mexican VAT revenues are more susceptible to contractions when above their long-run equilibrium level. The opposite holds for Mexican IT revenues in the short run. Argentina and the Dominican Republic show a higher growth potential in IT compared to VAT revenues. But this advantage comes, in the case of the Dominican Republic, at the cost of IT revenues being relatively more prone to overheating. In the case of Venezuela neither VAT nor IT is strictly preferable compared to the respective alternative. This is due to the fact that the growth potential for both being fairly high and the susceptibility to short-run fluctuations fairly low. Similarly on the bubble cases are Colombia and Peru, where the latter is characterized by an asymmetric elasticity over the short run for both VAT and IT revenues. The economies of Brazil, Bolivia, and Chile face a clear-cut trade-off, in the sense that tax revenues with the higher growth potential are found to be more volatile in the short and medium run and vice versa.¹⁶

In order to identify the most promising revenue sources more exactly, we also consider the disaggregate IT components, PIT and CIT, as well as domestic VAT, external VAT, social security contributions, and revenues from commodities. Disregarding a potential trade-off between growth and (asymmetric) volatility, we find that long-run elasticities for CIT revenues outweigh the ones for PIT in any case (see second column of sub-tables on PIT and CIT revenue elasticity estimates in Table 1). The same applies to VAT components. Estimated long-run elasticities of external VAT revenues throughout outweigh the corresponding ones of internal VAT revenues. For Ecuador the long-run elasticity estimate of social security contributions stands out. It is larger in size than for any other considered revenue series (see the “social security” part of Table 1). The finding that the highest growth potential for the Chilean economy lies in its revenues from commodities does not come as a surprise.

With the exception of Argentina, the above assessment remains untouched if we consider a possible trade-off between growth potential and susceptibility of revenues

to cyclical fluctuations. For our estimates based on disaggregate revenue components, we find for Argentine external VAT revenues to show the highest growth potential (corresponding long-run elasticity estimate is 3.44). In contrast to internal VAT, CIT and PIT, it is also rather stable source of revenues as regards cyclical volatility.¹⁷ Argentine PIT revenues, for example, clearly show a lower growth potential but are at the same time less prone to economic fluctuations than are revenues from (internal) VAT. Hence, seen from an incumbent government the possibly existential business cycle stability of revenues comes at a cost.

One might be worried that the period of analysis covers the recent financial crisis with its start usually dated in the third quarter of 2008. In order to rule out the possibility that our results are biased by substantial noise at the end of our sample period, we considered limiting series to range up to the last quarter in 2007 only. This exclusion of the financial crisis just implies minor quantitative changes in estimated elasticities and corresponding statistical significance. It concerns mostly the commodities revenue elasticities and adjustment speed estimates. Overall and qualitatively, results are well in line with our findings for the whole sample period (Table 1). We also considered another robustness check. In many countries of the region CIT stems largely from commodity exports, i.e. from the same source as non-tax revenue. This suggests including commodity prices and exchange rates as additional covariates in the long-run and short-run equations for CIT and IT in order to more cleanly isolate the responsiveness of the respective tax revenues to macroeconomic conditions. Our estimates are nearly unchanged by this inclusion.¹⁸

Our results generally resemble the ones of prior studies that also used asymmetric ARDL models to estimate tax elasticities (Bruce *et al.* 2006, Nichols & Tosun 2008, and Wolswijk 2009). All three prior studies identify asymmetric behavior of tax revenue sources, which, in line with our results, tends to be more pronounced when revenue is above its steady state value. By comparing our estimates of VAT revenue elasticities to those of Bruce *et al.* (2006) for U.S. state sales tax revenues, we find average VAT elasticity estimates to be fairly close.¹⁹ Our average estimate is 0.631 in the below-equilibrium scenario and 1.891 for above-equilibrium conditions. Corresponding average figures in the study by Bruce *et al.* (2006) are 0.149 and 1.804, respectively.

Table 1. Long-Run and Short-Run Revenue Elasticity: Detailed Estimates

	LR Elasticity		SR Elasticity		Adjustment Speed			
			below LR Equilibrium	above LR Equilibrium	below LR Equilibrium	above LR Equilibrium		
IT								
Argentina	2.677	***	2.137	**	2.137	**	-0.903	***
Bolivia	2.268	***	-2.682		6.838	***	-0.843	***
Brazil	2.388	***	-2.506	*	3.518	***	-0.704	***
Chile	1.102	***	-0.648		2.832	***	-0.765	***
Colombia	2.122	***	1.901	**	1.901	**	-1.030	***
Dominican Rep.	2.025	***	-0.222		3.757	***	-0.455	***
Ecuador	2.929	***	-1.224		4.163		-0.202	*
Mexico	1.223	***	-3.470	***	0.887		-0.765	***
Peru	2.007	***	-1.989	**	3.846	***	-0.497	***
Uruguay	1.714	***	-0.337		4.389	**	-1.128	***
Venezuela	3.138	***	1.289	**	1.289	**	-0.298	***
PIT								
Argentina	0.945	**	1.990		1.990		-0.353	***
Bolivia	-0.652	***	-3.710	**	1.664		-0.911	***
Brazil	2.957	***	0.091		7.777	***	-0.248	
Chile	1.929	***	-1.786	**	2.302	*	-0.629	***
Peru	1.610	***	0.360		0.360		-0.899	***
CIT								
Argentina	2.876	***	1.544		1.544		-0.539	***
Bolivia	2.772	***	-2.897		8.671	***	-1.038	***
Brazil	3.810	***	4.432	**	4.432	**	-0.600	***
Chile	1.306	***	-1.043		3.698	***	-0.708	***
Dominican Rep.	2.186	***	1.685		7.072	***	-0.659	***
Peru	2.102	***	-2.238	*	5.363	***	-0.378	**
Uruguay	3.415	***	-1.675		-1.675		-1.034	***
VAT								
Argentina	1.723	***	1.434	***	2.453	***	-0.371	***
Bolivia	1.890	***	0.024		2.844	**	-1.440	***
Brazil	1.766	***	1.031	***	1.031	***	-0.129	*
Chile	0.808	***	-0.615		1.421		-0.584	***
Colombia	1.756	***	3.348	**	3.348	**	-0.932	***
Dominican Rep.	1.636	***	-0.287		1.953	***	-0.353	***
Mexico	1.907	***	-0.649		2.670	***	-0.845	***
Peru	1.606	***	-0.387		2.036	***	-0.604	***
Uruguay	2.095	***	2.213	***	2.213	***	-0.908	***
Venezuela	2.550	***	0.962	**	0.962	**	-0.514	***

Table 1 (cont'ed)

	LR Elasticity			SR Elasticity			Adjustment Speed		
				below LR Equilibrium		above LR Equilibrium	below LR Equilibrium		above LR Equilibrium
Internal VAT									
Argentina	1.210	***		0.871	**	1.965	***	-0.300	**
Bolivia	1.645	***		-0.814		3.547	**	-1.746	***
Chile	0.946	***		-0.732	*	0.736		-0.278	***
Colombia	1.452	***		-1.095		2.699	***	-1.264	***
Peru	1.112	***		-0.232		1.436	**	-0.688	***
Uruguay	1.590	***		1.603	**	1.603	**	-1.000	***
External VAT									
Argentina	3.438	***		-0.376		-0.376		-0.768	***
Bolivia	3.113	***		0.900		0.900		-0.684	***
Chile	1.095	***		-1.713		1.792		-0.607	***
Colombia	2.659	***		4.646	***	1.469		-0.283	
Peru	2.123	***		-0.083		2.834	**	-0.468	***
Uruguay	2.324	***		1.916	**	1.916	**	-0.436	**
Social Security									
Brazil	1.966	***		0.353		0.353		-0.644	***
Chile	0.935	***		-0.318		1.420	***	-0.194	**
Ecuador	3.580	***		-2.574		3.283	*	-0.630	***
Mexico	1.476	***		-1.367	*	1.114	***	-0.160	*
Peru	0.993	***		-1.759	**	1.529		-0.966	***
Commodities									
Argentina	1.492	***		0.397	*	0.397	*	-0.872	***
Bolivia	-0.011			-1.086	*	0.545		-0.602	***
Chile	2.996	***		0.019		0.019		-0.389	***
Ecuador	-0.051			-0.195		1.758	***	-0.714	***
Mexico	0.671	***		0.626	***	0.626	***	-0.828	***
Peru	1.945	***		1.297	*	1.297	*	-0.846	***
Venezuela	1.409	***		0.611	**	0.611	**	-0.815	***

Notes: SR, LR denote short-run and long-run, respectively; *, **, *** denote significance at the 10, 5, 1% level.

