

# Updating of Equivalent Fiscal Pressure in Latin America and the Caribbean

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### **Abstract\***

The tax database for the Latin American and Caribbean (LAC) region, prepared by the IDB and CIAT, shows significant innovations in relation to the already existing databases: (i) it introduces the concept of Equivalent Fiscal Pressure (EFP), which complements the traditional tax revenues, plus all the mandatory social security contributions systems (public and actuarial private) and freely available government revenues from natural resources; and (ii) it provides expanded information on the fiscal situation of the different levels of government and different taxes. This document includes a brief analysis of the evolution of the EFP, as well as specific characteristics of its revenue structure. Additionally, as an example of an exercise allowed by the data, we calculate the short- and long-term buoyancy of the EFP for all LAC countries as well as for subgroups of countries. The results show that the long-term buoyancy of the EFP is approximately 1.34, thereby suggesting a tax effort for the long term on the side of revenues. On the other hand, the short-term buoyancy is around 0.86, probably due to low taxation of individual income and the large proportion of taxation on consumption.

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\* Our special recognition goes to all those who contributed to the compilation of information for updating the EFP database, especially: Agnes Rojas, Dalmiro Moran, Julio Lopez, Miguel Pecho, Angel Melguizo, Juan Carlos Benítez, Karla Hernandez, Michelle Harding, Michael Hanni, Ricardo Martner, Juan Pablo Jiménez, and Daniel Titelman. In addition, we appreciate the support of the ministries of finance and national tax agencies of Argentina, Barbados, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Uruguay, and Venezuela, as listed in the database.

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## **1. Introduction**

Accompanying this document is the updated tax database for the Latin American and Caribbean (LAC) region, prepared jointly by the IDB and CIAT for the 1990–2015 period. This database shows two important differences in relation to existing databases, such as those of ECLAC or the OECD methodology (OECD/ECLAC/CIAT/IDB, 2017). First, it includes the concept of Equivalent Fiscal Pressure (EFP) developed by Barreix et al. (2013). EFP is the sum of tax revenues, including public social contributions (pensions and health), obligatory private contributions (actuarial) and income resulting from natural resources, and those of public enterprises (royalties, dividends, and other freely available government revenues) as well as private (royalties, “extra” taxes on income and net wealth, etc.).

The concept of EFP is broader than traditional concepts regarding tax revenues or fiscal revenues because it includes resources that are available to the public sector (those derived from natural resources) or which respond to a public regulation and must be obligatorily paid (obligatory private actuarial contributions).

In particular, the incorporation of revenues resulting from the exploitation of natural resources is justified because when they are channeled through dividends of state enterprises, royalties, or the like, they are actually taken into account in the traditional databases, including them as revenues. However, they are not considered in the databases when the public sector makes use of them through other means, such as a public monopoly of electric power refinement or distribution.

In the case of private and obligatory social security contributions (mainly health and pensions), they should also be taken into account because when considering only the public ones being included as tax revenues, it sets a bias in the comparisons against those countries with a significant part of their social protection systems databased on obligatory contributions, which are nevertheless managed by the public sector. In fact, although with significant exceptions (such as the United States, particularly in health), in general in the OECD countries, social benefits and contributions as well as income from natural resources (obtained through taxes) are not relevant and they tend to be public. On the other hand, in LAC, although in some countries the situation is the same, in others, it is the opposite. Social benefits and contributions have a significant private, even actuarial component since the reform of pensions in Chile in the early 1980s, while part of the revenues obtained from natural resources do not all originate from taxes. If

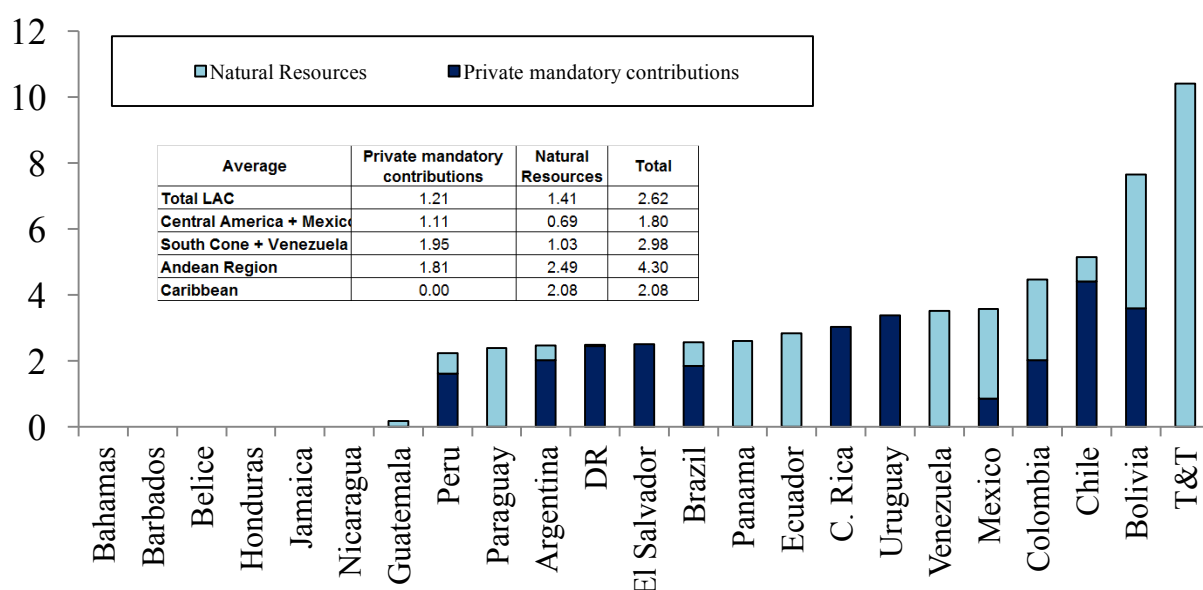
this were not taken into account, these latter countries would inevitably show lower revenues for the public sector than what they really are.

It is not a matter of replacing the tax revenue concept with that of Equivalent Fiscal Pressure, but rather that EFP should also be taken into account. Second, the IDB-CIAT database, in contrast to others, also affords more detailed information on the fiscal situation of the different taxes, as well as of the different management levels: central, state, and municipal governments. Its main results are shown below.

## 2. Equivalent Fiscal Pressure

The new resources incorporated in the EFP have a significant quantitative relevance in some LAC countries. Thus, with respect to obligatory private contributions, the largest average figures in 2011–2015 are found in Chile (4.4 percent of GDP), Bolivia (3.6 percent), Uruguay (3.4 percent), and Costa Rica (3.0 percent). Those standing out with respect to proceeds from natural resources are Trinidad and Tobago (10.4 percent of GDP), Bolivia (4.0 percent), and Venezuela (3.4 percent). The sum of both resources implies an average of 2.7 percent of GDP in LAC, with a maximum in Trinidad and Tobago (10.4 percent of GDP), followed by Bolivia (7.6 percent) and Chile (5.1 percent). On the other hand, the Bahamas, Barbados, Belize, Honduras, Jamaica, and Nicaragua are unimportant. In general, the new resources are more relevant in the Andean region and less so in Central America and the Caribbean.

**Figure 1. Income from Natural Resources and Private Mandatory Contributions (% GDP), 2011–2015**



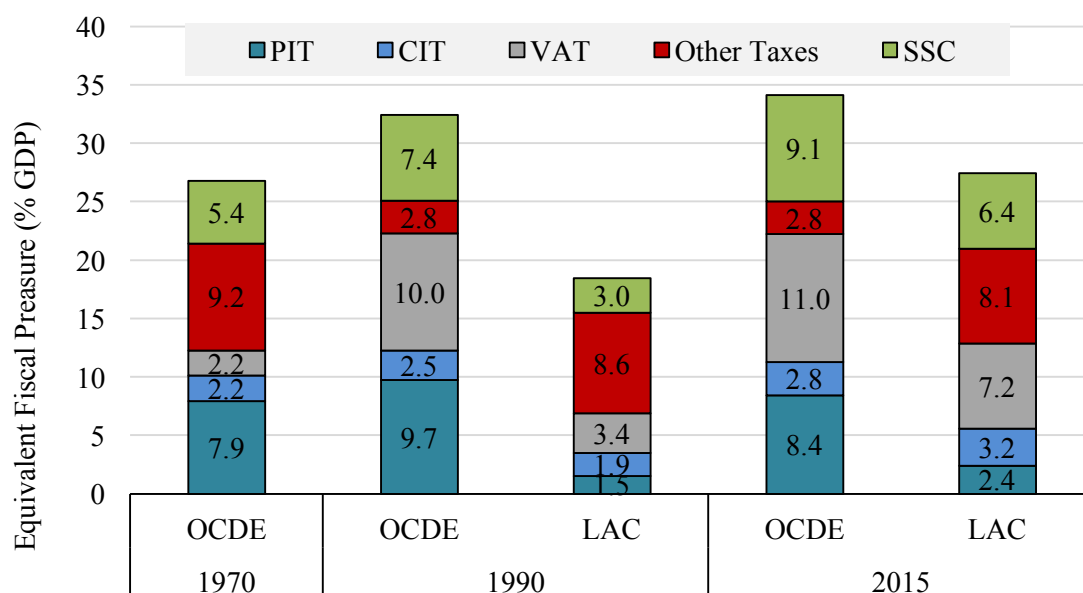
Source: Authors' elaboration based on the IDB-CIAT database (2017).



If one compares revenues in LAC countries with those of the OECD countries, the results are very different, regardless of whether one considers these new resources (Figures 2 and 3). The comparison would be erroneous, because one would also have to consider those in OECD countries. In any case, in most of these countries they do not have a significant weight. An important exception is the United States due to obligatory contributions to medical insurance (Patient Protection and Affordable Care Act, 2010), which are not considered in the original methodology and because of the importance of said economy within OECD countries.

Figure 2 shows the evolution of the tax burdens through time (measured in weighted average of GDP in PPP at current values) and the comparison between regions. For 2015, the total burden for OECD countries is 34.1 percent while for LAC countries it is 27.3 percent. This difference (6.8 percentage points) can be disaggregated, to a great extent, because of the greater social security collection (2.7 percentage points) and individual income tax (6 percentage points), which is compensated in favor of LAC countries through other taxes (5.3 percentage points) that include revenues from natural resources.

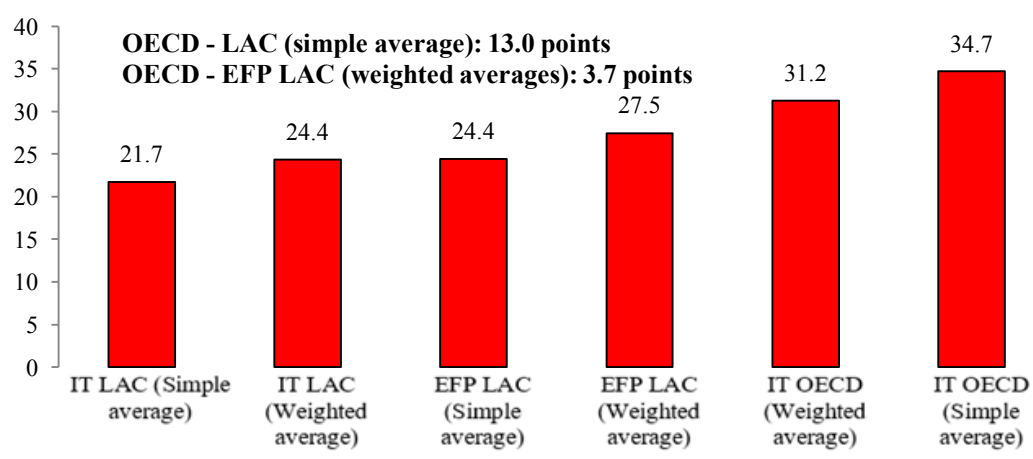
**Figure 2. Equivalent Fiscal Pressure: OECD and LAC, 1970–2015\***



\* Weighted averages of GDP PPP at current prices of that year. World Bank Indicators (2017).  
Source: Authors' elaboration based on the IDB-CIAT database (2017) and OECD/ECLAC/CIAT/IDB (2017).

