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Fiscal Sustainability of Latin American Countries Under Cross-Dependency and Structural Breaks

RESEARCH

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ABSTRACT

This work investigates the hypothesis of fiscal sustainability for 18 Latin American countries from 1991 to 2022. We applied a panel cointegration methodology to evaluate the existence of a long-term relationship between government revenue and expenditures, incorporating cross-sectional dependence and endogenously estimated structural breaks. Since Latin American economies are heterogeneous, a unified analysis was not effective. Therefore, we grouped countries according to economic, financial, and geographic features, which made it possible to handle distinct fiscal patterns among them and identify a sustainable group of 6 countries. We also provided empirical evidence for the role played by cross-dependence terms, carefully selected control variables, and the proper estimation and modelling of the breakpoints. The impacts of COVID-19 have proven to be crucial in making some countries unsustainable.

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1. INTRODUCTION

Assessing the fiscal perspectives of Latin American countries has garnered attention among researchers and policymakers, as most of these economies are characterized, to varying degrees, by a higher vulnerability to external shocks, unstable domestic situations, and a frequent risk of credit downgrades in the international market. This challenging scenario motivates the analysis of the fiscal sustainability of these countries. According to Blanchard et al. (1990), a fiscal policy is classified as sustainable if the expected present value of the primary surplus is at least sufficient to offset the current level of the public debt.

This work provides a fiscal sustainability analysis of 18 Latin American countries, based on a panel econometric approach that accounts for cross-sectional dependence and structural breaks, including the effects of the COVID-19 pandemic. Although there are some empirical studies on public finances for these countries, the existing literature fails to test, incorporate, and estimate the effects of these essential features, besides overlooking the impacts of the pandemic, which may cast doubt on some findings. Cross-dependence and structural breaks are supposed to be remarkable in Latin American countries; their incorporation, as well as extending the study period to cover the harmful impacts of the pandemic, are expected to be essential to avoid spurious inferences and achieve reliable and updated conclusions on fiscal sustainability.

Cross-sectional dependence comes from integrated economies. Economic and political events in a Latin American country often have spillover effects on the others, as a consequence, for instance, of regional trade agreements, financial integration, and common sources of fiscal resources.[1] Omitting cross-dependence terms from a panel model may lead to misleading inferences. The panel unit root and cointegration tests, which assumed cross-sectional independence, are inadequate and could lead to significant size distortions in the presence of neglected cross-section dependence (Baltagi & Pesaran 2007). Traditional unit root and cointegration tests may lead to erroneously accepting “no sustainability,” as they suffer from a loss of power (Amba et al. 2017). The present work conducts tests for cross-dependence terms and, as long as their impacts are confirmed, we augment the underlying models to account for them.

As for structural breaks, they are also expected for Latin American countries, since most of these economies have similar export compositions and comparable levels of external vulnerability, with a common and higher exposure to price fluctuations and crises. Moreover, we observe some critical events over our study period that could be sources of structural breaks, such as the commodities boom, the 2008 financial crisis, and the COVID-19 pandemic. Structural breaks affect the size and power of cointegration tests (Campos et al. 1996). Ignoring these effects might lead to spurious inferences in favor of the “no cointegration” hypothesis (Westerlund & Edgerton 2008), which, for our purposes, would produce mistaken results supporting fiscal unsustainability.

In this paper, we estimate the significant breakpoints by statistical criteria and incorporate them into the empirical models underlying fiscal sustainability tests, endogenously estimating the magnitude of their impacts on the parameters of interest, while controlling for effects that could distort the main conclusions. This approach also allowed the assessment of the periods over which each break affected the models, thereby easing the economic interpretation of these effects.

Nevertheless, although Latin American countries share several common features, there is also some political and economic heterogeneity among them, besides a few differences regarding the structures of revenue and expenditures.[2]

This would make a unified analysis for the panel of 18 countries rather ineffective. On the other hand, specific-country analyses, like those proposed by some previous works, overlook common

1 An example was the reduction of import tariffs for Latin American countries. This measure leveraged the flow of transactions between these countries, thus connecting the composition of income and expenses of the countries.

2 Due, e.g., to the different forms of distribution of fiscal powers among distinct levels of government, the contrasting amounts of resources necessary to sustain social security systems and the disparate availability of natural resources.

factors amongst countries, thereby reducing the power of tests (see, e.g., Duran-Vazquez et al. 2011), besides omitting cross-dependence terms, leading to the aforementioned negative consequences.