Bold figures denote estimates for which the respective SR elasticity is estimated to be, at least at the 10% level of significance, statistically different from the respective LR elasticity estimate.

LR elasticity estimates: IT components: due to missing information no legislative changes controlled for Ecuador and Venezuela; VAT components: due to missing information no legislative controls for Venezuela, for Brazil no rate changes included (state tax) as control, no estimation for Ecuador due to lack of cointegration; Social security contributions: due to missing information no legislative controls for Ecuador, no estimation for Argentina and Uruguay due to lack of cointegration; Revenues from commodities: due to missing information (or too many changes to control for) no legislative controls for Ecuador, Venezuela (and Argentina);

SR elasticity estimates: For above-equilibrium coefficients the tested hypothesis is the joint hypothesis of the sum of below-equilibrium coefficient and difference equaling zero; shortfall of controls applies analogously to LR elasticity estimates.

This is an interesting finding, inasmuch as it suggests the similarity of revenues from sales tax and VAT in their intensity to react to business cycle dynamics. In the case of PIT revenues, our below-equilibrium mean elasticity estimate differs slightly from corresponding estimates for U.S. federal states, while the above-equilibrium value is fairly similar. Our above-equilibrium average elasticity estimate amounts to 2.819. The corresponding estimate in Bruce *et al.* (2006) is 2.663. For re-adjustment speed estimates, Bruce *et al.* identify on the whole more asymmetry, though average figures are again of quite similar dimension.²⁰ It remains for future work to compare our results with estimates for developed economies when they were as poor as today's developing countries. In the context of labor standards, such a comparison is, for example, made in the recent study by Hall & Leeson (2007).

5 CONCLUSION

Our study by using adequate econometric techniques tried to give some orientation for what Tanzi & Zee (2000) called “the art of the possible rather than the pursuit of the optimal,” that is, for the creation of growing and at the same time stable tax revenues in the Latin American economies. We find that about half of the analyzed economies face a clear-cut trade-off between growth and volatility of revenues. This trade-off is for the vast majority of economies in the region and across tax categories statistically significant in a below long-run equilibrium or bust scenario. In boom scenarios, a statistically significant difference between long-run and short-run revenue elasticities is less frequently found. This suggests policymakers to have to weigh up their targets (growth vs. volatility of revenues) rather during busts than boom phases, during which concentrating on the long-run or growth target might be sufficient. In more than half of the cases, we find revenues to react asymmetrically to macroeconomic conditions in the short and medium run: Above their long-run equilibrium level they react stronger to economic fluctuations. Below it, they react weaker. Hence, a myopic strategy in terms of raising revenues by fostering more GDP responsive tax categories in the short run is both more promising (upturn phase of boom above long-run equilibrium) and risky (downturn phase of boom above long-run equilibrium). If uncertainty in the realization of short-term revenues is given a highly negative weight, changes in the tax structure to raise revenues are thus preferably implemented in bust periods. Given the heterogeneity of tax structures and tax expenditures in the region (Bernardi *et al.* 2008), in particular with regard to VAT, our results do not allow a general rec-

ommendation of, for example, favoring a particular tax category instead of another. As some taxes might have already reached their ceiling in terms of rates or are more easily avoided than others, a case-based drawing of conclusions is required.

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Endnotes

¹ As can be seen from the figures reported in Tanzi & Zee (2000, p. 303), this average level of tax revenue for all developing countries in the Western Hemisphere taken together has been fairly stable, lying between 17.6-18%, for approximately the second half of the 1980s and 1990s, respectively.

² Within the region the tax burden is rather heterogeneous. While Brazil and Argentina collect more than 30% of GDP, Mexico and Haiti do not reach 10% in 2008. For the vast majority, however, the respective share lies between 10 and 20%.

³ In Mexico revenues recovered early in 2009 as the special tax on production and services overcompensated foregone revenues from other sources. For Colombia the slight increases for second and third quarter of 2009 stem most probably from a high level of tax receipts, particularly withholding taxes, from the mining sector.

⁴ For simplicity reasons, we will refer to the Plurinational State of Bolivia as Bolivia and to the Bolivarian Republic of Venezuela as Venezuela.

⁵ Jiménez & Tromben (2006) give an overview of tax regimes for non-renewables.

⁶ In this context, the literature distinguishes between tax buoyancy and tax elasticity. Tax buoyancy measures the total response of tax revenues including discretionary policy, that is, the response if tax code changes are not controlled for in the empirical model. Tax elasticity, in contrast, isolates built-in responsiveness to changes in national income. For the necessity to control for tax reforms in the context of estimating income elasticities of tax revenues see, for example, Caminada & Goudswaard (1996).

⁷ Note, the standard measure to deflate commodity prices is the Manufactures Unit Value Index (MUV) provided by the IMF or the Worldbank (e.g., Cashin *et al.* 2000). However, for the period under consideration it has not been constructed in quarterly or monthly form. Labys (2006) suggests the PPI provided by the U.S. Department of Commerce as an alternative due to the fact that it shows a high correlation as well as structural and behavioral similarities with the Worldbank's MUV.

⁸ For Peru, the price index is computed on the base of prices for copper, gold, zinc, and crude petroleum. Each price is weighted according to its share in the export volume of these four goods. For Argentina, the price index we used is based on the prices of beef, soybeans, soybean oil, and crude petroleum.

⁹ Due to the fact that we are after peculiarities and national idiosyncrasies in the relationship between revenues and cyclical variables and, hence, do not treat the series in an unbalanced panel framework, it hardly makes sense to resort to more powerful panel unit root tests such as Maddala & Wu (1999).

¹⁰ In case of PIT and CIT showing progressive structure, only maximum rates are considered.

¹¹ We use an ARDL(1,1) specification to estimate short-term elasticities and adjustment factors. The BIC supports this ARDL(1,1) specification in the vast majority of cases. For reasons of comparability we thus decided for using the ARDL(1,1) specification throughout.

¹² This is just to say that, for example, eq. (5) might be written in the more general form $T_t^i = a_0^i + a_1^i T_{t-1}^i + b_0^i y_t + b_1^i y_{t-1} + \epsilon_t^i$, where $\beta_0^i = \frac{a_0^i}{1-a_1^i}$, $\beta_1^i = \frac{b_0^i}{1-b_1^i}$ and β_0^i, β_1^i are given in (1).

¹³ We decided to indicate the whole year to capture both tax revenue effects due to campaigning, which precedes elections, and “honey mooning” effects that take effect in the aftermath of elections; the use of other schemes –e.g. indexing election quarters only– does not qualitatively alter our results.

¹⁴ Including further covariates that are either hardly available for the considered countries and frequency of data or hardly varying or both, does also not qualitatively alter our estimates. This is particularly the case for including debt-to-GDP ratios and/or dummies on high casualty terrorist bombings. Corresponding results are available on request from the authors.

¹⁵ In general, as Latin American economies rely more on VAT than do more industrialized countries (see Gavin & Perotti 1997), some rates have reached fairly high levels: 21% in Argentina, 14.9% in Bolivia, 20.5% in Brazil, 19% in Chile, 16% in Colombia, 16% in the Dominican Republic, 12% in Ecuador, 16% in Mexico, 18% in Peru, 22% in Uruguay, and 12% in Venezuela (ECLAC 2013).

¹⁶ Note, negative values for short-run coefficients estimates suggest a countercyclical reaction of revenues (cf. some of the entries in Table 1). Although not in accordance with our intuition, countercyclical responses are, for example, also estimated by Bruce *et al.* (2006) and Nichols & Tosun (2008).

¹⁷ It is noteworthy that this result does not hold if we do not –among others– control for hyperinflation that hit the Argentine private sector in the late 1980s, triggering an episode of political instability comparable to the recent Argentine crisis of 1999-2002. Detailed results are available on request from the authors. We should also not fail to mention another caveat and that is the circumstance that Argentinean data has been criticized in the past for alleged manipulation.

¹⁸ Detailed estimates for both robustness checks are available on request from the authors.

¹⁹ Note, Bruce *et al.* analyze responsiveness of tax revenues to income fluctuations. As opposed to our strategy employing GDP fluctuations, this approach does not isolate the responsiveness to business cycle dynamics but possibly also captures nonlinearities in tax schedules.