Thus, considering a longer period, the simple average between 2011 and 2015 of the OECD countries indicates tax resources of 34.7 percent of GDP and 21.7 percent in LAC. If these same figures are weighted according to each country's GDP in the corresponding group, the OECD registers tax resources of 31.2 percent of GDP in OECD countries and 24.4 percent in LAC countries. If new resources are taken into account, however, there is a significant change in the results. Without being weighted, LAC revenues represent 24.4 percent of GDP, while if weighted according to GDP (in parity of purchasing power at current prices) they may represent 27.5 percent in 2015. Thus, the difference between OECD and LAC tax revenues through simple average is very high, 13.0 points, while in EFP and with a weighted average it is reduced to only 3.7 points (see Figure 3).

**Figure 3. Comparison of Tax Revenue and Equivalent Fiscal Pressure between LAC and OECD Countries, Average 2011–2015**



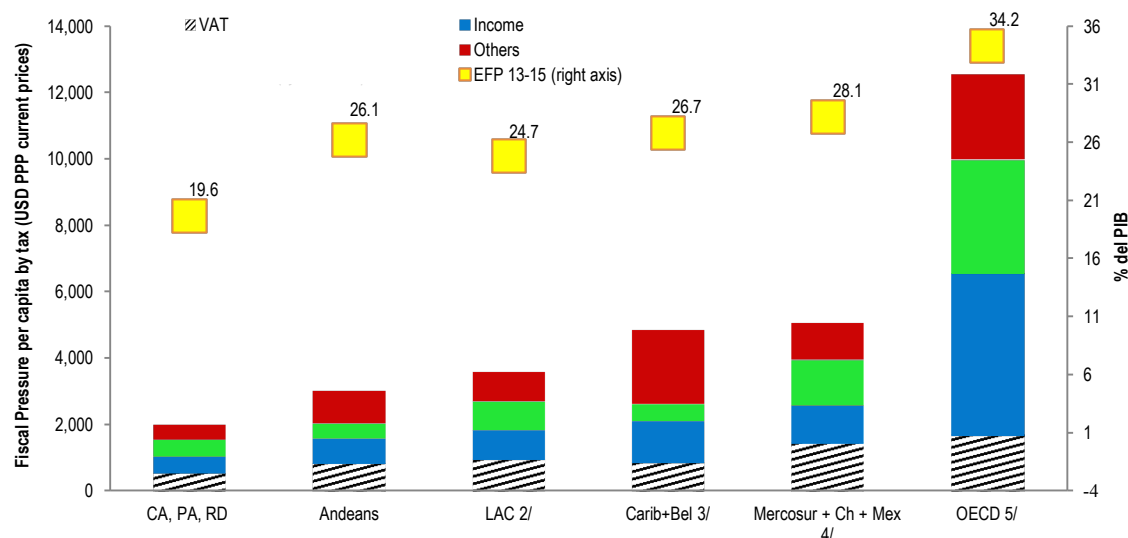
Source: Authors' elaboration based on the IDB-CIAT database (2017), OECD/ECLAC/CIAT/IDB (2017), and World Bank (2017).

Figure 4 shows an approximation of average government collection per inhabitant between 2011 and 2015. In per capita terms, the significant difference in collection between LAC and OECD countries is evident. This latter collects 3.5 times more resources per capita than the former. Specifically, the groups with lower collection per inhabitant are Central American and Andean countries.

It is clear that the tax pressure on GDP (2013–2015 weighted average in USD PPP 2011) differs substantially due to the much higher per capita income in the OECD countries. For example, the percentage of burden in MERCOSUR+CH+MX, which has the highest per capita GDP of the region, is 28.1 percent or 22 percent less than (on average) that of OECD countries. However, in monetary values it is almost three times more (2.78). This difference between LAC countries and developed countries is relevant due to the

much lower amount of resources available in the countries for facing essential public goods and services needs that are necessary for achieving greater levels of development. This is a warning sign of the need to improve the effectiveness of public expenditure as well as the need to combat evasion and avoidance, which affect the already scarce revenues (in relative terms), for producing the necessary public physical and social infrastructure for competing in global markets.

**Figure 4. EFP per capita by tax (in USD PPP 2011) and % of GDP<sup>1</sup> for the Period 2013 to 2015**

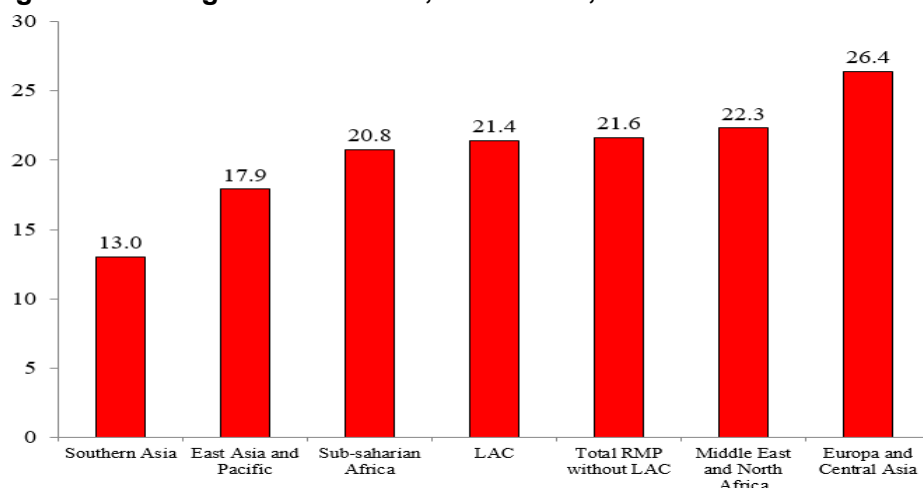


Source: Authors' elaboration based on the IDB-CIAT database (2017), OECD/ECLAC/CIAT/IDB (2017), World Bank (2017), and IMF (2017). For calculations and averages we used the GDP in USD PPP international current prices for 2011.

On the other hand, on being compared with average revenue countries of the rest of the world, LAC countries are very close to the total average. In fact, LAC countries are only significantly lower when compared with average revenue countries from Europe and Central Asia, which, to a great extent, still preserve the inertia of the state presence of the previous planned economy systems.

<sup>1</sup> The average fiscal pressure and GDP per capita were weighted by equal GDP. 2/ LAC and subregions doesn't include Argentina. Mercosur includes Brazil, Paraguay, Uruguay, Chile, and Mexico. Caribbean includes the Bahamas, Barbados, Belize, Jamaica, and Trinidad and Tobago. 3/ OECD excludes Chile, Slovakia, Slovenia, Estonia, Israel, Mexico, and the Czech Republic.

**Figure 5. Average Tax Revenue, 2011–2013, Medium-Income Countries**

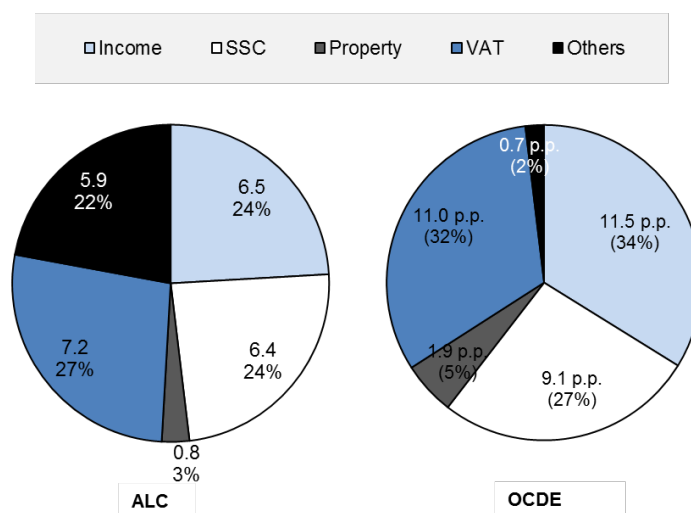


Source: IDB and CIAT (2017), OECD/ATAF/AUC (2016), and IMF (2017).

### 3. Revenue Structure

If one analyzes the different elements that comprise the EFP (Figure 6), according to the LAC average, the greater revenues correspond to general consumption taxes (7.2 percent of GDP in 2015), followed by income, profit, and capital gains taxes (6.5 percent) and social contributions (6.4 percent). At the other extreme, one may find the property taxes, private actuarial contributions, and selective taxes on consumption.

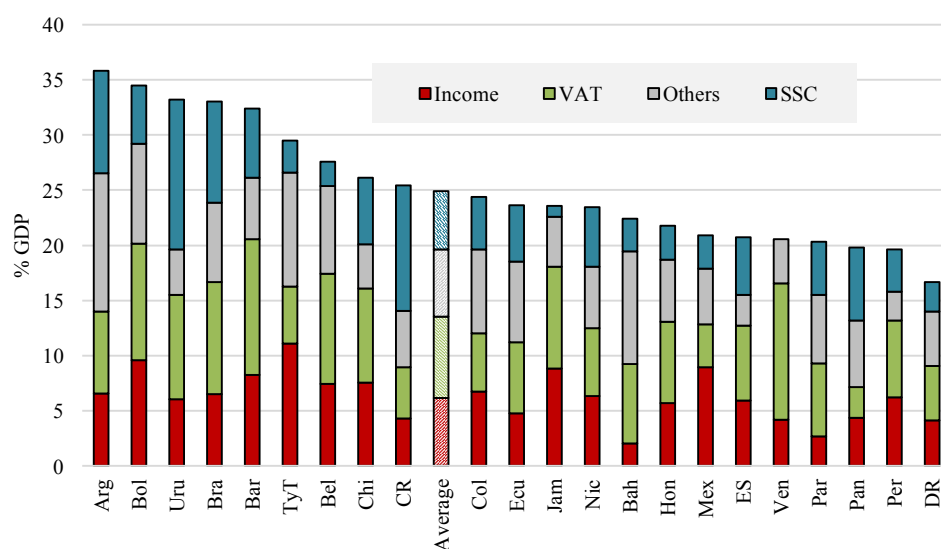
**Figure 6. Composition of EFP in LAC and OECD, 2015 (% GDP and total income)**



Source: Authors' elaboration based on the IDB-CIAT database (2017).

In any case, there are very important differences between LAC countries in relation to each of the main elements (Figure 7).

**Figure 7. Tax Pressure on Countries in Latin America and the Caribbean, 2015**

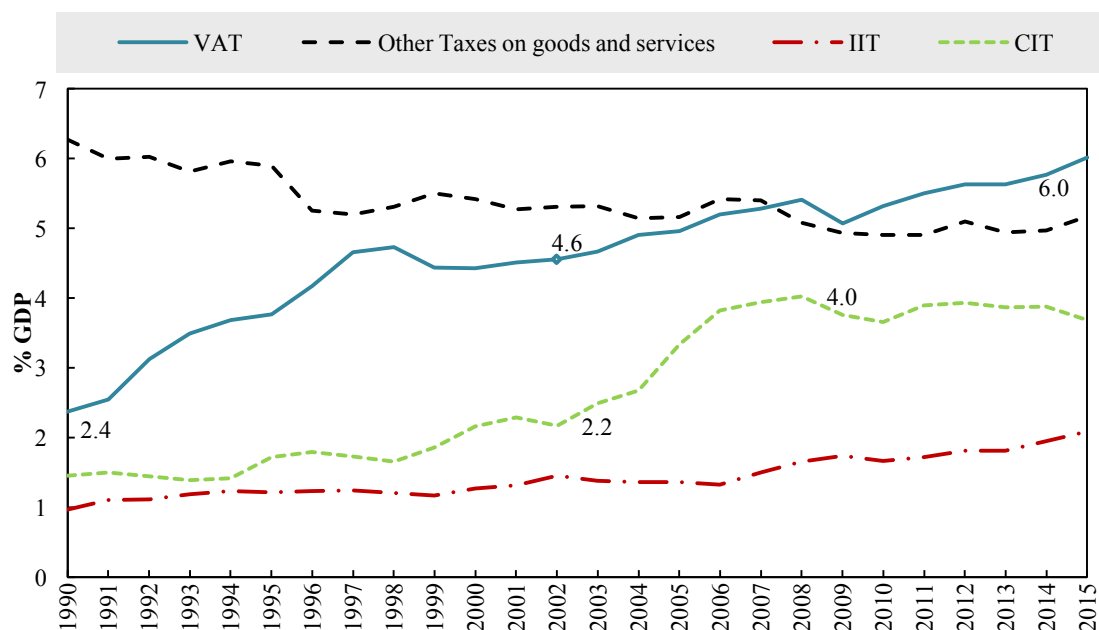


Source: Authors' elaboration based on the IDB-CIAT database (2017).