We propose a solution for this problem through grouping countries, using a criterion provided by the International Monetary Fund (IMF 2015), based on similarities in economic performance, degree of external financing accessibility, and geographical location. Our group-specific models proved to be more realistic than the unified one, while homogeneous enough to capture shared features. This strategy enabled us to deal with the distinct fiscal patterns among the Latin American economies. Furthermore, by estimating group-specific models, we have been able to identify a subpanel of 6 countries that meet sustainability conditions, which proved to be impossible from the whole panel.

We highlight the crucial role of including the COVID-19 years in an econometric analysis, unlike previous works. Before the advent of the pandemic, most Latin American countries had been facing a strong fiscal crisis over a few decades (Hartlyn 2019), and some of them were making efforts to improve their political institutions to improve transparency and adopting austere fiscal rules that could lead to economic stability (Martorano 2018). By strongly affecting the global economy, the pandemic raised a question of whether these countries would have been successful in achieving fiscal sustainability even under the pandemic's harmful impacts, which may further justify the renewed interest from policymakers on fiscal perspectives of Latin American economies.

As an additional contribution, this work provides further evidence, based on empirical contrafactual exercises, supporting the crucial role played by cross-dependence terms, a careful selection of the controls, estimation of breakpoints, modeling of the structural breaks, and the incorporation of COVID-19 effects.

The structure of the work is the following: Section 2 presents the literature review; Sections 3 and 4 present the theoretical foundations and the empirical model; Section 5 describes the data; in Section 6, we apply the methodology to 3 groups of countries; Section 7 takes a closer look at the identified breakpoints and relates them to events over the study period, highlighting the COVID-19 impacts; Section 8 provides a comparison to the related literature; Section 9 further analyzes the effects of incorporating cross-dependence terms, structural breaks, and control variables on results and conclusions; Section 10 concludes.

2. LITERATURE REVIEW

The literature on public finance investigates the fiscal sustainability of Latin American countries through a variety of approaches.[3] Regarding country-specific analyses, Chortareas et al. (2004) applied unit root tests to public debt time series. A cointegration analysis of revenues and expenditures is employed by Issler and Lima (2000), Kalyoncu and Ozturk (2010), and Del Cristo and Puig (2016). Bertussi and Triches (2012) and Campos and Cysne (2020) specified multicointegration models to analyze a relationship involving accumulated revenues and expenses and the stock of debt. Tests for identifying indebtedness limits were conducted by Checherita-Westpha et al. (2014) and Fournier and Fall (2015). Celasun et al. (2007), Campos and Cysne (2019), Lozano-Espitia and Julio-Román (2020), and Aquino et al. (2021) estimated fiscal reaction functions, which measures how the primary surplus reacts to public debt increases.

As for investigations based on panel models, Holmes (2006) assessed the stationarity of current account deficits across a panel of 16 Latin American countries. Alberola and Montero (2006) investigated the minimum threshold of primary balance required to achieve fiscal sustainability. Tran (2018) examined the maximum debt limit a country would support before defaulting. These works, however, either do not test for and properly specify cross-sectional dependence terms, or do not incorporate structural breakpoints, thereby overlooking some essential features for the analysis of fiscal sustainability.

3 This literature review is summarized in Annex I.

Some authors have incorporated structural breaks into their sustainability analyses. Chortareas et al. (2008) analyzes the sustainability of government debt by employing unit-root tests with breaks and threshold nonlinearities. Donoso and Martin (2014), for instance, investigated the stationarity of the current account deficit in Latin American countries considering structural breaks. However, these works do not estimate the specific periods of the breakpoints, neither test for cross-sectional dependence among panel units. Robledo and Velandia (2015) relax the assumption of a stable cointegrating relationship, but allow for breaks only in the deterministic component, besides employing a method that is not suitable under both cross-dependence and structural breaks.

Alagidede and Tweneboah (2015), Christophe and Llorca (2017), Khadan (2019), and Yersh (2020) account for cross-dependence terms in their sustainability analysis. Nevertheless, they do not consider structural breaks in their models.