²⁰ Applying our methodology to tax revenue and income series for a sample of 19 Sub-Saharan economies in annual frequency, ranging from 1980 to 2009, also produces fairly similar results. Preliminary estimates are available on request.

Appendix A: Data detail and data sources

Table A.1

[Table is continued on the following 8 pages.]

Argentina	
Income Tax	
Period	Q1 1993 - Q1 20
Source	Ministerio de Economía y de Finanzas Públicas, Administración Federal de Ingresos Públicos
Notes	Includes withholding taxes
Personal Income Tax	
Period	Q1 1997 - Q1 2009
Source	Administración Federal de Ingresos Públicos
Notes	Does not include withholding taxes
Corporate Income Tax	
Period	Q1 1997 - Q1 2009
Source	Administración Federal de Ingresos Públicos
Notes	Does not include withholding taxes
Value Added Tax	
Period	Q1 1993 - Q1 2009
Domestic Value Added Tax	
Period	Q1 1993 - Q1 2009
Source	Ministerio de Economía y de Finanzas Públicas, Administración Federal de Ingresos Públicos
External Value Added Tax	
Period	Q1 1993 - Q1 2009
Source	Ministerio de Economía y de Finanzas Públicas, Administración Federal de Ingresos Públicos
Social Security	
Period	Q1 1993 - Q1 2009
Source	Ministerio de Economía y de Finanzas Públicas
Revenue from Commodities	
Period	Q2 2000 - Q1 2009
Source	Administración Federal de Ingresos Públicos
Notes	Export duties
Real GDP	
Source	Banco Central de la República Argentina
Notes	In Pesos of 1993
Current GDP	
Source	Banco Central de la República Argentina
Commodity Prices	
Beef, Australia & New Zealand, frozen boneless, U.S. import price FOB port of entry (¢/lb.)	
Soybeans, United States, n° 2 yellow, CIF Rotterdam	
Soybean oil, The Netherlands, FOB ex-mill	
Crude petroleum, average of Dubai/Brent/Texas equally weighted (\$/barrel)	
Source	IMF: International Financial Statistics
Notes	Price index weighted with share in total export duties
Exchange Rate	
Source	ECLAC
Government Expenditures	
Source	Secretaría de Hacienda, Ministerio de Economía

Election Years	
Source	<i>International Institute for Democracy and Electoral Assistance (International IDEA)</i>
Notes	<i>Includes presidential and parliamentary elections</i>
CPI	
Source	ECLAC
Notes	1999=100
Debt-to-GDP Ratio	
Source	Gross government debt (% of GDP) Datastream / Oxford Economics
High Casualty Terrorist Bombings	
Source	Center for Systemic Peace
Notes	Bomb attacks on non-combatant (civilian and political) targets by non-state actors resulting in 15 or more deaths.
Deflator	
	GDP – Deflator
Bolivia	
Income Tax	
Period	Q1 1990 - Q1 2009
Source	Ministerio de Economía y de Finanzas Públicas
Personal Income Tax	
Period	Q1 1990 - Q1 2009
Source	Ministerio de Economía y de Finanzas Públicas
Corporate Income Tax	
Period	Q1 1990 - Q1 2009
Source	Ministerio de Economía y de Finanzas Públicas
Value Added Tax	
Period	Q1 1990 - Q1 2009
Source	Ministerio de Economía y de Finanzas Públicas
Domestic Value Added Tax	
Period	Q1 1990 - Q1 2009
Source	Ministerio de Economía y de Finanzas Públicas
External Value Added Tax	
Period	Q1 1990 - Q1 2009
Source	Ministerio de Economía y de Finanzas Públicas
Revenue from Commodities	
Period	Q1 1990 - Q1 2009
Source	Ministerio de Economía y de Finanzas Públicas
Notes	Includes special tax on hydrocarbons, direct tax on hydrocarbons and utility tax on mining industry
Real GDP	
Source	Banco Central de Bolivia
Notes	In Bolivianos of 1990
Current GDP	
Source	Banco Central de Bolivia
Commodity Price	
Russian Natural Gas, in Germany U.S. Dollars per Thousand Cubic Meters (FMI)	
Source	IMF: International Financial Statistics
Exchange Rate	
Source	ECLAC
Government Expenditures	
Period	Q1 1994 – Q1 2009
Source	Ministerio de Economía y Finanzas Públicas

Election Years	
Source	<i>International Institute for Democracy and Electoral Assistance (International IDEA)</i>
Notes	<i>Includes presidential and parliamentary elections</i>
CPI	
Source	ECLAC
Notes	2007=100
Deflator	GDP – Deflator
Brazil	
Income Tax	
Period	Q1 1994 - Q1 2009
Source	Tesouro Nacional
Notes	Withholding taxes are included
Personal Income Tax	
Period	Q1 1994 - Q1 2009
Source	Tesouro Nacional
Notes	Withholding taxes are excluded
Corporate Income Tax	
Period	Q1 1994 - Q1 2009
Source	Tesouro Nacional
Notes	Withholding taxes are excluded
Value Added Tax	
Period	Q1 1998 - Q1 2009
Source	Receita Federal
Notes	State tax
Social Security	
Period	Q1 1998 - Q1 2009
Source	Tesouro Nacional
Real GDP	
Source	Instituto Brasileiro de Geografia e Estatística
Notes	Index 1995=100
Government Expenditures	
Source	Tesouro Nacional
Election Years	
Source	<i>International Institute for Democracy and Electoral Assistance (International IDEA)</i>
Notes	<i>Includes presidential and parliamentary elections</i>
Deflator	Consumer Price Index
Source	ECLAC
Notes	Dec1993=100
Chile	
Income Tax	
Period	Q1 1993 - Q1 2009
Source	Servicio de Impuestos Internos
Notes	Includes CIT from the private mining sector, net values
Personal Income Tax	
Period	Q1 1993 - Q1 2009
Source	Servicio de Impuestos Internos
Notes	Gross values
Corporate Income Tax	

Period	Q1 1993 - Q1 2009
Source	Servicio de Impuestos Internos
Notes	Includes CIT from the private mining sector, gross values
Value Added Tax	
Period	Q1 1993 - Q1 2009
Source	Servicio de Impuestos Internos
Notes	Net values
Domestic Value Added Tax	
Period	Q1 1993 - Q1 2009
Source	Servicio de Impuestos Internos
Notes	Gross values
External Value Added Tax	
Period	Q1 1993 - Q1 2009
Source	Servicio de Impuestos Internos
Notes	Gross values
Social Security	
Period	Q1 1990 - Q1 2009
Source	Servicio de Impuestos Internos
Revenue from Commodities	
Period	Q1 1993 - Q1 2009
Source	Servicio de Impuestos Internos
Notes	Specific tax and provisional payments of income tax and net transfers from CODELCO
Real GDP	
Source	Banco Central de Chile
Notes	In Pesos of 2003
Current GDP	
Source	Banco Central de Chile
Commodity Price	
Copper, wire bars, U.S. producer, FOB refinery (¢/lb.)	
Source	IMF: International Financial Statistics
Exchange Rate	
Source	ECLAC
Government Expenditures	
Source	Dirección de Presupuestos
Election Years	
Source	
Notes	<i>International Institute for Democracy and Electoral Assistance (International IDEA)</i>
	<i>Includes presidential and parliamentary elections</i>
CPI	
Source	ECLAC
Notes	Dec2008=100
Debt-to-GDP Ratio	
Source	Gross government debt (% of GDP) Datastream / Oxford Economics
Deflator	
GDP – Deflator	
Colombia	
Income Tax	
Period	Q1 1998 - Q4 2008
Source	Consejo Superior de Política Fiscal
Notes	Includes CIT from the mining sector
Value Added Tax	
Period	Q1 1998 - Q4 2008