#### 4. Evolutionary analysis 1990–2015

Within the composition of LAC tax revenues, the increase of VAT since the 1990s is worth noting. This tax has replaced the “other goods and services taxes” as the most important in the region, in particular tariffs due to the consolidation of the opening to trade. Also worth noting is the increase in collection of corporate income tax, which increased from 1.5 percent of GDP in 1990 to 3.7 percent in 2015, while the other main categories have remained relatively constant through time.

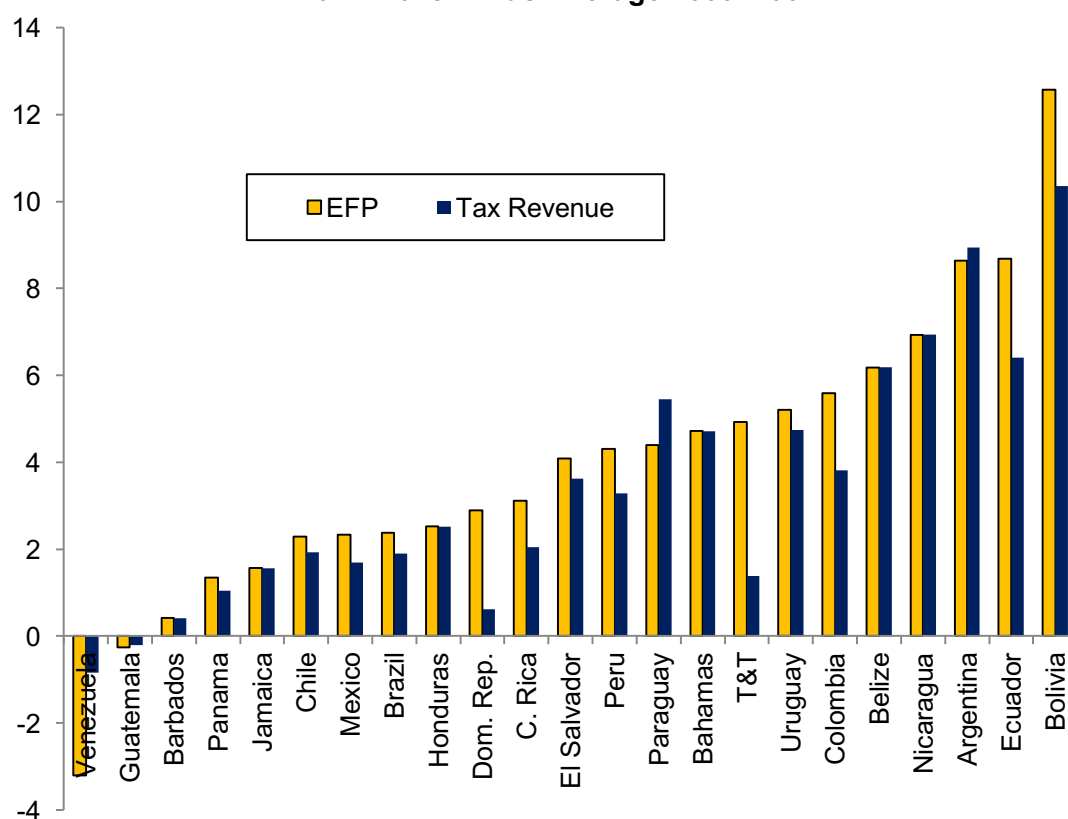
**Figure 8. Evolution of the Main Taxes in LAC, 1990–2015 (% GDP)**



Source: OECD/ECLAC/CIAT/IDB (2017).

On average, there has been a significant increase since the beginning of the past decade in EFP, as well as tax revenues: 4.0 and 3.4 percent of GDP, respectively, between 2000–2004 and 2011–2015. The greatest increases have occurred in Bolivia (12.6 and 10.3 points, respectively), Argentina (8.6 and 8.9), and Ecuador (8.7 and 6.4), while the most modest results have taken place in Venezuela (a drop of 3.2 in EFP and 0.8 in tax revenues), Guatemala (both practically stable), and Barbados (increase of approximately half a point).

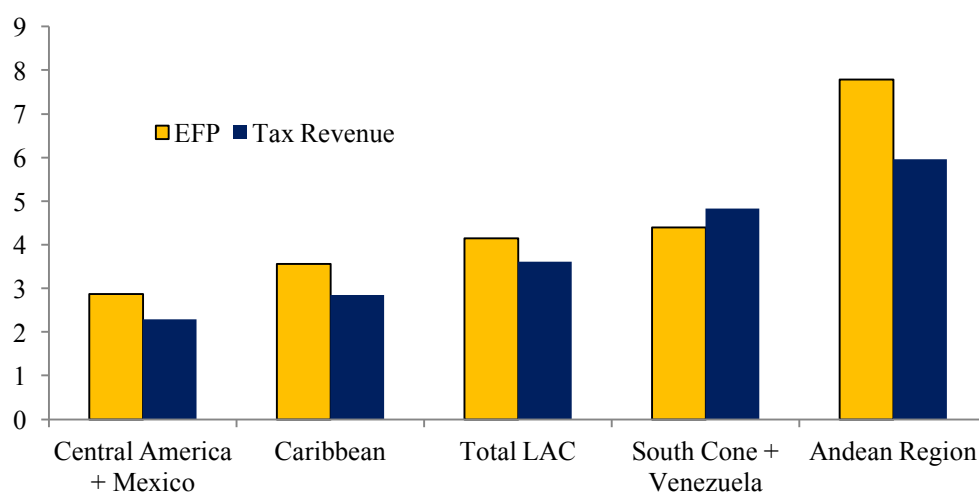
**Figure 9. Variation of Equivalent Fiscal Pressure and Tax Revenue, Average 2011–2015 Minus Average 2000–2004**



Source: Authors' elaboration based on the IDB-CIAT database (2017).

In general, the Andean region is the one showing the greatest increase in revenues (i.e., taxes as well as in terms of EFP), with the opposite situation occurring in Central America, Mexico, and the Caribbean countries.

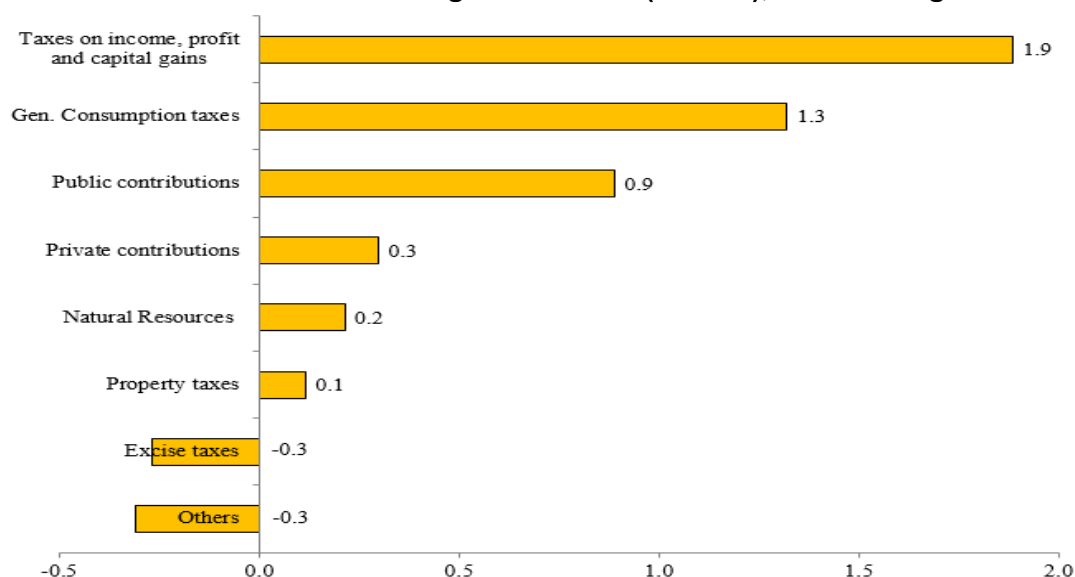
**Figure 10. Variation by Regions, Average 2011–2015 Minus Average 2000–2004**



Source: Authors' elaboration based on the IDB-CIAT database (2017).

This positive variation in EFP, however, has not been homogeneous in all the elements that comprise it. Thus, there are significant increases in the taxation of income, profits, and capital gains (1.9 pp), in general consumption taxes (1.3 pp), and in public social contributions (0.9 pp). On the other hand, there is a decrease in revenues from selective taxes on consumption (0.3 pp) and in “other tax figures” (0.3 pp).

**Figure 11. Variation of the Main Elements of Equivalent Fiscal Pressure, Average 2011–2015 minus Average 2000–2004 (% GDP), LAC Average**



Source: Authors' elaboration based on the IDB-CIAT database (2017).

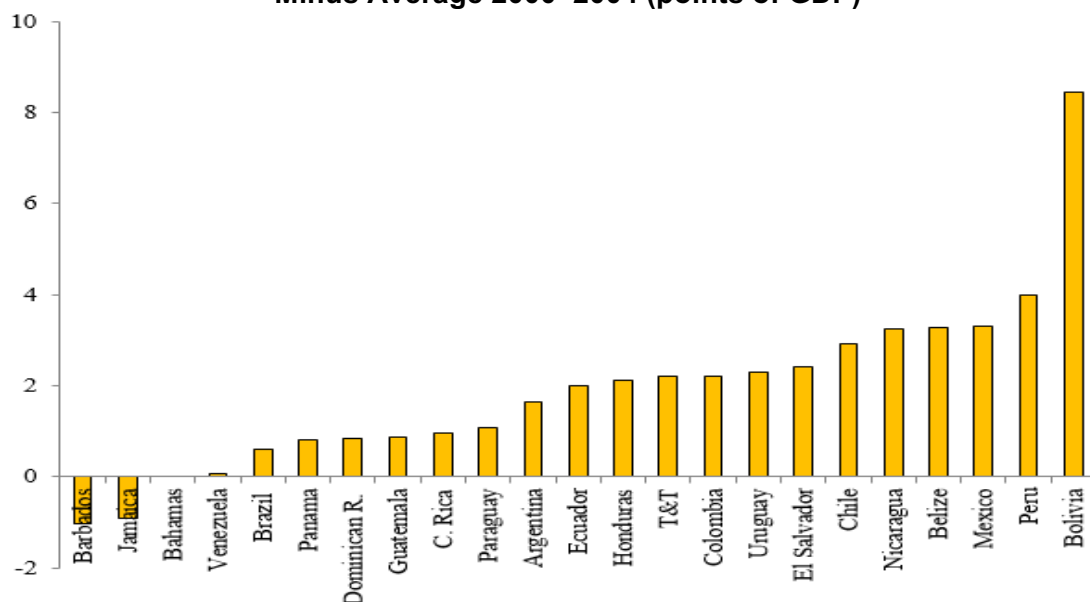
Due to the unequal behavior of the different elements, there have been some changes in the structure of the EFP since the beginning of the past decade up to the present, which are worth noting. Thus, in the average of the LAC countries, one observes a greater participation in the taxation of income, profits, and capital gains (its weight compared to the total increases 4.2 points) as well as in public social contributions (a 1.4-point increase). On the contrary, worth noting is the decrease shown by the weight of selective taxes on consumption (2.8 points). Undoubtedly, the supercycle of commodities and the international decrease of the financial cost, as well as an improvement in the control of personal income, have contributed thereto.

If one analyzes by countries and elements, in income, profits, and capital gains taxation the greatest increases occur in Bolivia (8.4 points of GDP) and in Peru (4 points), while in Barbados and Jamaica there are even decreases (of approximately one point). On the one hand, the greatest increases in general consumption taxation occurs in Venezuela (3.4 points) and in Paraguay (2.6), while in Trinidad and Tobago it decreases almost one point. On the other hand, the greatest increases in selective taxes on consumption take



place in the Dominican Republic (0.9 points) and Jamaica (0.6), while the greatest decreases occur in Mexico and Trinidad and Tobago (both with 1.2 points).