Our study employs the cointegration test developed by Westerlund and Edgerton (2008), which make it possible to properly handle the effects of both structural changes and cross sectional dependence, also accounting for heteroskedastic and serially correlated errors, unit-specific time trends and structural breaks in both the intercept and slope of the underlying models. Furthermore, we estimate the breakpoints by a procedure recently proposed by Ditzen et al. (2021), which enabled us to measure specific impacts of the breaks and assess their economic interpretations. Finally, we incorporate the impacts of the COVID-19 pandemic.

3. THEORETICAL FRAMEWORK

According to Blanchard et al. (1990), a fiscal policy is sustainable if the expected present value of the primary surplus is at least sufficient to offset the current level of public debt. Hakkio and Rush (1991) showed that for fiscal sustainability to hold, the time series of government revenues and expenses must be cointegrated. We explain this equivalence throughout this section.

Firstly, the government`s one-period budget constraint is given by

$$B_t = (1 + r_t)B_{t-1} + G_t - R_t \tag{1}$$

Where B_t and B_{t-1} are the market value of the government debt, in $t-1$ and t, G_t and R_t are the public expenditure and tax revenue, respectively, and r_t is the real interest rate. Rearranging (1), we have:

$$B_t - B_{t-1} = \Delta B_t = G_t^r - R_t \tag{2}$$

where $G_t^r = G_t + r_t B_{t-1}$ is the government expenditure inclusive of interest payment and Δ is the difference operator. Now, assuming that r_t is stationary, with unconditional mean equal to r, the equation (2) can be rewritten as:

$$B_t - (1 + r)B_{t-1} = E_t - R_t \tag{3}$$

where $E_t = G_t + (r_t - r)B_{t-1}$. Since (3) holds for every period, we can solve it "forward" (that is, for t, $t+1$, $t+2$, ...), which yields:

$$B_t = \sum_{s=0}^{\infty} \frac{R_{t+j} - E_{t+j}}{(1+r)^{j+1}} + \lim_{j \to \infty} \frac{B_{t+j}}{(1+r)^{j+1}} \tag{4}$$

Applying the difference operator Δ in (4) and using (2), we get:

$$\Delta B_t = G_t^r - R_t = \sum_{j=0}^{\infty} \frac{(\Delta R_{t+j} - \Delta E_{t+j})}{(1+r)^{j+1}} + \lim_{j \to \infty} \frac{B_{t+j}}{(1+r)^{j+1}} \tag{5}$$

Assume that R_t and E_t are non-stationary, so that ΔR_t and ΔE_t are stationary. In particular, assume that R and E follow random walks with drift:

$$R_t = \alpha_1 + R_{t-1} + \varepsilon_{1t} \qquad E_t = \alpha_2 + E_{t-1} + \varepsilon_{2t} \tag{6}$$

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In this case, the equation (5) can be rewritten as

$$G_t^r = \alpha + R_t + \lim_{j\to\infty} \frac{\Delta B_{t+j}}{(1+r)^{j+1}} + \varepsilon_t \tag{7}$$

where $\alpha \equiv \frac{(\alpha_1+\alpha_2)}{(1+r)}$ and $\varepsilon_t \equiv \frac{(\varepsilon_{1t}+\varepsilon_{2t})}{(1+r)}$.

To ensure that the government generates future surplus equal, in expected present-value terms, to the current market value of its debt. we impose the following condition:

$$E_t \lim_{j\to\infty} \frac{\Delta B_{t+j}}{(1+r)^{j+1}} = 0 \tag{8}$$

where E_t denotes the expect value at time *t*. Under this condition, the government is not allowed to finance the debt by issuing a new debt (no Ponzi scheme). So, the limit term in equation (7) is zero. Rewriting the equation (7) as a regression equation, we have

$$G_t^r = \alpha + bR_t + \varepsilon_t$$

The null hypothesis is $b = 1$ and ε_t stationary. In other words, if G^r and R are non-stationary, the null hypothesis is that $b = 1$ and that G_t^r and R are cointegrated. It is equivalent to check whether $\Delta B_t = (G_t^r - R_t)$ is stable in the long run. If it holds, fiscal policy is deemed sustainable. In what follows, we relate this condition to the definition of cointegration, thus providing the rationale behind our econometric analysis for investigating fiscal sustainability.