Source	Consejo Superior de Política Fiscal
Domestic Value Added Tax	
Period	Q1 1998 - Q4 2008
Source	Consejo Superior de Política Fiscal
External Value Added Tax	
Period	Q1 1998 - Q4 2008
Source	Consejo Superior de Política Fiscal
Real GDP	
Source	Banco de la República Colombia
Notes	In Pesos of 2000, already deseasonalized, linked series
Government Expenditures	
Source	Consejo Superior de Política Fiscal
Election Years	
Source	<i>International Institute for Democracy and Electoral Assistance (International IDEA)</i>
Notes	<i>Includes presidential and parliamentary elections</i>
High Casualty Terrorist Bombings	
Source	Center for Systemic Peace
Notes	Bomb attacks on non-combatant (civilian and political) targets by non-state actors resulting in 15 or more deaths.
Deflator	
Source	Consumer Price Index
Notes	ECLAC Dec2008=100
Dominican Republic	
Income Tax	
Period	Q1 1992 - Q1 2009
Source	Banco Central de la República Dominicana
Personal Income Tax	
Period	Q1 1997 - Q1 2009
Source	Dirrección General de Impuestos Internos
Notes	Shortfall in time series does not allow application of econometric model
Corporate Income Tax	
Period	Q1 1997 - Q1 2009
Source	Dirrección General de Impuestos Internos
Value Added Tax	
Period	Q1 1992 - Q1 2009
Source	Banco Central de la República Dominicana
Real GDP	
Source	Banco Central de la República Dominicana
Notes	In Dominican Republic Dollars of 1991
Current GDP	
Source	Banco Central de la República Dominicana
Government Expenditures	
Source	Banco Central de la República Dominicana
Election Years	
Source	<i>International Institute for Democracy and Electoral Assistance (International IDEA)</i>
Notes	<i>Includes presidential and parliamentary elections</i>
CPI	
Source	ECLAC

Notes	Jan1999=100
Deflator	GDP – Deflator
Ecuador	
Income Tax	
Period	Q1 1994 - Q1 2009
Source	Dirección General Adjunta de Estadística de la Hacienda Pública
Value Added Tax	
Period	Q1 1994 - Q1 2009
Source	Dirección General Adjunta de Estadística de la Hacienda Pública
Social Security	
Period	Q1 1996 - Q1 2009
Source	Dirección General Adjunta de Estadística de la Hacienda Pública
Revenue from Commodities	
Period	Q1 1994 - Q1 2009
Source	Dirección General Adjunta de Estadística de la Hacienda Pública
Real GDP	
Source	Banco Central del Ecuador
Notes	In U.S. Dollars of 2000
Commodity Price	
Crude petroleum, average of Dubai/Brent/Texas equally weighted (\$/barrel)	
Source	IMF: International Financial Statistics
Exchange Rate	
Source	ECLAC
Government Expenditures	
Period	Q1 1994 – Q1 2009
Source	Dirección General Adjunta de Estadística de la Hacienda Pública
Election Years	
Source	<i>International Institute for Democracy and Electoral Assistance (International IDEA)</i>
Notes	<i>Includes presidential and parliamentary elections</i>
Deflator	
Source	Consumer Price Index
Notes	ECLAC 2004=100
Mexico	
Income Tax	
Period	Q1 1993 - Q1 2009
Source	Secretaría de Hacienda y de Crédito Público
Value Added Tax	
Period	Q1 1993 - Q1 2009
Source	Secretaría de Hacienda y de Crédito Público
Social Security	
Period	Q1 1993 - Q1 2009
Source	Secretaría de Hacienda y de Crédito Público
Revenue from Commodities	
Period	Q1 1993 - Q1 2009
Source	Secretaría de Hacienda y de Crédito Público Oil yields tax, special tax on production and services (IEPS), and fees on oil production
Real GDP	
Source	Banco de México
Notes	In Pesos of 2003, linked series
Commodity Price	

Crude petroleum, average of Dubai/Brent/Texas equally weighted (\$/barrel)	
Source	IMF: International Financial Statistics
Exchange Rate	
Source	ECLAC
Government Expenditures	
Source	Secretaría de Hacienda y de Crédito Público
Election Years	
Source	<i>International Institute for Democracy and Electoral Assistance (International IDEA)</i>
Notes	<i>Includes presidential and parliamentary elections</i>
Debt-to-GDP Ratio	Gross government debt (% of GDP)
Source	Datastream / Oxford Economics
Deflator	Consumer Price Index
Source	ECLAC
Notes	2nd fortnight Jun2002 = 100
Peru	
Income Tax	
Period	Q1 1998 - Q1 2009
Source	Superintendencia Nacional de Administración Tributaria
Notes	Gross values
Personal Income Tax	
Period	Q1 1998 - Q1 2009
Source	Superintendencia Nacional de Administración Tributaria
Notes	Gross values
Corporate Income Tax	
Period	Q1 1998 - Q1 2009
Source	Superintendencia Nacional de Administración Tributaria
Notes	Gross values
Value Added Tax	
Period	Q1 1998 - Q1 2009
Source	Superintendencia Nacional de Administración Tributaria
Notes	Gross values
Domestic Value Added Tax	
Period	Q1 1998 - Q1 2009
Source	Superintendencia Nacional de Administración Tributaria
Notes	Gross values
External Value Added Tax	
Period	Q1 1998 - Q1 2009
Source	Superintendencia Nacional de Administración Tributaria
Notes	Gross values
Social Security	
Period	Q3 1999 - Q1 2009
Source	Superintendencia Nacional de Administración Tributaria
Notes	Supportive contributions for pension plans are not included
Revenue from Commodities	
Period	Q1 1998 - Q1 2009
Source	Superintendencia Nacional de Administración Tributaria
Notes	Includes CIT on the mining and hydrocarbon sectors and transfer from the mining sector, gross values
Real GDP	
Source	Banco Central de Reserva del Perú
Notes	In Nuevos Soles of 1994

Current GDP

Source	Banco Central de Reserva del Perú
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Commodity Prices

Copper, wire bars, U.S. producer, FOB refinery (¢/lb.)

Zinc, special high grade, LME, cash settlement

Gold, 99.5% fine, afternoon fixing London (\$/troy ounce)

Crude petroleum, average of Dubai/Brent/Texas equally weighted (\$/barrel)

Source	IMF: International Financial Statistics
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Notes	Price index weighted with share in total exports
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Exchange Rate

Source	ECLAC
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Government Expenditures

Source	Banco Central de Reserva del Perú
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Election Years

Source	
--------	--

*International Institute for Democracy and Electoral Assistance
(International IDEA)*

Notes	
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*Includes presidential and parliamentary elections***CPI**

Source	ECLAC
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Notes	Dec2001=100
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Deflator	GDP – Deflator
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Uruguay**Income Tax**

Period	Q1 1999 - Q1 2009
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Source	Ministerio de Economía y de Finanzas
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Personal Income Tax

Source	Ministerio de Economía y de Finanzas
--------	--------------------------------------

Notes	Not used (as implemented not before 2007, replacing various taxes)
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Corporate Income Tax

Period	Q1 1999 - Q1 2009
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Source	Ministerio de Economía y de Finanzas
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Value Added Tax

Period	Q1 1999 - Q1 2009
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Source	Ministerio de Economía y de Finanzas
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Notes	Does not include tax on social security contribution
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Domestic Value Added Tax

Period	Q1 1999 - Q1 2009
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Source	Ministerio de Economía y de Finanzas
--------	--------------------------------------

External Value Added Tax

Period	Q1 1999 - Q1 2009
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Source	Ministerio de Economía y de Finanzas
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Social Security

Period	Q1 1999 - Q1 2009
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Source	Ministerio de Economía y de Finanzas
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Real GDP

Source	Banco Central del Uruguay
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Notes	In Pesos of 2005
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Current GDP

Source	Banco Central del Uruguay
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Government Expenditures

Source	Ministerio de Economía y de Finanzas
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Election Years

Source

*International Institute for Democracy and Electoral Assistance
(International IDEA)*

Notes

Includes presidential and parliamentary elections

CPI	
Source	ECLAC
Notes	Mar1997=100
Deflator	GDP - Deflator
Venezuela	
Income Tax	
Period	Q1 1993 - Q1 2009
Source	Ministerio del Poder Popular de Planificación y de Finanzas
Value Added Tax	
Period	Q4 1993 - Q1 2009
Source	Ministerio del Poder Popular de Planificación y de Finanzas
Revenue from Commodities	
Period	Q1 1993 - Q1 2009
Source	Ministerio del Poder Popular de Planificación y de Finanzas
Notes	CIT on oil industry, royalties payments, and dividends from PDVSA
Real GDP	
Source	Banco Central de Venezuela
Notes	In Bolívares of 1997, linked series
Commodity Price	
Crude petroleum, average of Dubai/Brent/Texas equally weighted (\$/barrel)	
Source	IMF: International Financial Statistics
Exchange Rate	
Source	ECLAC
Government Expenditures	
Source	Ministerio del Poder Popular de Planificación y de Finanzas
Election Years	
Source	<i>International Institute for Democracy and Electoral Assistance (International IDEA)</i>
Notes	<i>Includes presidential and parliamentary elections</i>
Debt-to-GDP Ratio	
Gross government debt (% of GDP)	
Source	Datastream / Oxford Economics
Deflator	
Consumer Price Index	
Source	ECLAC
Notes	Dec2007=100

Notes:

(i) In general, we included withholding revenues for IT, although not in the case of the PIT and CIT series of Argentina and Brazil. However, it is taken care of in the respective IT series of both countries.