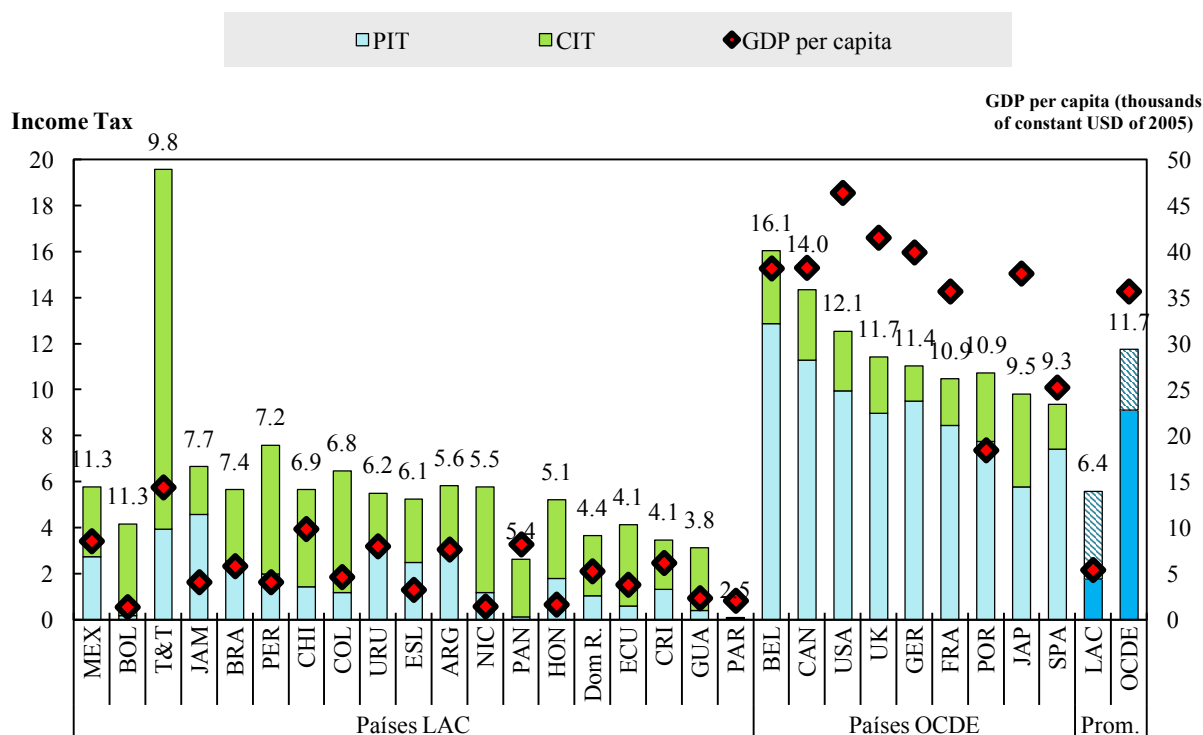
**Figure 12. Taxation of Income, Utilities, and Capital Gains, Average 2011–2015 Minus Average 2000–2004 (points of GDP)**



Source: Authors' elaboration based on the IDB-CIAT database (2017).

The importance of corporate income tax (CIT) in the tax structure is especially relevant with respect to commodities in developed countries (Figure 2). Revenues resulting from CIT have become even more important since 2003, when the commodities supercycle decade began, as shown in the increase in the prices of such goods in international markets in the 2003–2013 decade. On the other hand, Individual Income Tax (IIT) collection continues to be low in LAC, with the greater part of revenues coming from wage earners. It is fair to recognize that there are relevant reasons for this difference: the average nominal revenues are almost four times greater in the developed countries than in LAC; wage participation is above 65 percent in the OECD, while in the region, it does not amount to 40 percent; likewise, formality and evasion are significantly higher in LAC.

**Figure 13. CIT and IIT According to GDP per capita for LAC and OECD (2014)**



Source: Barreix, Benítez, and Pecho (2017).

With respect to tax deductions, one may mention that in deciles of low revenues, standard tax reliefs are greater than their income from wages. As income from wages increases, average standard tax deductions also decrease slowly. However, even the deciles with higher revenues are allowed to deduct some proportion of their gross income from wages.

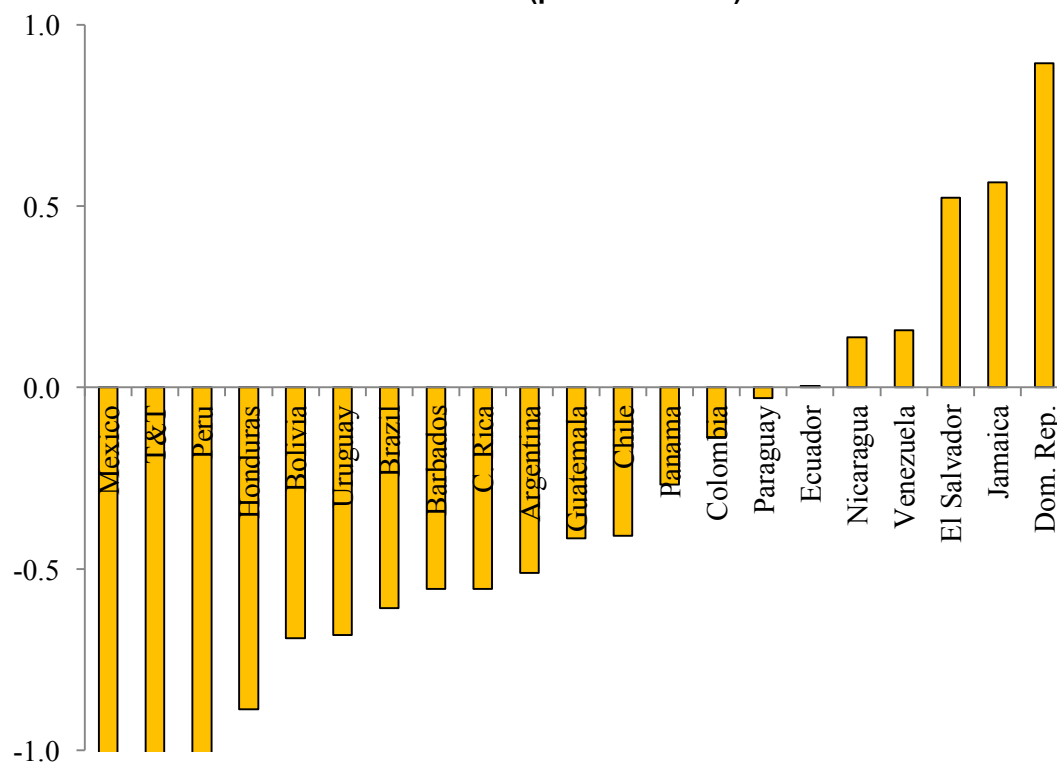
**Figure 14. Tax Exemptions from IIT (Tax Exemptions/Wage Income by Decile)**



Source: Barreix, Benítez, and Pecho (2017) and OECD/CIAT/IDB (2016).

The most important category in LAC is revenues from general consumption taxes. In particular, growth in 2000–2004 and 2011–2015 has been above 1 pp for most of the LAC countries. This increasing trend was mentioned before (see Figure 8). Nevertheless, selective taxes on consumption have decreased their contribution to government funds, as shown in Figure 15.

**Figure 15. Selective Taxes on Consumption, Average 2011–2015 Minus Average 2000–2004 (points of GDP)**

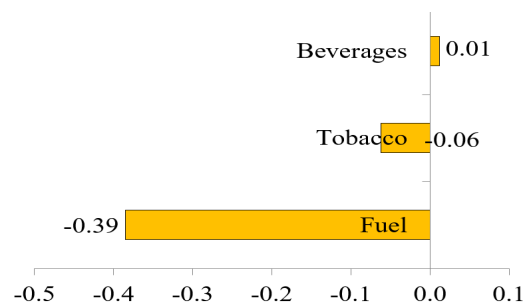


Source: Authors' elaboration based on the IDB-CIAT database (2017).

In the case of selective taxes on consumption, although collection from all the main figures has been reduced, it is in fuel where the reduction has been most significant (0.4 points of GDP), and it has taken place in all the countries for which there is data available, except the Dominican Republic, but especially in Mexico,<sup>2</sup> Bolivia, and Peru.

<sup>2</sup> Mexico modernized its legislation in 2015.

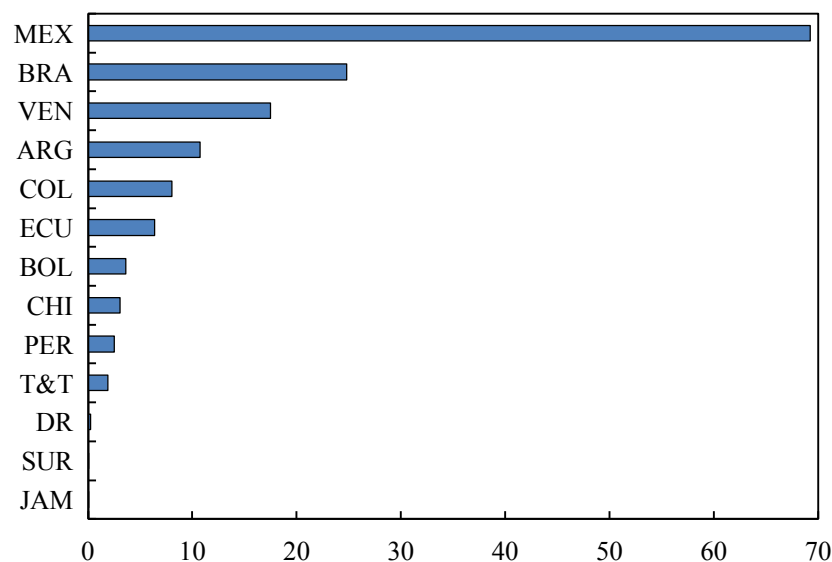
**Figure 16. Selective Taxes on Consumption, Average 2011–2015 Minus Average 2000–2004 (points of GDP)**



Source: Authors' elaboration based on the IDB-CIAT database (2017).

In particular, in LAC tax revenues from natural resources are especially important, and this differentiates it from other regions. This is one of the reasons for their inclusion in the calculation of EFP. Not all LAC countries have natural resources, but the majority of them do. Figure 17 shows tax revenues from nonrenewable natural resources from several LAC countries, which illustrates the importance of these revenues for the governments of these countries.

**Figure 17. Tax Revenue from Nonrenewable Natural Resources (2015 USD, in billions)**

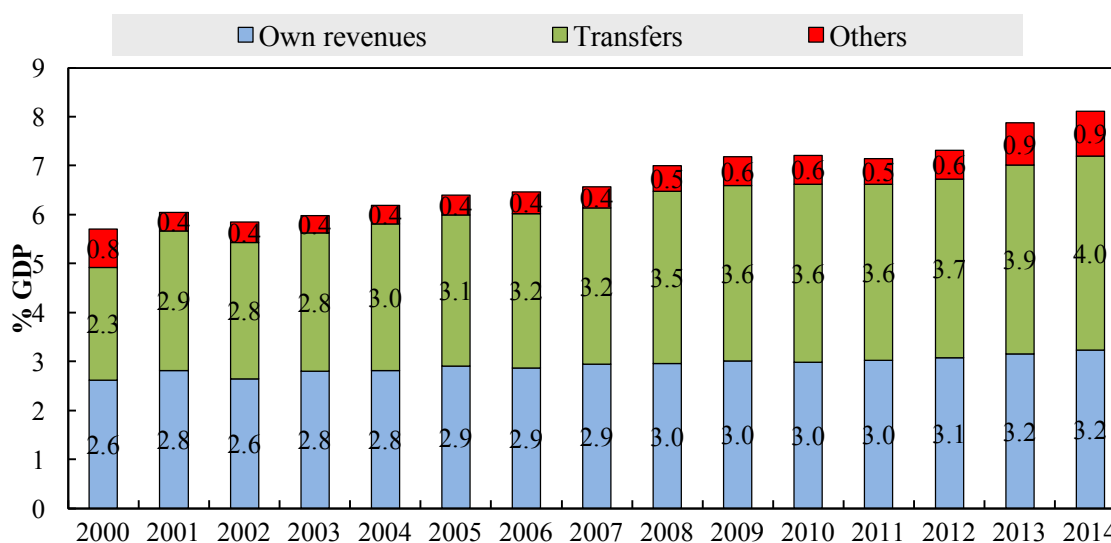


Source: OECD/ECLAC/CIAT/IDB (2017).

## 5. Subnational Governments

Thanks to the details of the IDB-CIAT database (2017), one may make an analysis even at the level of subnational governments. Figure 18 shows the increased importance of transfers within total revenues. Several LAC countries are greatly dependent on the system of transfers from the central government toward local governments. In spite of this, the subnational governments' own revenues have increased from 2.6 percent of GDP to 3.2 percent. This shows an improvement, although small, in tax decentralization.