A simple definition of cointegration is postulated by Engle and Granger (1987) for a vector of *k* non-stationary (I(1)) time series, c_t. It assumes that, although each element of c_t is I(1), a linear combination of them, $a'c_t$, where a is a ($k \times 1$) vector, may be stationary. In this case, these *k* series are said to be cointegrated, with cointegrating vector *a*, so that deviations of G_t^r and R_t from the equilibrium relationship $(G_t^r - R_t)$ follows a stationary trajectory around zero. We conclude that fiscal sustainability may be investigated by testing if G_t^r and R_t are cointegrated, with a specific cointegrating vector $a = [1, -1]'$. Finally, Quintos (1995) proves that this equivalence holds even if the cointegration is $a = [1, -\beta]'$, as long as $0 < \beta < 1$.

4. EMPIRICAL STRATEGY METHODOLOGY

Since fiscal sustainability is equivalent to a long-term relationship between the time series of government revenue and expenditures, we are going to conduct a cointegration analysis. Firstly, we tested for the presence of cross-dependence (subsection 4.1) and breakpoints (subsection 4.2). Since both features were identified, we applied unit root panel tests that account for both cross dependence and structural breaks, developed by Carrion-i-Silvestre et al. (2005).[4] Since the panels were non-stationary, we proceed with the panel cointegration tests developed by Westerlund and Edgerton (2008) (subsection 4.3). Finally, if the panel is found to be cointegrated, we classify it as fiscally sustainable.

4.1 CROSS-SECTIONAL DEPENDENCE (CD) TEST

Traditional panel cointegration tests such as McCoskey and Kao (1998), Pedroni (1999; 2004), and Westerlund (2005a; 2005b) require independence among cross-sectional units. Baltagi and Pesaran (2007) show that these tests may lead to unreliable inferences under neglected cross sectional dependence, since their size and power properties become suspect. Cross dependence among panel units may arise due to spillover effects, or even due to unobservable common factors.

4 If both cross-dependence and structural breaks had been rejected, we would apply the MW test (Maddala & Wu 1999).

In light of this perspective, we applied the cross-dependence test proposed by Pesaran (2004), which is robust to structural breaks. This test is based on the average of pairwise correlation coefficients of OLS residuals from regressions for each panel unit. Consider the following panel data model:

$$y_{it} = \alpha_i + \beta' \boldsymbol{x_{it}} + u_{it},\ i = 1, \dots, N;\ t = 1, \dots, T, \tag{9}$$

where x_{it} is a regressor vector, β is a ($k \times 1$) parameters vector, α_i are the fixed effects, and u_{it} is an error term. The hypotheses of the test are: H_0: $\rho_{ij} = \rho_{ji} = cor(u_{it}, u_{jt}) = 0$, for $i \neq j$ vs H_1: $\rho_{ij} = \rho_{ji} \neq 0$, for $i \neq j$. The test statistic is:

$$CD = \sqrt{\frac{2T}{N(N-1)}} \left(\sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{\rho}_{ij} \right) \tag{10}$$

where $\hat{\rho}_{ij}$ is the estimate of the pairwise Pearson´s correlation coefficients of the residuals from the OLS estimation of (9), for each panel member. Under H_0, the distribution of the CD statistic is approximately Normal. If H_1 is evidenced, we conclude that cross-dependence terms must be incorporated into the model.

4.2 TESTING AND ESTIMATING STRUCTURAL BREAKS

Westerlund & Edgerton (2008) show that the conventional tests aimed at distinguishing between spurious and cointegrated processes tend to favor the spurious model when the true generating process is subject to structural breaks.

This study adopts the panel test for structural breaks by Ditzen et al. (2021). Beginning with a null hypothesis of no breaks, sequential tests comparing *s* versus *s* + 1 breaks enable the determination of the appropriate number of breaks. The location of potential breaks is determined by minimizing the sum of squared residuals between the actual data and the average growth rate before and after the trend break. Consider a model with *N* units, *T* periods, and *s* breaks:

$$y_{i,t} = x'_{i,t}\beta + w'_{i,t}\delta_j + \overline{x}'_t a_i + \overline{w}'_t b_{i,j} + e_{i,t} \tag{11}$$

where $t = T_{j-1}, \dots, T_j$; $i = 1, \dots, N$; $j = 1, \dots, s + 1$ with $T_0 = 0$ and $T_{s+1} = T$. Hence, there are *s* breaks, or *s* + 1 regimes with *j* covering the observations $T_{j-1}, \dots, T_j$. $y_{i,t}$ denotes the dependent variable, $w_{i,t}$ and $x_{i,t}$ are the regressors, and $e_{i,t}$ is the error component. Cross-sectional averages $\overline{x}_t = N^{-1}\sum_{i=1}^{N} x_{i,t}$ and $\overline{w}_t = N^{-1}\sum_{i=1}^{N} w_{i,t}$ control for a possible error dependence.