(ii) For Argentina we did not include gross receipts tax. It is similar to VAT but is levied on the seller of goods. It is a provincial tax with different rates across provinces and activities. It would be interesting to consider this tax as well as it is a major source of revenues for the provinces. However, information is not available on a quarterly time series basis. It is also not comparable to other countries.

(iii) In Brazil VAT is levied only at the state level. Hence, estimates refer to the state tax.

Appendix B: Controls for exogenous changes in tax schedules, commodity sectors, and in social security systems

Table B.1

[Table is continued on the following 2 pages.]

LR Elasticities (LR-E)			Symmetric SR-E		Asymmetric SR-E	
Argentina						
IT	Law 25063	Q1 99 - Q1 09				
	Law 25239	Q1 00 - Q1 09				
	Decree 314/06	Q2 06 - Q1 09				
	Law 26287	Q2 07 - Q1 09				
	Decree 1426/08	Q1 08 - Q1 09				
PIT	Decree 1426/08	Q1 08 - Q1 09	Law 25239	Q1 00	Law 25239	Q1 00
CIT	Law 25063	Q1 99 - Q1 09				
	Decree 1426/08	Q1 08 - Q1 09				
VAT	Law 20631	Q4 97 - Q1 09	Decree 493/01	Q3 01	Decree 493/01	Q3 01
	Law 25063	Q1 99 - Q1 09				
	Decree 493/01	Q3 01 - Q1 09				
	Law 25710, 25717	Q1 03 - Q1 09				
Domestic VAT	Decree 493/01	Q3 01 - Q1 09	Decree 493/01	Q3 01		
External VAT	Law 25063	Q1 99 - Q1 09			Decree 493/01	Q3 01
	Decree 493/01	Q3 01 - Q1 09				
	Law 25710, 25717	Q1 03 - Q1 09				
	Law 26346	Q1 08 - Q1 09				
Social Security	Law 25453, Decree 1009/01	Q3 01 - Q1 09				
	Decree 279/08, General Resolution 2431, 08	Q2 08 - Q1 09				
Bolivia						
IT	Law 1606	Q1 95 - Q1 09	Law 1606	Q3 95	Law 1606	Q3 95
	Law 1606	Q3 95 - Q1 09				
PIT	Law 2493, 2196	Q3 01 - Q1 09				
CIT	Law 1606	Q3 95 - Q1 09	Law 1606	Q3 95	Law 1606	Q3 95
VAT			Law 1606	Q3 95		
Domestic VAT	Law 2064	Q3 00 - Q1 09	Law 1606	Q3 95	Law 1606	Q3 95
External VAT	Law 1606	Q3 95 - Q1 09	Law 1606	Q3 95	Law 1606	Q3 95
	Law 1834	Q2 98 - Q1 09				
	Law 2064	Q3 00 - Q1 09				
	Law 3302	Q1 06 - Q1 09				
Commodities	Law 1981	Q1 00 - Q1 09	Law 1981	Q1 00	Law 1981	Q1 00
	Law 3058	Q2 05 - Q1 09				

Note: SR, LR denote short-run and long-run, respectively; Q1,..., Q4 denote first to fourth quarter, respectively;

^{a)} D.O.F. denotes *Diario Oficial de la Federacion*

[Table is continued on the following 3 pages.]

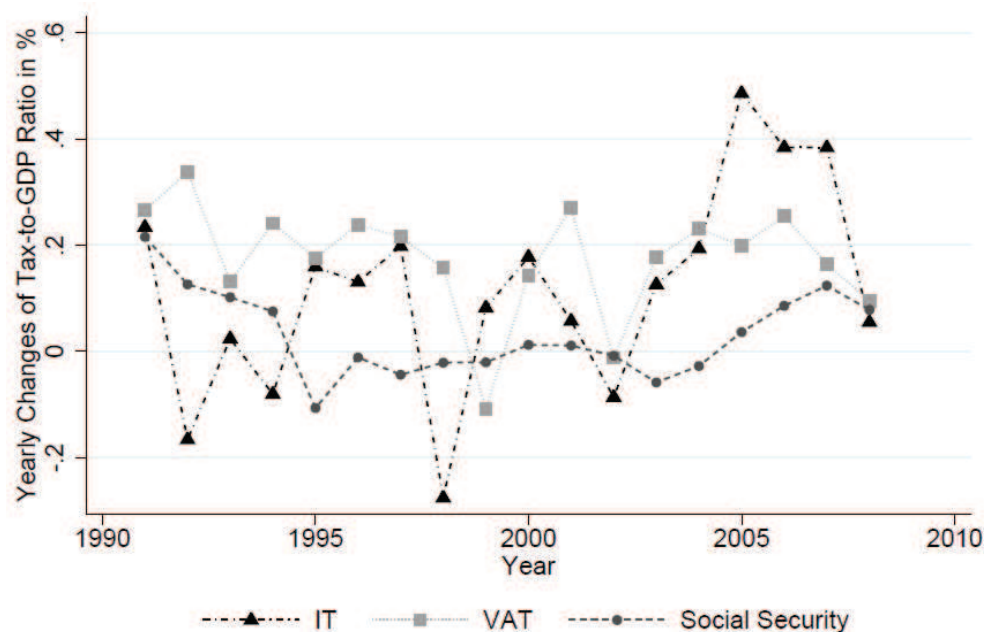
[continued]		LR-E	Symmetric SR-E	Asymmetric SR-E
Brazil				
IT	Law 8981/95 Law 9249/95, 9778/98	Q1 95 - Q1 09 Q1 98 - Q1 09		
CIT	Law 8981/95	Q1 95 - Q1 09		
Social Security	Provisional Measure 413/08	Q3 08 - Q1 09		
Chile				
IT	Law 20170	Q1 07 - Q1 09	Law 19578 Q3 05	
PIT	Law 19578	Q3 05 - Q1 09		Law 19738 Q1 02
CIT	Law 19506 Law 20170	Q4 97 - Q1 09 Q1 07 - Q1 09		Law 19506 Q4 97
VAT	Law 19398 Law 19738 Law 20190	Q4 95 - Q1 09 Q1 02 - Q1 09 Q2 07 - Q1 09		
Domestic VAT	Law 19738	Q1 02 - Q1 09	Law 19888 Q4 03	Law 19888 Q4 03
External VAT	Law 20190	Q2 07 - Q1 09		
Colombia				
IT	Law 633 Law 863	Q1 01 - Q4 08 Q1 04 - Q4 08		
Domestic VAT	Law 633	Q1 01 - Q4 08		
External VAT	Law 488 Law 1111	Q1 99 - Q4 08 Q1 07 - Q4 08	Law 1111 Q1 07	
Dominican Republic				
IT	Law 288-04	Q4 04 - Q1 09		
VAT	Law 147-00 Law 557-05	Q1 01 - Q1 09 Q1 06 - Q1 09	Law 11-92 Q3 09	
Mexico				
IT	D.O.F. ^{a)} 01-01-2002 D.O.F. 26-11-2005, 08-12-2005, 23-12-2005	1Q 02 - Q1 09 1Q 06 - Q1 09		
VAT	D.O.F. 28-12-1994 D.O.F. 30-12-2002	1Q 95 - Q1 09 1Q 03 - Q1 09	D.O.F. 28-12-1994 1Q 95	D.O.F. 28-12-1994 1Q 95
Social Security	D.O.F. 21-12-1995 D.O.F. 20-12-2001	1Q 96 - Q1 09 1Q 03 - Q1 09	D.O.F. 21-12-1995 1Q 96 D.O.F. 20-12-2001 1Q 03	D.O.F. 20-12-2001 1Q 03
Commodities	D.O.F. 21-12-2005	1Q 06 - Q1 09		