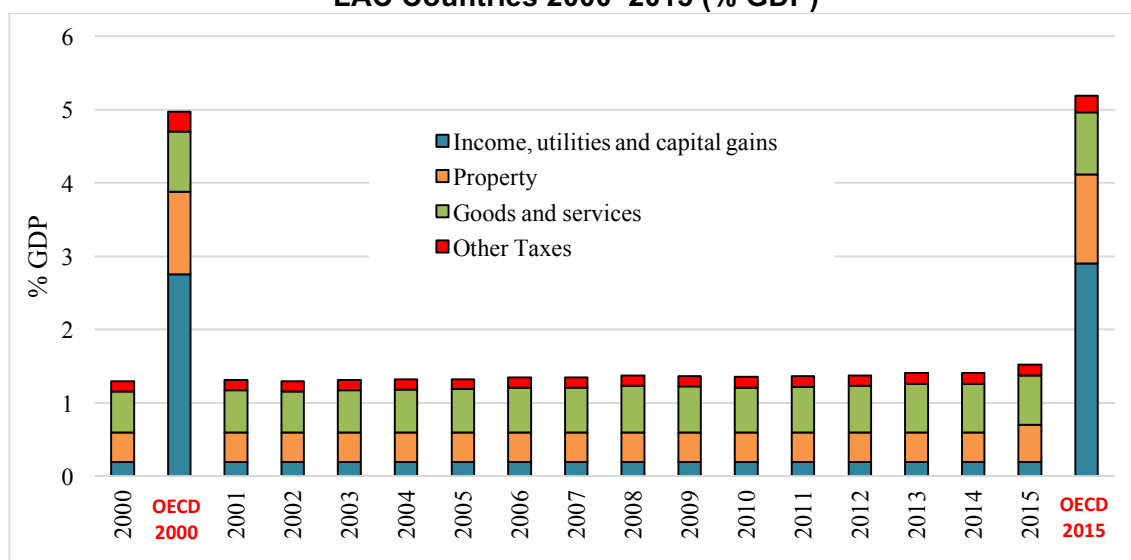
**Figure 18. Source of Income from Subnational Governments in LAC Countries, 2000–2014 (% GDP)**



Source: OECD/ECLAC/CIAT/IDB (2017).

Figure 19 shows that tax collection by subnational governments is quite a bit lower in LAC countries when compared with OECD countries. As mentioned in the previous paragraph, increases in the subnational governments' own revenues have been small. In addition, in Figure 19 one may perceive that improvement has been due to property taxes. Again, revenues from property, especially real estate, and not having additional taxation of income of enterprises and individuals at the subnational level, makes these government levels very dependent on transfers from the central government.

**Figure 19. Tax Revenue of Subnational Governments According to Tax Type, LAC Countries 2000–2015 (% GDP)**



Source: OECD/ECLAC/CIAT/IDB (2017).

## 6. Estimations of Buoyancies in the LAC Region<sup>3</sup>

In this section, the EFP database will be used as input for estimating the buoyancy of tax revenues (EFP) in select LAC countries. This exercise serves two purposes: (i) to show the potential of the database for empirical tax analysis, as well as (ii) make a first estimation of the buoyancy of the IDB-CIAT EFP for LAC countries.

An unbalanced data panel will be used, with annual periodicity for 23 LAC countries in the period 1990–2015.<sup>4</sup> We are also interested in analyzing the change in buoyancies for LAC subgroups. We will specifically analyze four groups: (1) Central America, Panama, and the Dominican Republic (CA+PN+DR); (2) Venezuela, Colombia, Bolivia, Ecuador, and Peru (Andean); (3) Belize, Trinidad and Tobago, Jamaica, Barbados, and Bahamas (Caribbean); and (4) Chile, Mexico, Brazil, Paraguay, Uruguay, and Argentina (Mercosur+CH+MX). These groups were determined according to the similarities of the different economies.

According to Liu and Poplawski-Ribeiro (2015), long-term buoyancy measures the stable relationship between the tax burden and the growth of the economy throughout a broad time horizon. This will depend on the economic structure and improvements in tax policy and administration, among other variables. In particular, a long-term buoyancy greater than one would imply that a greater economic growth would improve tax resources, and

<sup>3</sup> To see the econometric details, consult Annex 3.

<sup>4</sup> Tables A.1 and A.2 of Annex 5 show the source and general information of the data used.

the opposite would be true if the elasticity were less than one. To have estimates from this indicator is important because of the impact of economic growth on revenue generation and, accordingly, on long-term tax sustainability through genuine resources (Beling et al., 2014).

On the other hand, short-term buoyancy is related to the stabilizing function of tax policy. Specifically, if the short-term buoyancy is close to one, the tax system is a good automatic stabilizer of tax revenues. On the other hand, if the short-term buoyancy differs significantly from one, then the taxes are more unstable than the economy and its function for stabilizing society's available revenue is lower. The following equation was used to calculate the magnitude of buoyancies in LAC:

$$\Delta EFP_{it} = \phi_i(EFP_{i,t-1} - c_i - \theta'_i X_{i,t-1}) + \delta'_{i0} \Delta X_{it} + \varepsilon_{it} \quad (1)$$

With  $X_{it} = (\ln(RGDP_{it}), \ln(Def_{it}), \ln(TOT_{it}))'$ , where  $EFP_{it}$  is the Equivalent Fiscal Pressure,  $RGDP_{it}$  the real GDP,  $Def_{it}$  the GDP deflator, and  $TOT_{it}$  the terms of trade. Equation (1) captures the short-term corrections in the EFP to achieve balance in the long term.<sup>5</sup> The inclusion of  $RGDP_{it}$  corresponds to an approximation of the relevant tax base for calculating buoyancy.  $Def_{it}$  is included to estimate either the Olivera-Tanzi effect (Tanzi, 1978), which deteriorates actual tax collection and its delay with respect to prices, or its nonexistence due to inflation of the business tax. In the opposite sense, there may be the bracket creep effect, which increases collection due to increases in inflation because it drags nominal wages to higher tax brackets (Liu and Poplawski-Ribeiro, 2015).

Lastly, we consider the  $TOT_{it}$ s important within the explanatory variables. On the one hand, for economies that are greatly dependent on the export of commodities, if the  $TOT_{it}$ s improve, it is to be expected that revenues will increase. On the other hand, the inclusion of the  $TOT_{it}$ s is also important even for countries without natural resources to exploit. For example, if a country grants significant tax benefits to exporting sectors (e.g., free zones in Central America and Dominican Republic), an increase in  $TOT_{it}$ s may cause a change in the productive structure (long-term effect) toward exporting sectors and rather have a negative effect on tax revenues (Liu and Poplawski-Ribeiro, 2015). Buoyancy estimators for LAC are calculated through the Mean-Group (MG) estimators because this methodology allows for assuming that the buoyancies are heterogeneous

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<sup>5</sup> This is a classic representation of the VEC error correction equation. For additional details on the short- and long-term relationships and the derivation of equation (1), consult Annex 3.

among countries.<sup>6</sup> Table 1 shows the results of estimates for LAC as a single group and the aforementioned subgroups.

**Table 1. Estimation Equation (1), LAC and Subgroups**

Variable	LAC	Andean	CA+PN+DR	Caribbean	Mercosur+CH+MX
<b>Long Term</b>					
<b>Buoyancy</b>	<b>1.34***</b>	<b>1.46***</b>	<b>0.79***</b>	<b>1.17**</b>	<b>1.94***</b>
<i>Def<sub>it</sub></i>	1.36***	1.43***	1.45***	0.59	1.80***
<i>TOT<sub>it</sub></i>	0.08	0.11	-0.12	0.37	0.069
<b>Short Term</b>					
<b>Buoyancy</b>	<b>0.86***</b>	<b>1.02***</b>	<b>0.67**</b>	<b>0.84**</b>	<b>0.96***</b>
<i>Def<sub>it</sub></i>	0.79***	0.77***	0.92***	0.50*	0.89***
<i>Def<sub>it-1</sub></i>	-0.18**	-0.36**	-0.15	0.15	-0.35**
<i>TOT<sub>it</sub></i>	0.04	0.082	-0.02	0.122	0.01
<i>TOT<sub>it-1</sub></i>	-0.02	0.13**	-0.12	0.05	-0.08

Source: Authors' elaboration. Standard errors in parentheses. Significance at 1 percent,\*\*\* 5 percent,\*\* and 10 percent.\*

The results show that the long-term buoyancy for LAC is 1.34, which means that tax revenues react above the economic growth. This is an indication of long-term tax sustainability for the LAC region as a whole. Nevertheless, there is heterogeneity in  $EF_{it}$  buoyancy by group. While in CA+PN+DR the buoyancy is lower than the unit, in Mercosur+CH+MX it is almost two. In Central America, there is evidence of long-term collection weakness, while in Mercosur the expanded buoyancy could reflect progress in tax administration and a thrust of the tax burden in tax policy in the past 25 years. In the Andean and Caribbean cases, one finds buoyancies that are greater than the unit, although in magnitudes that are mostly similar to the LAC total.

On the other hand, the short-term buoyancy for LAC is estimated at 0.86, probably due to the great proportion of consumption taxation. The same situation applies in the case of the subgroups. In fact, Corbacho, Fretes Cibils, and Lora (2013) note that the automatic stabilizers on the revenue side are relatively small and ineffective in LAC, which is consistent with our results.<sup>7</sup>

In the case of inflation, there is a positive effect in tax revenues in the long and short term. In fact, this could be explained by the carryover effect in the long-term tax bracket,

<sup>6</sup> We cannot assume a priori that buoyancies are the same for all the countries. For a discussion thereon, see Annex 3.

<sup>7</sup> It is important to point out that estimations are similar to those obtained by Martner (2006), Machado and Zuloeta (2012), and Cardoza (2017) because in the first place, the long-term effects were superior to the short-term ones and, in addition, the magnitudes are similar. In a strict sense, the comparison cannot be direct, because the authors of the studies mentioned calculate buoyancies and elasticities country by country and not as a single group. Nevertheless, on obtaining a simple average of short- and long-term effects, it is seen that Martner (2006) found effects in the order of 0.79 and 1.47, Machado and Zuloeta (2012) 0.73 and 1.49, and Cardoza (2017) 0.77 and 1.31 within the short and long term respectively. It must be mentioned that these studies used either the tax burden or the tax revenues, but not EFP.



but a negative effect in the short-term due to the Olivera-Tanzi effect. Lastly,  $TOT_{it}$ s present a positive effect in the short as well as long term. Nevertheless, these effects are not significant. It is important to point out that the  $TOT_{it}$ s contemporary effect is positive for all the groups except for Central America. The negative sign could be explained by the fact that an improvement in the  $TOT_{it}$ s causes a deviation of the economic activity toward exporting sectors with tax benefits. Only the delayed effect of the  $TOT_{it}$ s in the Andean countries was found to be significant.<sup>8</sup>

## 7. Conclusions

The tax database for the LAC region developed by the IDB and CIAT shows significant innovations in relation to existing databases; that is: (i) it introduces the EFP concept, which complements the traditional revenues from taxation, plus all obligatory social security contribution systems (public and actuarial private) and freely available government revenues from natural resources; and (ii) provides expanded information on the fiscal situation of the different government levels and different taxes.

The new resources (NR) added to the EFP are “private” obligatory social security contributions and revenues obtained from natural resources. With respect to the former, the highest average figures in 2011–2015 are found in Chile (4.4 points of GDP), Bolivia (3.6), Uruguay (3.4), and Costa Rica (3.0). As for the latter, worth noting are Trinidad and Tobago (10.4 points of GDP), Bolivia (4.0), and Venezuela (3.4).

The sum of both resources implies an LAC average of 2.7 points of GDP, with a maximum in Trinidad and Tobago (10.4 points of GDP) followed by Bolivia (7.6) and Chile (5.1). On the other hand, in the Bahamas, Barbados, Belize, Honduras, Jamaica, and Nicaragua, they are not significant.