[continued]		LR-E	Symmetric SR-	Asymmetric SR-E
Peru				
IT	Law 27356 Law 27804 Legislative Decree 945	Q1 01 - Q1 09 Q1 03 - Q1 09 Q1 04 - Q1 09	Law 27804 Q1 03	Law 27804 Q1 03
PIT	Law 27356 Law 27804 Legislative Decree 945	Q1 01 - Q1 09 Q1 03 - Q1 09 Q1 04 - Q1 09	Law 27804 Q1 03	Law 27804 Q1 03
CIT	Law 27356 Law 27804	Q1 01 - Q1 09 Q1 03 - Q1 09		Law 27804 Q1 03
VAT			Supreme Decree 024-2004, Legislative Decree 950 Q2 04	
External VAT	Supreme Decree 024-2004, Legislative Decree 950	Q2 04 - Q1 09	Supreme Decree 024-2004, Legislative Decree 950 Q2 04	Supreme Decree 024-2004, Legislative Decree 950 Q2 04
Commodities	Law 27356 Law 27804	Q1 01 - Q1 09 Q1 03 - Q1 09	Law 27804 Q1 03	Law 27804 Q1 03
Uruguay				
IT				Law 17296 Q1 04
CIT	Law 17453	Q2 02 - Q2 07		
Social Security	Law 11705	Q1 04 - Q4 04		
VAT	Law 17296 Law 17453, 17503 Law 18083 Law 18341	Q2 01 - Q1 09 Q2 02 - Q1 09 Q3 07 - Q1 09 Q2 08 - Q1 09		
Domestic VAT	Law 17453, 17503 Law 18341	Q2 02 - Q1 09 Q2 08 - Q1 09	Law 17453, 17503 Q2 02	Law 17453, 17503 Q2 02
External VAT	Law 17296 Law 17615, 17651	Q2 01 - Q1 09 Q2 03 - Q1 09		

Note: We decided to do the cleaning –in the case of value added and income taxes (VAT and IT) – by focusing on just one actual rate, i.e. the top rate or the main rate, rather than averaging rates. For our IT estimates we used the respective top rate of the CIT. To examine whether our results change for IT if average rates are used, we ran some additional regressions: First, we averaged for some taxes across brackets in order to obtain an average rate. Secondly, we also considered average rates for IT by averaging PIT and CIT rates. Our results are qualitatively unaffected.

Appendix C: Annual growth rates of tax sources & statistics of differenced series

Figure C.1



Source: own calculations based on data obtained from ECLAC; diagram refers to all Latin American economies excluding Cuba (N = 19) – there is no qualitative difference for corresponding quantities based on data from our selected sample of analysis (N = 11; see Table A.1)

Table C.1

[Table is continued on the following page.]

Series in first differences				Dickey-Fuller test p-value		
	N	Mean	Variance	Levels	Levels w/ trend	First differences
Argentina						
IT	48	0.0015	0.0305	0.1592	0.3374	0.0000
VAT	64	-0.0095	0.0382	0.0935	0.3193	0.0000
Com. Rev.	28	0.0768	0.0493	0.0000	0.0000	0.0000
GDP	64	0.0080	0.0004	0.9875	0.9875	0.0065
Com. Price	29	0.0399	0.0220	0.0081	0.0008	0.0000
Bolivia						
IT	76	0.0044	0.0631	0.0051	0.0240	0.0000
VAT	76	0.0059	0.0303	0.2164	0.0604	0.0000
Com. Rev.	76	-0.0414	0.3036	0.4588	0.6784	0.0000
GDP	76	0.0089	0.0002	0.9392	0.1896	0.0000
Com. Price	76	0.0221	0.0099	0.9785	0.9719	0.0000
Brazil						
IT	60	0.0128	0.0176	0.2275	0.2260	0.0000
VAT	56	0.0096	0.0008	0.9746	0.0370	0.0000
GDP	72	0.0067	0.0002	0.9611	0.2996	0.0000
Chile						
IT	64	0.0136	0.0697	0.5359	0.8527	0.0000
VAT	64	0.0012	0.0153	0.0006	0.0048	0.0000
Com. Rev.	63	0.0203	0.3089	0.1293	0.0044	0.0000

GDP	76	0,0121	0,0002	0,0720	0,9116	0,0000
Com. Price	76	0,0048	0,0022	0,9894	0,9955	0,0000
Colombia						
IT	43	0,0075	0,0215	0,2324	0,3966	0,0000
VAT	43	0,0091	0,0244	0,0304	0,1310	0,0000
GDP	59	0,0080	0,0002	0,9899	0,9715	0,0000
Ecuador						
IT	60	0,0352	0,0459	0,7213	0,0846	0,0000
VAT	60	0,0221	0,0072	0,8513	0,1399	0,0000
Com. Rev.	60	-0,0016	0,1585	0,0007	0,0055	0,0000
GDP	64	0,0078	0,0003	0,9783	0,8637	0,0000
Com. Price	77	0,0091	0,0193	0,6911	0,3526	0,0000
Mexico						
IT	76	0,0034	0,0967	0,1714	0,3977	0,0000
VAT	76	-0,0024	0,6062	0,0000	0,0000	0,0000
Com. Rev.	76	-0,1468	1,8848	0,8896	0,8248	0,0000
GDP	64	0,0055	0,0003	0,6506	0,9759	0,1509
Com. Price	76	0,0068	0,0182	0,6610	0,4283	0,0000
Peru						
IT	44	-0,0009	0,2100	0,0168	0,0819	0,0000
VAT	44	0,0042	0,0065	0,5917	0,7985	0,0000
Com. Rev.	44	-0,1127	0,5125	0,0835	0,3005	0,0000
GDP	44	0,0111	0,0002	0,9981	0,6494	0,0004
Com. Price	76	0,0037	0,0062	0,8286	0,8618	0,0000
Dominican Rep.						
IT	71	0,0781	0,3578	0,0121	0,2078	0,0000
VAT	71	-0,0156	0,2818	0,0128	0,0486	0,0000
GDP	68	0,0132	0,0003	0,9065	0,5015	0,0000
Uruguay						
IT	40	-0,0027	0,1515	0,2078	0,4475	0,0000
VAT	40	-0,0006	0,0063	0,0510	0,1551	0,0000
GDP	40	0,0045	0,0004	0,9891	0,9054	0,0024
Venezuela						
IT	76	0,0177	0,0658	0,2273	0,0222	0,0000
VAT	61	0,0213	0,0199	0,4878	0,4043	0,0000
Com. Rev.	76	-0,0063	0,1373	0,0190	0,0378	0,0000
GDP	64	0,0060	0,0019	0,8996	0,7894	0,0000
Com. Price	76	0,0068	0,0182	0,6610	0,4283	0,0000

Appendix D: Alternative regression results

Table D.1 Elasticity and adjustment speed estimates without further covariates

[Table is continued on the following page.]

	LR Elasticity			SR Elasticity			Adjustment Speed		
				below LR Equilibrium		above LR Equilibrium	below LR Equilibrium		above LR Equilibrium
IT									
Argentina	2.677	***		2.963	***	2.963	***	-0.883	***
Bolivia	2.268	***		-2.797		3.795	**	-0.915	***
Brazil	2.388	***		-0.784		3.571	***	-1.136	***
Chile	1.102	***		-0.523		2.585	***	-0.684	***
Colombia	2.122	***		0.556		0.556		-0.930	***
Dominican Rep.	2.025	***		-0.072		4.273	***	-0.425	***
Ecuador	2.929	***		-1.245		-1.245		-0.426	***
Mexico	1.223	***		-3.286	***	1.351	***	-0.616	***
Peru	2.007	***		-1.166	*	2.579	***	-0.980	***
Uruguay	1.714	***		0.741		0.741		-1.114	***
Venezuela	3.138	***		1.321	***	1.321	***	-0.324	***
PIT									
Argentina	0.945	**		2.713	**	2.713	**	-0.391	***
Bolivia	-0.652	***		-2.996	**	1.972	*	-0.714	***
Brazil	2.957	***		-0.417		6.834	***	-0.641	***
Chile	1.929	***		-1.613	**	2.167	*	-0.643	***
Peru	1.610	***		0.304		0.304		-0.833	***
CIT									
Argentina	2.876	***		3.519	**	3.519	**	-0.410	***
Bolivia	2.772	***		-3.343		5.560	**	-1.083	***
Brazil	3.810	***		1.149		7.103	***	-1.242	***
Chile	1.306	***		-1.238	*	3.556	***	-0.705	***
Dominican Rep.	2.186	***		0.850		8.296	***	-0.648	***
Peru	2.102	***		-1.519		3.568	**	-0.355	**
Uruguay	3.415	***		-2.803	*	2.104		-1.115	***
VAT									
Argentina	1.723	***		1.433	***	2.352	***	-0.373	***
Bolivia	1.890	***		1.124	*	1.124	*	-0.843	***
Brazil	1.766	***		1.087	***	1.087	***	-0.167	**
Chile	0.808	***		-0.519		1.523	**	-0.650	***
Colombia	1.756	***		3.652	***	3.652	***	-0.907	***
Dominican Rep.	1.636	***		0.065		2.001	***	-0.342	***
Mexico	1.907	***		-0.053		2.576	***	-0.802	***
Peru	1.606	***		-0.372		1.565	***	-0.566	***
Uruguay	2.095	***		2.460	***	2.460	***	-0.944	***
Venezuela	2.550	***		1.026	**	1.026	**	-0.430	***

[Table D.1 continued]

	LR Elasticity			SR Elasticity			Adjustment Speed		
				below LR Equilibrium	above LR Equilibrium		below LR Equilibrium	above LR Equilibrium	
Internal VAT									
Argentina	1.210	***		1.166	***	2.066	***	-0.365	***
Bolivia	1.645	***		-0.533		2.368	*	-1.322	***
Chile	0.946	***		-0.640		0.553		-0.271	***
Colombia	1.452	***		-0.529		2.965	***	-1.316	***
Peru	1.112	***		-0.147		1.587	***	-0.636	***
Uruguay	1.590	***		1.759	***	1.759	***	-1.652	***
External VAT									
Argentina	3.438	***		2.042		2.042		-0.762	***
Bolivia	3.113	***		1.719	**	1.719	**	-0.708	***
Chile	1.095	***		-1.513		2.092	*	-0.669	***
Colombia	2.659	***		4.042	***	1.082		-0.214	
Peru	2.123	***		0.835		0.835		-0.463	***
Uruguay	2.324	***		2.201	***	2.201	***	-0.394	**
Social Security									
Brazil	1.966	***		0.540	**	0.540	**	-0.744	***
Chile	0.935	***		-0.461		0.924	**	-0.194	***
Ecuador	3.580	***		1.687		1.687		-0.415	***
Mexico	1.476	***		0.974	***	0.974	***	-0.207	**
Peru	0.993	***		-2.304	***	1.469	*	-0.960	***
Commodities									
Argentina	1.492	***		0.490	**	0.490	**	-0.901	***
Bolivia	-0.011			-0.170		-0.170		-0.527	***
Chile	2.996	***		0.238		0.238		-0.342	***
Ecuador	-0.051			-0.010		1.527	***	-0.679	***
Mexico	0.671	***		0.427	***	0.427	***	-0.865	***
Peru	1.945	***		1.470	**	1.470	**	-0.921	***
Venezuela	1.409	***		0.666	***	0.666	***	-0.832	***

Notes: Only tax rates and policy dummies were included. For the price elasticities of revenues from commodities exchange rates are controlled for. SR, LR denote short-run and long-run, respectively; *, **, *** denote significance at the 10, 5, 1% level..

Table D.2 Estimates with debt-to-GDP ratio as additional control

Table D-2 Estimates with debt to GDP ratio as additional control									
LR Elasticity			SR Elasticity			Adjustment Speed			
			below		above			below	above
			LR Equilibrium		LR Equilibrium			LR Equilibrium	LR Equilibrium
IT									
Argentina	2.677	***	1.610		1.610	-0.846	***	-0.846	***
Brazil	2.388	***	-2.590	*	3.542	***	-0.714	***	-0.714
Chile	1.102	***	-0.429		3.218	***	-0.767	***	-0.767
Mexico	1.223	***	-3.917	***	0.421	-0.702	***	-0.193	
Venezuela	3.138	***	1.244	**	1.244	-0.300	***	-0.300	***
PIT									
Argentina	0.945	**	2.556		2.556	-0.360	***	-0.360	***
Brazil	2.957	***	0.055		8.197	***	-0.176		-1.288
Chile	1.929	***	-1.509	**	3.480	***	-0.722	***	-0.722
CIT									
Argentina	2.876	***	-4.017		2.328	-0.485	***	-0.485	***
Brazil	3.810	***	4.882	**	4.882	-0.722	***	-0.722	***
Chile	1.306	***	-0.864		4.024	-0.707	***	-0.707	***
VAT									
Argentina	1.723	***	1.442	***	2.501	-0.378	***	-0.378	***
Brazil	1.766	***	1.028	***	1.028	-0.115		-0.115	
Chile	0.808	***	-0.310		1.549	-0.699	***	-0.699	***
Mexico	1.907	***	-0.729		2.587	-0.754	***	-0.754	***
Venezuela	2.550	***	1.037	**	1.037	-0.509	***	0.266	**
Internal VAT									
Argentina	1.210	***	0.448		1.729	-0.295	**	-0.295	**
Chile	0.946	***	-0.251		0.941	-0.451	***	-0.451	***
External VAT									
Argentina	3.438	***	1.663		1.663	-0.745	***	-0.745	***
Chile	1.095	***	-1.510		2.316	-0.616	***	-0.616	***
Social Security									
Brazil	1.966	***	0.358		0.358	-0.668	***	-0.668	***
Chile	0.935	***	-0.161		1.641	-0.240	***	-0.729	***
Mexico	1.476	***	-1.068		1.340	-0.181	*	-0.181	*
Commodities									
Argentina	1.492	***	0.411	*	0.411	-0.842	***	-0.128	
Chile	2.996	***	-0.169		-0.169	-0.394	***	-0.394	***
Mexico	0.671	***	0.661	***	0.661	-0.784	***	-0.784	***
Venezuela	1.409	***	0.615	**	0.615	-0.819	***	-0.819	***

Notes: In addition to the covariates of the baseline regression we control for the first difference of the log debt-to-GDP ratio for a selected sample of countries in the short-run specification. SR, LR denote short-run and long-run, respectively; *, **, *** denote significance at the 10, 5, 1% level..

Table D.3 Elasticity and adjustment speed estimates with alternative tax rate measures

	LR Elasticity			SR Elasticity			Adjustment Speed					
				below LR Equilibrium	above LR Equilibrium		below LR Equilibrium	above LR Equilibrium				
IT												
Argentina	2.677	***		2.137	**		2.137	**	-0.903	***	-0.903	***
Brazil	2.388	***		-2.014			3.920	***	-0.699	***	-0.699	***
Chile	1.975	***		-0.920	*		2.295	***	-0.971	***	-0.971	***
Dominican Rep.	2.025	***		-0.190			3.571	***	-0.210		-0.777	***
Mexico	1.233	***		-3.437	***		0.886		-0.763	***	-0.173	
Peru	2.007	***		-1.989	**		3.846	***	-0.497	***	-0.497	***
PIT												
Chile	1.682	***		-1.901	**		2.323	*	-0.569	***	-0.569	***
Peru	1.609	***		0.372			0.372		-0.918	***	-0.918	***
CIT												
Brazil	4.346	***		4.720	**		4.720	**	-0.636	***	-0.636	***

Notes: For IT the average rate of the CIT and PIT was included to the baseline specification instead of the CIT rate. This was not done for Peru and Colombia as the CIT and PIT rates do not differ, and for Bolivia since the CIT rate does not change over time. In the case of PIT the average over the progressive brackets was included instead of the top rate. In Bolivia PIT is not progressive and in Brazil only two brackets existed until the last quarter considered with the lower one remaining constant over time. In the remaining countries this exercise was not carried out due to data limitations. In the case of CIT in Brazil, the average over the rates for different business forms was included. This was not done for the remaining countries due to data limitations.

SR, LR denote short-run and long-run, respectively; *, **, *** denote significance at the 10, 5, 1% level.