If one compares LAC revenues with those of the OECD, the results are very different regardless of whether these new resources are taken into account. In simple average for 2015, LAC tax resources are 21.7 percent of GDP, and 34.7 percent in the OECD. If one considers EFP with its new resources, the LAC average is 24.4 percent; if weighted,<sup>9</sup> it amounts to 27.5 percent (31.2 percent in the OECD); that is, the difference between OECD and LAC in tax revenues and simple average is too high—13.0 points—while in

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<sup>8</sup> One of the reasons for the non-significance of the parameters could be that the GDP variable already includes all exports, including those of natural resources, which could cause the parameter that accompanies the  $TOT_{it}$  to be biased towards zero. A possible solution can be to separate the GDP by components, and use a proxy of the tax base absorption (C+I+G) and not the full GDP.

<sup>9</sup> Weighted by the real GDP.

EFP and weighted mean it is reduced to only 3.7 points. If compared with the countries with average revenue in the rest of the world, LAC is very close to the average.

According to the figures, in LAC 2011–2015, on average, the greater revenues correspond to general consumption taxes (6.7 points of GDP), followed by income taxes (6.1) and public social contributions (3.6). At the other extreme are property taxes (0.7), obligatory private contributions (1.2), and selective taxes on consumption (1.7). In all, there are significant differences between the LAC countries in relation to each of the main elements.

On average, there has been a considerable increase since the beginning of the past decade under the influence of the commodities supercycle, in EFP as well as in tax revenues: 4.0 and 3.4 points of GDP between 2000–2004 and 2011–2015, respectively. Increases have taken place in Bolivia, Argentina, and Ecuador, while the most modest results have taken place in Venezuela, Guatemala, and Barbados, with an increase of approximately one point.

However, this increase in EFP has not been homogeneous in all the elements that comprise it. There are significant increases in income taxation and in general consumption taxes and public social contributions, while the decrease in selective taxes on consumption is noteworthy.

Consequently, in the LAC average there is greater participation in total revenues from income taxation and public social contributions and a decrease in selective taxes on consumption.

In income taxation, the greater increases occur in Bolivia and Peru, while in Barbados and Jamaica there are even decreases. In general consumption taxation, the greater increases take place in Venezuela and Paraguay, while there is a decrease in Trinidad and Tobago. The greater increases in selective taxes on consumption occur in the Dominican Republic and Jamaica, and the greater decreases take place in Mexico and Trinidad and Tobago.

In the particular case of selective taxes on consumption, although there has been a decrease in all the main figures, there has been a clear decrease in fuel, which has occurred in all the countries except for the Dominican Republic, and especially so in Mexico, Bolivia, and Peru.

Lastly, as an example of the use of the database, this study made a first approximation of the buoyancy of the short- as well as long-term EFP. The exercise covered LAC in its

entirety as well as subgroups of countries. The following subgroups were determined in this exercise: Central America (Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, Panama, and Dominican Republic), Caribbean (Bahamas, Barbados, Belize, Jamaica, and Trinidad and Tobago), Mercosur + Chile + Mexico (Argentina, Brazil, Chile, Mexico, Paraguay, and Uruguay), and Andean countries (Bolivia, Colombia, Ecuador, Peru, and Venezuela).

The results show that LAC has an estimated long-term buoyancy of 1.34, while short-term was estimated at 0.86. The subgroups show long-term buoyancies of 1.46, 0.79, 1.17, and 1.94 for the Andean countries, Central America, Caribbean, and Mercosur, respectively. The short-term buoyancies of the subgroups were estimated at 1.02, 0.67, 0.84, and 0.96 for the Andean countries, Central America, Caribbean, and Mercosur, respectively. The long-term buoyancies greater than the unit show advances of the tax administration as well as of the tax burden. While those that are less than one (only Central America) show a lower collection. In the case of short-term buoyancy, it is less than the unit for the majority of the subgroups, thereby showing that individual income taxes are low and there is a high participation of consumption taxation.

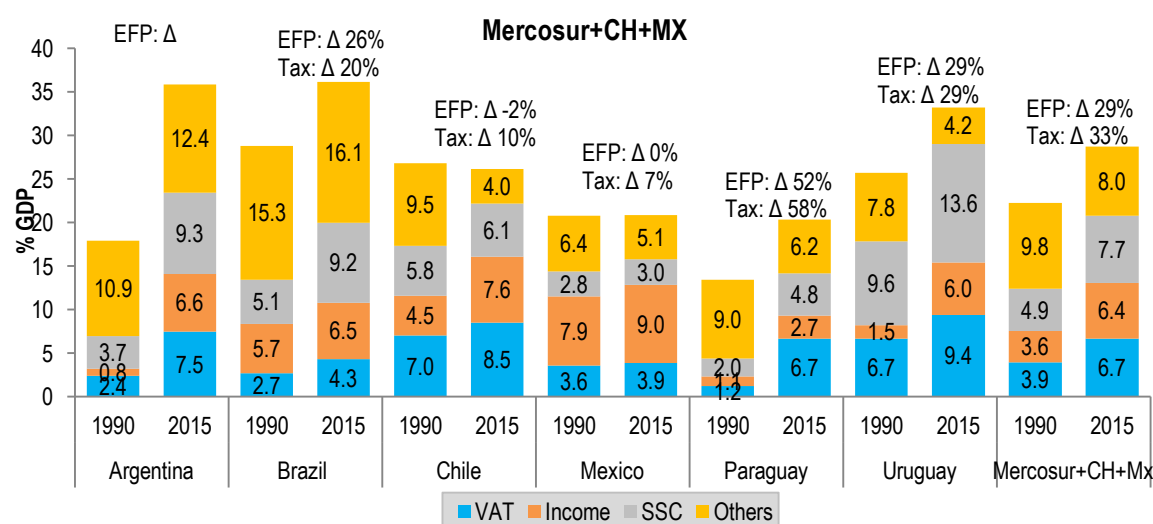
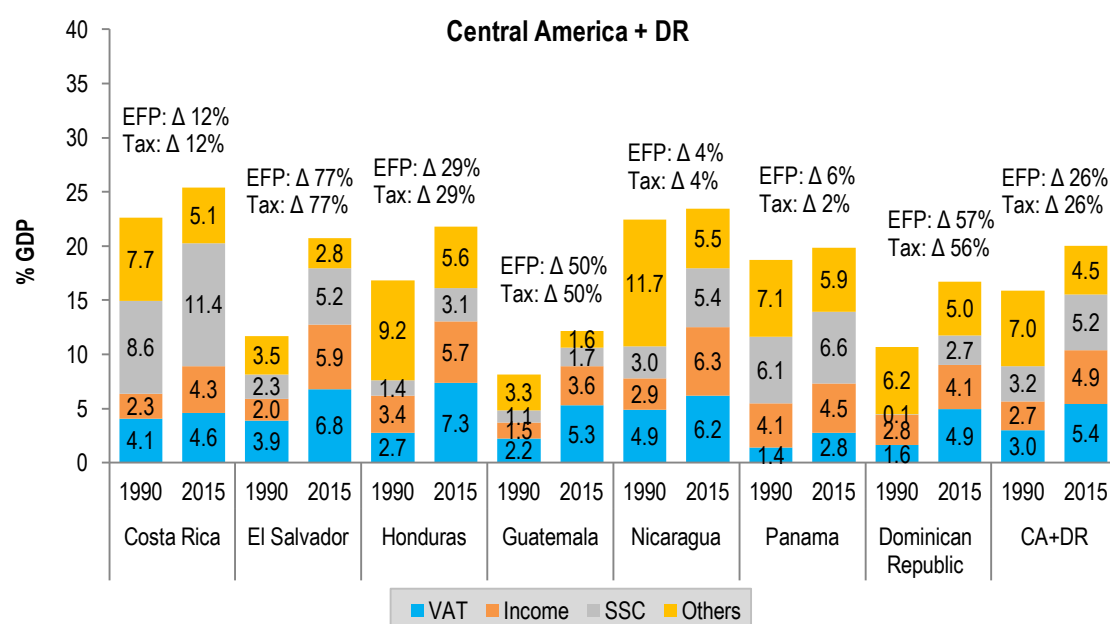
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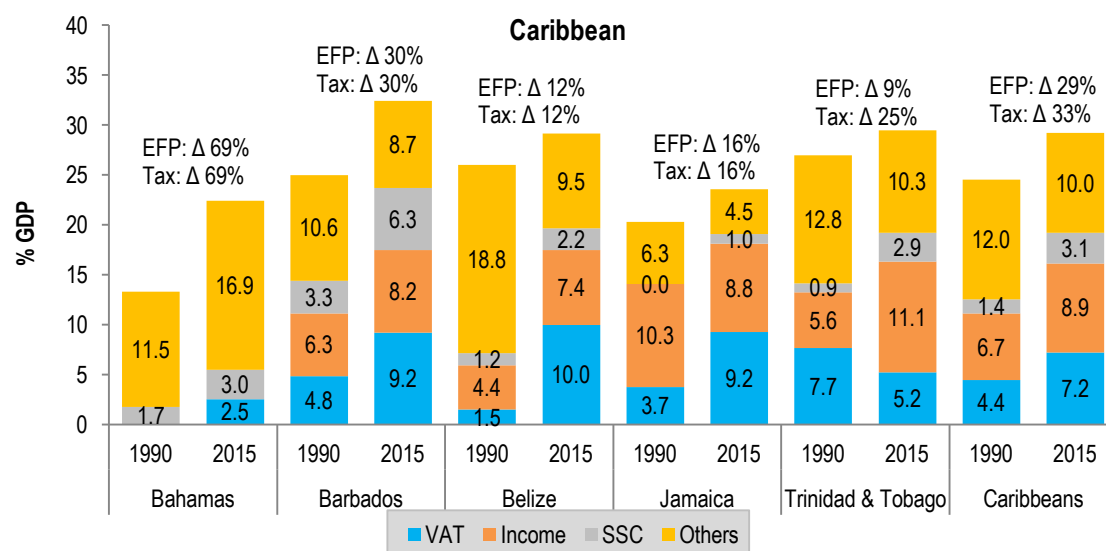
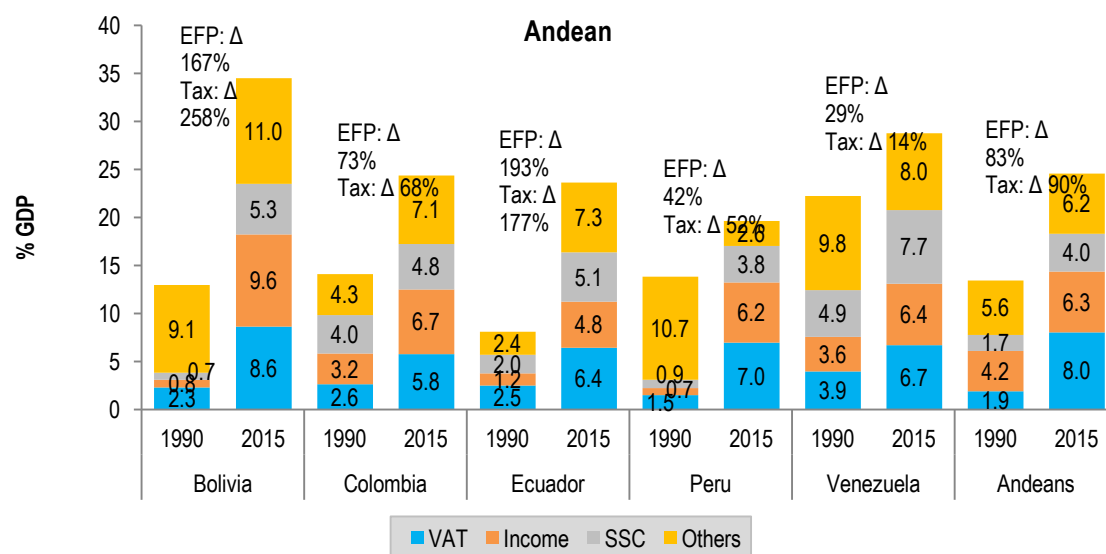
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## Annexes

### Annex 1. Evolution of Main Taxes in Latin America and the Caribbean, 1990 Versus 2015





## Annex 2. General Comments

The figures collected in the present report cover a series of changes in the aggregates from the original data offered in the IDB-CIAT database. As a followup, a range of comments and general or specific changes are indicated for each country in respect to the original database.

**1.** The concept of tax revenue collected in this document is the EFP minus the private compulsory contributions (actuarial) and the income derived from the exploitation of natural resources.