Table D.4 Estimates with dummies for terrorist bombings as proxy for civil unrest

	LR Elasticity			SR Elasticity			Adjustment Speed			
				below LR Equilibrium	above LR Equilibrium		below LR Equilibrium	above LR Equilibrium		
IT										
Argentina	2.677	***		2.137	**		-0.903	***	-0.903	***
Colombia	2.122	***		1.914	**		-1.045	***	-1.045	***
PIT										
Argentina	0.945	**		1.990			-0.353	***	-0.353	***
CIT										
Argentina	2.876	***		1.544			-0.539	***	-0.539	***
VAT										
Argentina	1.723	***		1.396	***		-0.372	***	-0.372	***
Colombia	1.756	***		3.559	**		-0.991	***	-0.991	***
Internal VAT										
Argentina	1.210	***		0.858	**		-0.294	**	-0.294	**
Colombia	1.452	***		-1.744			-1.295	***	-1.295	***
External VAT										
Argentina	3.438	***		-1.375			-0.776	***	-0.776	***
Colombia	2.659	***		4.659	***		-0.313		-0.313	
Commodities										
Argentina	1.492	***		0.397	*		-0.872	***	-0.172	

Notes: Dummies were included to the baseline specification indicating quarters in which bomb attacks on non-combatant (civilian and political) targets were carried out by non-state actors. These occurred Argentina in Q3 1994 and in Colombia in Q4 1998, Q2 and Q3 2002, and Q1 2003. SR, LR denote short-run and long-run, respectively; *, **, *** denote significance at the 10, 5, 1% level.

D.5 Elasticity and adjustment speed estimates for sample periods truncated from above at Q4 2007

	LR Elasticity			SR Elasticity		Adjustment Speed			
				below LR Equilibrium	above LR Equilibrium	below LR Equilibrium		above LR Equilibrium	
IT									
Argentina	2.681	***		1.939 *	1.939 *	-0.879	***	-0.879	***
Bolivia	2.046	***		-1.812	6.788 **	-0.884	***	-0.884	***
Brazil	2.483	***		-0.824	5.215 **	-0.666	***	-0.666	***
Chile	1.100	***		-0.495	4.269 ***	-0.772	***	-0.772	***
Colombia	2.080	***		1.442	1.442	-1.051	***	-1.051	***
Dom. Rep.	1.839	***		-0.609	5.110 ***	-0.427	***	-0.427	***
Ecuador	2.478	***		-0.654	6.202 **	-0.315		-0.315	
Mexico	1.151	***		-3.357 **	1.192	-0.700	***	-0.232	*
Peru	1.929	***		-0.978	4.052 ***	-0.329	*	-0.329	*
Uruguay	1.245	***		-0.429	6.237 **	-1.222	***	-1.222	***
Venezuela	3.122	***		1.282 **	1.282 **	-0.293	***	-0.293	***
PIT									
Argentina	1.003	**		1.139	1.139	-0.329	***	-0.329	***
Bolivia	-0.712	**		-3.658 **	2.503	-0.942	***	-0.942	***
Brazil	1.999	***		-1.157	6.485 **	-0.099		-0.099	
Chile	1.897	***		-1.402 *	2.773 *	-0.634	***	-0.634	***
Peru	1.244	***		0.005	1.679 ***	-0.902	***	-0.902	***
CIT									
Argentina	3.053	***		0.476	0.476	-0.549	***	-0.549	***
Bolivia	2.660	***		-2.097	9.129 ***	-1.060	***	-1.060	***
Brazil	3.734	***		4.181	4.181	-0.527	***	-0.527	***
Chile	1.297	***		-1.118	4.799 ***	-0.707	***	-0.707	***
Dom. Rep.	2.393	***		1.532	10.725 ***	-0.514	***	-0.514	***
Peru	2.211	***		-1.871	6.338 ***	-0.333	*	-0.333	*
Uruguay	3.446	***		-1.952	-1.952	-1.039	***	-1.039	***
VAT									
Argentina	1.787	***		1.365 ***	2.396 ***	-0.360	***	-0.360	***
Bolivia	2.098	***		0.438	3.508 **	-0.985	***	-0.985	***
Brazil	1.834	***		-0.097	1.184 **	-0.087		-0.087	
Chile	0.846	***		-0.812 **	1.718 ***	-0.734	***	-0.734	***
Colombia	1.662	***		4.080 **	4.080 **	-1.513	***	-0.295	
Dom. Rep.	1.648	***		-0.360	1.706 ***	-0.355	***	-0.355	***
Mexico	1.874	***		-0.631	4.292 ***	-0.736	***	-0.736	***
Peru	1.413	***		-0.421	1.749 ***	-0.765	***	-0.765	***
Uruguay	2.137	***		2.724 ***	2.724 ***	-1.020	***	-1.020	***
Venezuela	3.238	***		0.947 *	0.947 *	-0.568	***	0.293	**

[Table D.5 continued]

Internal VAT						
Argentina	1.128 ***	1.353 ***	2.726 ***	-0.495 ***	-0.495 ***	
Bolivia	1.663 ***	-0.388	2.682	-1.734 ***	-0.760 ***	
Chile	0.924 ***	-0.767 **	1.233 ***	-0.313 ***	-0.313 ***	
Colombia	1.215 ***	8.436 ***	2.709	-1.681 ***	-0.428	
Peru	1.047 ***	-0.175	1.988 ***	-0.745 ***	-0.745 ***	
Uruguay	1.634 ***	1.999 **	1.999 **	-1.423 ***	-0.162	
External VAT						
Argentina	3.514 ***	-1.753	-1.753	-0.792 ***	-0.792 ***	
Bolivia	3.174 ***	1.369	1.369	-0.663 ***	-0.663 ***	
Chile	1.086 ***	-1.154	4.119 ***	-0.697 ***	-0.697 ***	
Colombia	2.717 ***	4.179 ***	4.179 ***	-0.294 *	-0.294 *	
Peru	1.620 ***	-0.719	2.013 ***	-0.681 ***	-0.681 ***	
Uruguay	2.390 ***	3.408 ***	0.152	-0.438 **	-0.438 **	
Social Security						
Brazil	1.990 ***	0.405	1.591 **	-0.784 ***	-0.784 ***	
Chile	0.917 ***	-0.215	2.112 ***	-0.192 **	-0.947 ***	
Ecuador	3.745 ***	-2.191	2.148	-0.508 ***	-0.508 ***	
Mexico	1.579 ***	-3.117 ***	1.337 **	-0.221 **	-0.221 **	
Peru	0.950 ***	-1.333 *	2.242 ***	-1.070 ***	-1.070 ***	
Commodities						
Argentina	1.308 ***	0.126	2.499 ***	-0.706 **	-0.706 **	
Bolivia	0.025	0.069	0.069	-0.474 ***	-0.474 ***	
Chile	3.738 ***	0.009	0.009	-0.400 ***	-0.400 ***	
Ecuador	-0.273 *	0.817	0.817	-0.545 ***	-0.545 ***	
Mexico	0.556 ***	0.442 **	0.442 **	-0.783 ***	-0.783 ***	
Peru	2.063 ***	0.837	0.837	-0.940 ***	-0.940 ***	
Venezuela	1.581 ***	0.597 *	0.597 *	-1.311 ***	-0.530 **	

Notes: Corresponds to specifications underlying estimates shown in Table 1. SR, LR denote short-run and long-run, respectively; *, **, *** denote significance at the 10, 5, 1% level

D.6 Estimates for IT and CIT measures including commodity prices and exchange rates as covariates

	LR Elasticity			SR Elasticity		Adjustment Speed		
				below LR Equilibrium	above LR Equilibrium	below LR Equilibrium	above LR Equilibrium	
IT								
Bolivia	1.505	***		-0.925	-0.925	-1.186	***	0.265
Chile	1.129	***		-0.839	3.081 ***	-0.741	***	-0.741 ***
Ecuador	3.344	***		-0.928	5.938 **	-0.220	*	-0.220 *
Mexico	1.226	***		-2.365 **	0.328	-0.320	***	-0.320 ***
Peru	2.044	***		-0.851	3.308 ***	-1.143	***	-0.119
Venezuela	3.126	***		1.435 ***	1.435 ***	-0.319	***	-0.319 ***
CIT								
Bolivia	2.006	***		-0.177	-0.177	-1.186	***	0.390
Chile	1.358	***		-1.323 *	3.850 ***	-0.700	***	-0.700 ***
Peru	2.080	***		-1.807	5.670 ***	-0.356	***	-0.356 ***

Notes: Corresponds to specifications underlying estimates shown in Table 1, but includes commodity prices and exchange rates as additional covariates; we treated CIT revenues from commodities in the case of Venezuela and Peru as revenues from commodities – in the cases of Bolivia, Chile, Mexico, Colombia, and Ecuador the distinction is not possible; SR, LR denote short-run and long-run, respectively;

*, **, *** denote significance at the 10, 5, 1% level

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