**2.** For the countries where it is possible, the different tax categories have been aggregated, including those collected by the central government as well as those collected by subnational governments. This affects mostly the property taxes and in some cases the VAT and selective taxes on consumption.

**3.** Selective taxes on consumption on beverages, tobacco, and fuels are the aggregates of various modalities (beer, alcohol, cigarettes, tobacco, special fuels, normal fuels, etc.).

### **Specific Comments**

#### Ecuador

The income of individuals and legal entities in the original database does not include withholdings and advances, which appear separately but jointly. To add them, such withholdings and advances (WA) have been separated first, depending on the weight that individuals and legal entities have in the data, i.e.,  $r_n = \text{IIT} / (\text{IIT} + \text{CIT})$  and  $r_j = \text{CIT} / (\text{IIT} + \text{CIT})$ , where IIT and CIT are the direct income (without including withholdings and advance payments) of individuals and legal entities, respectively. Then the withholdings and advance payments assigned in this way have been added to the direct income of each category, i.e.,  $r_n * \text{WA}$  and  $r_j * \text{WA}$ .

#### El Salvador

Regarding the individual and legal income withholdings and the refunds for the income tax, the same procedure has been used as in Ecuador.

Regarding the Contribution to the Stabilization and Economic Development Fund, given that it is a special tax on gasoline created at the time to finance the costs of the armed conflict and currently used to subsidize domestic gas consumption, it has been included in selective and, therefore, in taxes.

#### Honduras

The temporary solidarity contribution and the tax on net assets have been added to the corporate income tax.

#### Jamaica

The education tax has been added to the individual income tax.



## Nicaragua

The special tax for the road maintenance fund, which taxes the fuels, has been included among selective taxes on consumption.

Regarding the data of medium-income countries (Figure 5), various sources have been used: national administration, ADB, IMF, AfDB, OECD (revenue statistics in Africa), and ICTDGRD database.

### **Annex 3. Econometric Details**

#### **A.3.1 Short- and Long-Term Buoyancies**

For the tax policy, it is important to differentiate the short-term and long-term buoyancies, because the long-term is an indicator of tax sustainability, while the short-term buoyancy reflects the cyclic variability of tax revenues (Sobel and Holcombe, 1996). In particular, we want to study the short- and long-term buoyancies for the LAC case, as well as for the subgroups of countries. What makes this specific exercise is innovative is using the Equivalent Fiscal Pressure, because it is the tax revenues indicator relevant for the LAC countries due to the importance of natural resources.

According to Liu and Poplawski-Ribeiro (2015), long-term buoyancy measures the stable relation between collection and economy for a broad horizon of time. This will depend on economic structure and improvements in tax collection, among other variables. In particular, a long-term buoyancy greater than one would imply that greater economic growth would improve the fiscal balance in terms of revenues, and the opposite will be true if the elasticity is less than one. Having estimations of this indicator is important because of the impact of economic growth on long-term fiscal sustainability (Beling et al., 2014). With panel data methodology, we can count on a long-term buoyancy measure for LAC as a whole as well as for subgroups of countries.

On the other hand, the short-term buoyancy is related to the stabilizing function of fiscal policy. Specifically, if the short-term buoyancy is greater than one, the tax system is a good automatic stabilizer. By contrast, if the short-term buoyancy is less than one, then taxes are more stable than the economy and their stabilizing function is lower. In this exercise, thanks to the panel data methodology, we can count on an aggregate measure of tax-stabilizing function in LAC and the subgroups of countries.

To estimate the short- and long-term buoyancies, we will use the panel version of the distributed lag model ARDL of Liu and Poplawski-Ribeiro (2015). Specifically, we want to estimate an ARDL (1, 1, ..., 1) in the following form:

$$y_{it} = \lambda_i y_{i,t-1} + \delta'_{i0} \mathbf{X}_{it} + \delta'_{i1} \mathbf{X}_{it-1} + \mu_i + \varepsilon_{it} \quad (A.1)$$

Where  $y_{it}$  is the natural logarithm of the real tax revenues and  $\mathbf{X}_{it}$  is a vector that contains the natural logarithm of the control variables. This vector contains the real GDP (as a proxy of the relevant base) plus other controls that will be discussed later;  $\mu_i$  is the constant that would vary only by country (country fixed effect), and  $\varepsilon_{it}$  is the error term. Equation (1) can be transformed into an Error Correction Model (ECM) to study the short-term relationships as follows:<sup>10</sup>

$$\Delta y_{it} = \phi_i (y_{i,t-1} - c_i - \theta'_i \mathbf{X}_{it-1}) + \delta'_{i0} \Delta \mathbf{X}_{it} + \varepsilon_{it} \quad (\square.2)$$

### A.3.2 Variables

First, the dependent variable will be the tax revenues in real terms measured by the Equivalent Fiscal Pressure ( $EFP_{it}$ ). Regarding the explanatory variables, first, the Real Gross Domestic Product ( $RGDP_{it}$ ) will be used as a proxy for the relevant tax base of the real tax revenues.

Additionally, GDP deflator will be included as a relevant price index for the tax revenue ( $Def_{it}$ ). The inclusion of this variable seeks to study how the real incomes of the treasury are eroded by price increases, which is known as the Olivera-Tanzi effect (Tanzi, 1978). In particular, this variable is important for LAC because it is usual to find countries with periods of high inflation. On the other hand, as mentioned by Liu and Poplawski-Ribeiro (2015), the effect of “drag in the tax bracket”<sup>11</sup> can also be captured. This effect occurs when inflation pushes nominal wages to higher tax brackets, and therefore to an increase in collection, or there are no adjustments for inflation in corporate income.

Finally, we consider important to add the terms of trade ( $TOT_{it}$ ) within the explanatory variables, just like Liu and Poplawski-Ribeiro (2015). On the one hand, for economies that depend significantly on exportation (or importation) of commodities, the terms of trade can have a significant effect on tax revenues. As mentioned in previous paragraphs, for several LAC countries, tax revenues for the exploitation of natural resources freely available to the government—especially mining and oil resources, but also renewable resources, such as hydroelectric power plants in Paraguay or the Panama Canal—are significant for half of the Latin American economies. If the terms of trade improve for any of these countries, it is expected that revenues from natural

<sup>10</sup> In Annex 3 the derivation of equation (2) from equation (1) is shown.

<sup>11</sup> Bracket creep effect.

resources will increase. In other words, we would expect a real increase in the Equivalent Fiscal Pressure.

On the other hand, the inclusion of terms of trade is also important even for countries that do not have natural resources to exploit, freely available to the government. For example, if a country grants important fiscal benefits to exportation sectors, an increase in the terms of trade may cause a change in the productive structure (long-term effect) towards export sectors, and have rather a negative effect on the tax revenues. This could happen with small economies as is the case of some Central American countries that do not depend so much on income from available natural resources but have adopted strategies of opening to international markets and promotion of the export sector, granting, among other facilities, fiscal benefits (e.g., duty-free-zone regimes).

The inclusion of the terms of trade may be debatable. On the one hand, the price of commodities could be considered a variable that better reflects the dynamics of fiscal revenues related to the exploitation of natural resources. However, LAC commodity-exporting countries exploit different natural resources, and therefore an indicator should be constructed that summarizes the aggregate dynamics of commodity prices relevant to each country; this document has not set such a scope, but rather may constitute a first step. On the other hand, if such an indicator is made, it may not be appropriate for countries that are not commodity exporters. Finally, the terms of trade may not reflect all the relevant dynamics of fiscal revenues from exploitation of natural resources, because the export (or import) of commodities in a country would not just depend on the price, but also the price elasticity of demand, substitute goods, and the dynamics of international markets. We believe that this topic can be better analyzed later in other studies.

### **A.3.3 Methodology**

As discussed in previous paragraphs, short- and long-term buoyancies will be estimated using the panel version of the heterogeneous dynamic Vector of Error Correction (VEC). The buoyancies can be estimated either heterogeneously for each country and then calculate an aggregate of this indicator, by the mean-group estimator (MG) developed by Pesaran and Smith (1995), or homogeneously for all countries via the pooled mean-group (PMG) estimator proposed by Pesaran, Shin, and Smith (1999).

Regarding the MG indicator, the equations for each country are estimated separately, then the indicator of the group of countries is the average of these separate estimates. The strength of this method is that it assumes heterogeneity of short- and long-term

elasticities between countries. Pesaran and Smith (1995) show that MG provides consistent estimators of the average coefficients of the group in question. In this sense, the coefficients can be interpreted as the average buoyancy of tax revenues with respect to the explanatory variables.

On the other hand, the PMG estimator assumes that short-term buoyancies, intersection, equilibrium correction parameters are heterogeneous between countries. However, they are restricted to be homogeneous among all countries. This methodology also generates consistent estimators like MG; however, if the assumption of homogeneity of long-term buoyancies is not met, then the long-term estimator would no longer be consistent and the magnitude of the error correction parameter would also be underestimated.

In this document, we will use the MG methodology because we do not find a priori elements to suppose that long-term buoyancies are homogeneous for LAC countries. In fact, the economic structure and tax framework of Central American countries is very different from that of South American or Caribbean countries. Therefore, it would not be prudent to assume a priori that long-term buoyancies are homogeneous in the LAC countries.<sup>12</sup>

### **A.3.4 Data**

An unbalanced panel will be used on an annual basis for 23 Latin American countries for the period 1990–2015. Tables 7 and 8 of Annex 5 show the source and general information of the data used. In addition, we are interested in studying how buoyancies change for LAC subgroups; specifically, we will study 4 groups: 1) Central America, Panama, and the Dominican Republic (CA+PN+DR), 2) Venezuela, Colombia, Bolivia, Ecuador, and Peru (Andean), 3) Belize, Trinidad and Tobago, Jamaica, Barbados, and the Bahamas (Caribbean), and 4) Chile, Mexico, Brazil, Paraguay, Uruguay, and Argentina (Mercosur+CH+MX).

### **A.3.5 Results**

Before estimating the model, unit root tests will be carried out using the Im, Pesaran, and Shin test (2003). In this test the null hypothesis is that all countries have a unitary root, while the alternative is that for some countries the series are stationary. The results show that for all cases there is sufficient evidence to say that in all countries these variables

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<sup>12</sup> Strictly speaking, the procedure in these cases would be to calculate the MG estimator and the PMG and then do a Hausman test to decide on one model or the other. However, the objective of this document is to show the potential of the database prepared by IDB and CIAT (2017), rather than the exhaustive study of all the buoyancies in LAC.

are  $I(1)$  (integrated in order one). Table 2 shows the statistic of Im, Pesaran, and Shin (2003) and its probability value for the four variables used.

**Table 2. Unit Root Test of Variables at Level**

Variable	IPS Statistics	p-value
$\ln (EFP_{it})$	3.64	0.999
$\ln (RGDP_{it})$	3.70	0.999
$\ln (Def_{it})$	0.32	0.624
$\ln (TOT_{it})$	0.18	0.571

Source: Authors' elaboration.

Taking the first differences of the variables, we find they are all  $I(0)$  (stationary). Table 3 shows the results of the unit root test of Im, Pesaran, and Shin (2003) for the variables in first difference. So we have the preconditions for a cointegration analysis and to study the long-term equilibrium relationships.

**Table 3. Unit Root Test of Variables in First Difference**

Variable	IPS Statistics	p-value
$\ln (EFP_{it})$	-11.86	0.000
$\ln (RGDP_{it})$	-9.21	0.000
$\ln (Def_{it})$	-8.93	0.000
$\ln (TOT_{it})$	-11.29	0.000

Source: Authors' elaboration.

Next, the panel data cointegration test of Pedroni (2004) was carried out because it allows heterogeneity in the cointegration vectors and this is suitable for the MG methodology.<sup>13</sup> The null hypothesis is that there is no cointegration, while the alternative is that all panels (countries) are cointegrated.

Specifically, this test allows for the assumption that all countries have different slope coefficients. In this way, the estimated residuals are calculated, and then it uses the traditional tests of unit root to corroborate if these are  $I(0)$ , namely Dickey-Fuller (DF), Augmented Dickey-Fuller (ADF), and Phillip-Perron (PP).<sup>14</sup>

Table 4 shows the results of the Pedroni test (2004) using different specifications and tests. In this case, the EFP is included as dependent variable, and as dependents the Real GDP, the GDP deflator, and terms of trade. All variables in natural logarithm. Basically, we are going to measure if there is a long-term relation between the EFP and the other variables.

<sup>13</sup> Eventually, if a cointegration test is required assuming that the cointegration vectors are homogeneous, the methodology of Kao (1999) can be used. However, this test would be more indicated when the PMG methodology is used, and it was not used here for the reasons explained above.

<sup>14</sup> It is important to note that the heterogeneity of the Pedroni test (2004) lies in the fact that it allows the Autoregressive Coefficients (AR) to vary by panel (country).

**Table 4. Panel Cointegration Test: Probability Values<sup>15</sup>**

Specification <sup>16</sup> \ Test	DF	ADF	PP
NT+C	0.0000	0.0000	0.4221
NT+C+NM	0.0000	0.0000	0.4665
T+C	0.0000	0.0000	0.0326
T+C+NM	0.0000	0.0000	0.0465
NT+NC	0.0000	0.0001	0.4705
NT+NC+NM	0.0000	0.0000	0.4924

Source: Authors' elaboration.

The results in Table 4 show that in all the cases of the Dickey-Fuller and Augmented Dickey-Fuller tests, there is clear evidence of cointegration. In other words, if we use these tests, we can affirm that the Equivalent Fiscal Pressure, the real GDP, the GDP Deflator, and the terms of trade present a stable equilibrium relation in the long term for all LAC countries. The specifications for the Phillip-Perron test, however, are not as conclusive as the previous two. In fact, only in two cases can we affirm that cointegration exists with a level of significance of 5 percent.

Taking into account all the tests, we find that in 14 of 18 different specifications there is evidence in favor of the alternative hypothesis of cointegration, so that the evidence points to the fact that the variables present an equilibrium relation in the long term. In other words, the relationship specified in equation (1) can be said to be non-spurious, and calculate long-term buoyancies.

Since we find this relationship stable, we can proceed to calculate the Vector of Error Correction (VEC) that is specified in equation (2). We can rewrite equation (2) in the following way in terms of the variables that will be used:

$$\Delta EFP_{it} = \phi_i(EFP_{i,t-1} - c_i - \theta'_i X_{i\Box-1}) + \delta'_{i0} \Delta X_{it} + \varepsilon_{it} \quad (A.3)$$

Where  $X_{it} = (\ln(RGDP_{it}), \ln(Def_{it}), \ln(TOT_{it}))'$ . Table 5 shows the results of the estimation of equation (3) of the long- and short-term buoyancies for the entire sample of LAC countries. The results show that the long-term buoyancy is 1.34, which means that fiscal revenues react beyond economic growth, meaning that for every 1 percent of economic growth the EFP grows 1.34 percent. This is an indication of long-term fiscal sustainability on the revenue side for the LAC region as a whole.

<sup>15</sup> For all cases a quadratic kernel was used, the Akaike Information Criterion (AIC) to determine the lags and consistent errors of Newey-West.

<sup>16</sup> T: trend; NT: without trend; C: with constant; NC: without constant; NM: without cross-sectional mean.

**Table 5. Estimation Equation (3), LAC Complete Sample**

Variable	LAC
<b>Long Term</b>	
$\ln (RGDP_{it})$	1.34*** (0.264)
$\ln (Def_{it})$	1.36*** (0.272)
$\ln (TOT_{it})$	0.08 (0.109)
<b>Short Term</b>	
$\Delta \ln (RGDP_{it})$	0.86*** (0.151)
$\Delta \ln (RGDP_{it-1})$	-0.44*** (0.144)
$\Delta \ln (Def_{it})$	0.79*** (0.104)
$\Delta \ln (Def_{it-1})$	-0.18** (0.091)
$\Delta \ln (TOT_{it})$	0.04 (0.046)
$\Delta \ln (TOT_{it-1})$	-0.02 (0.071)
TCE	-0.68*** (0.049)
Constant	-5.37*** (0.718)

Source: Authors' elaboration.

Note: Standard errors in parentheses. Significance at 1 percent,\*\*\* 5 percent,\*\* and 10 percent.\*

On the other hand, Table 5 shows that the short-term buoyancy for LAC is estimated at 0.86, or said another way, when there is economic growth of 1 percent, the fiscal revenues due to EFP grow 0.86 percent.

Finally, it is important to mention that the estimates are similar to those obtained by Martner (2006), Machado and Zuloeta (2012), and Cardoza (2017), although they were made by individual country, first because the long-term effects were higher than the short-term and, in addition, the magnitudes are similar.<sup>17</sup>

On the other hand, in the case of inflation, it is found that there is a positive effect on the tax revenue in the long and short term. This effect could be explained by the bracket creep effect on personal income and the lack of adjustment for inflation in corporate income in several LAC countries.

<sup>17</sup> Strictly speaking, the comparison cannot be direct because the authors in the aforementioned studies calculate the country-by-country buoyancies and elasticities and not as a single group. However, obtaining a simple average of the short- and long-term effects shows that Martner (2006) found effects of the order of 0.79 and 1.47, Machado and Zuloeta (2012) of 0.73 and 1.49, and Cardoza (2017) of 0.77 and 1.31 in the short and long term, respectively. It is necessary to clarify that these authors did not use the EFP, but other fiscal revenue measures.

Finally, the terms of trade have a positive effect in both the short and the long term. This is expected in LAC, as many of its countries are net exporters of commodities, so it would be expected that an improvement in the terms of trade will lead to an improvement in revenue. However, these effects are not significant and this could be due to two factors: (i) there are countries within the sample that are not exporters of commodities and therefore cannot extract fiscal resources from the exploitation of natural resources (e.g., Central America and the Caribbean); and (ii) the export supply has diversified in several LAC countries.

Finally, the same effects will be studied but for the groups of LAC countries that were defined in section 6. Table 6 shows the results of the estimates for these groups. The first result that we can see is the heterogeneity of the buoyancy of the EFP according to the group. While in Central America the buoyancy is less than one, in the expanded Mercosur it reaches almost two. In Central America, there is evidence of a lack of income in the long term, while in Mercosur the buoyancy could be reflecting an improvement in fiscal policy and tax administration in the last 25 years. In the case of the Andean countries and the Caribbean, the buoyancies are greater than one, but in magnitudes more similar to the total of LAC.

**Table 6. Estimation Equation (3), LAC Subgroups**

Variable	Andean	CA+PN+DR	Caribbean	Mercosur+CH+MX
<b>Long Term</b>				
$\ln(RGDP_{it})$	1.46*** (0.487)	0.79*** (0.337)	1.17** (0.485)	1.94*** (0.656)
$\ln(Def_{it})$	1.43*** (0.139)	1.45*** (0.488)	0.59 (0.412)	1.80*** (0.681)
$\ln(TOT_{it})$	0.11 (0.127)	-0.12 (0.216)	0.37 (0.374)	0.069 (0.096)
<b>Short Term</b>				
$\Delta \ln(RGDP_{it})$	1.02*** (0.342)	0.67** (0.278)	0.84** (0.408)	0.96*** (0.274)
$\Delta \ln(RGDP_{it-1})$	-0.66*** (0.267)	-0.65** (0.318)	0.17 (0.245)	-0.54*** (0.202)
$\Delta \ln(Def_{it})$	0.77*** (0.144)	0.92*** (0.169)	0.50* (0.284)	0.89*** (0.206)
$\Delta \ln(Def_{it-1})$	-0.36** (0.206)	-0.15 (0.160)	0.15 (0.187)	-0.35** (0.158)
$\Delta \ln(TOT_{it})$	0.082 (0.091)	-0.02 (0.10)	0.122 (0.147)	0.01 (0.34)
$\Delta \ln(TOT_{it-1})$	0.13** (0.062)	-0.12 (0.140)	0.05 (0.240)	-0.08 (0.091)
TCE	-0.57*** (0.129)	-0.75*** (0.077)	-0.65*** (0.090)	-0.69*** (0.115)
Constant	-6.63*** (1.340)	-4.25*** (1.253)	-5.57*** (1.663)	-5.61*** (1.559)

Source: Authors' elaboration.

Note: Standard errors in parentheses. Significance at 1 percent, \*\*\* 5 percent, \*\* and 10 percent.\*



In addition, it can be mentioned that the effect of inflation measured by the GDP deflator ( $Def_{it}$ ) is positive for all groups and in more or less similar magnitudes. Finally, it is important to note that the contemporary effect of the terms of trade ( $TOT_{it}$ ) is positive for all groups except for Central America. The negative sign could be explained by the fact that an improvement in the terms of trade causes a diversion of economic activity to export sectors that have tax benefits, especially duty-free zones. However, none of the contemporary effects is significant. Only the lagged effect of the terms of trade in the Andean countries was found significant. The non-significance could be explained because there may be effects that act in opposite directions.

#### **Annex 4. Derivation of the Error Correction Model (Equation (A.2)) from the Distributed Lag Model ARDL (Equation (A.1)).**

To study the equilibrium dynamics towards the long term, it is necessary to model the changes in the variable of interest. In this case we will have:

$$\Delta y_{it} = y_{it} - y_{it-1} \quad (A.4)$$

Subsequently, we can insert the equation (1) and rewrite the equation (A.4) as follows:

$$\Delta y_{it} = \lambda_i y_{i,t-1} + \delta'_{i0} \mathbf{X}_{it} + \delta'_{i1} \mathbf{X}_{it-1} + \mu_i + \varepsilon_{it} - y_{it-1} \quad (A.5)$$

That is,

$$\Delta y_{it} = (\lambda_i - 1) y_{i,t-1} + \delta'_{i0} \mathbf{X}_{it} + \delta'_{i1} \mathbf{X}_{it-1} + \mu_i + \varepsilon_{it} \quad (A.6)$$

At this point, we will define  $\phi_i = (\lambda_i - 1)$ , which would be the error correction parameter towards the equilibrium, so we can write (A.6) in the following way:

$$\Delta y_{it} = \phi_i y_{i,t-1} + \delta'_{i0} \mathbf{X}_{it} + \delta'_{i1} \mathbf{X}_{it-1} + \mu_i + \varepsilon_{it} \quad (A.7)$$

Additionally, we will define  $c_i = -\mu_i/\phi_i$ , which would be the dynamic fixed effect by country, so we can write (A.7) as follows:

$$\Delta y_{it} = \phi_i (y_{i,t-1} - c_i) + \delta'_{i0} \mathbf{X}_{it} + \delta'_{i1} \mathbf{X}_{it-1} + \varepsilon_{it} \quad (A.8)$$

Finally, to study the short-term relations between the dependent variable and the explicative variables, we proceed to the following transformation of the equation (A.8):

$$\Delta y_{it} = \phi_i (y_{i,t-1} - c_i) + \delta'_{i0} \mathbf{X}_{it} + \delta'_{i1} \mathbf{X}_{it-1} + \delta'_{i0} \mathbf{X}_{it-1} - \delta'_{i0} \mathbf{X}_{it-1} + \mu_i + \varepsilon_{it} \quad (A.9)$$

$$\Delta y_{it} = \phi_i(y_{i,t-1} - c_i) + (\delta'_{i1} + \delta'_{i0})X_{it-1} + \delta'_{i0}\Delta X_{it}\mu_i + \varepsilon_{it} \quad (A.10)$$

Defining  $\theta = -\frac{(\delta_{i0} + \delta_{i1})}{\phi_i} = \theta_i^1 \theta_i^2, \dots, \theta_i^k$ , we obtain  $\Delta y_{it} = \phi_i(y_{i,t-1} - c_i - \theta'_i X_{it-1}) +$

$$\Delta y_{it} = \phi_i(y_{i,t-1} - c_i - \theta'_i X_{it-1}) + \delta'_{i0}\Delta X_{it} + \varepsilon_{it} \quad (A.11)$$

## Annex 5. Additional Tables

**Table 7. Variable List and Source**

Variable	Description	Source
$EFP_{it}$	Equivalent Fiscal Pressure	IDB-CIAT
$RGDP_{it}$	Real GDP	WEO-IMF Database
$Def_{it}$	GDP deflator	WEO-IMF Database
$TOT_{it}$	Terms of Trade	WEO-IMF Database

**Table 8. Descriptive Statistics**

Variable	N° of countries	Minimum	Average	Maximum	N° of observations
$\ln(EFP_{it})$	23	-1.51	3.97	11.77	591
$\ln(RGDP_{it})$	23	-2.19	5.38	11.69	598
$\ln(Def_{it})$	23	-6.25	4.61	9.28	598
$\ln(TOT_{it})$	23	3.92	4.65	6.07	594