Let $\hat{\mathcal{T}}_s = \{\hat{T}_1, \dots, \hat{T}_s\}$ denote the s estimated breaks. The breakpoints are estimated by minimizing the sum of squared residuals (SSR) based on s breaks: $\hat{\mathcal{T}}_s = \arg\min_{\mathcal{T}_s \in \mathcal{T}_{s,\varepsilon}} SSR(\mathcal{T}_s)$. The testing hypotheses are: H_0:s breaks vs. H_1:(*s* + 1) breaks. The test statistic takes the form: $F(s+1|s) = \sup_{1 \leq j \leq s+1} \sup_{\tau \in \hat{\mathcal{T}}_{j,\varepsilon}} F(\tau|\hat{\mathcal{T}}_s)$, where $F(\tau|\hat{\mathcal{T}}_s)$ is an F statistic for testing restrictions on the breaks parameters, $\hat{\mathcal{T}}_{j,\varepsilon} = \{\tau | \hat{T}_{j-1} + (\hat{T}_j - \hat{T}_{j-1})\varepsilon \leq \tau \leq \hat{T}_j - (\hat{T}_j - \hat{T}_{j-1})\varepsilon,\ \hat{T}_0 = 0, \hat{T}_{s+1} = 1\}; \varepsilon \in (0,1)$. We start by testing the hypothesis of no breaks against the alternative of a single break, by $F(1|0)$. If no breaks are found, we set $\hat{s} = 0$. Otherwise, we estimate the breakpoint by $\hat{T}_1$ and split the sample in 2 parts. We then test for a break in each subsample by $F(2|1)$. If H_0 is not rejected, we set $\hat{s} = 1$. Otherwise, we estimate this breakpoint by $\hat{T}_2$ and split again (in 2 parts) the respective subsample. The process continues until it fails to reject H_0.

4.3 COINTEGRATION TEST

If cross dependence and structural breaks are confirmed in the previous tests, we employ the appropriate unit root panel test developed by Carrion-i-Silvestre et al. (2005). See Annex II for a description of this test. If unit roots are present, we proceed with the Westerlund & Edgerton (2008) panel test to check whether revenue and expenditure are cointegrated. This test allows for cross-sectional dependence and breakpoints in both the intercept and slope of the cointegrated relationship. The model is, for i = 1, 2, ..., N and t = 1, ..., T:

$$y_{it} = \alpha_i + \eta_i t + \delta_i D_{it} + x'_{it}\beta_i + (D_{it}x_{it})'\gamma_i + z_{it} \tag{12}$$

$$x_{it} = x_{it-1} + w_{it} \tag{13}$$

$$z_{it} = \lambda'_i F_t + v_{it} \tag{14}$$

$$F_{jt} = \rho_j F_{jt-1} + u_{jt} \tag{15}$$

$$\Delta v_{it} = \phi_i v_{it-1} + \sum_{j=1}^{p} \phi_{ji} \Delta v_{it-j} + e_{it} \tag{16}$$

where y_{it} is the dependent variable;[5] x_{it} is a vector containing the regressors,[6] D_{it} is a scalar break dummy such that $D_{it} = 1$ if $t > T_i$, and zero, otherwise; F_t is a vector of common factors with $j = 1, ..., r$; λ_i is a vector of loading parameters; α_i is the intercept and β_i is the slope before the break, while δ_i and γ_i represent the respective changes after the break. The disturbance z_{it} is assumed to have the following data-generating process that permits cross sectional dependence through the use of unobserved common factors.

Regarding the error processes, v_{it} and u_{it} are identically and independently cross-sectionally distributed, whereas e_{it} and w_{it} are mutually independent for all i and t. By assuming $\rho_j < 1$ for all j, we ensure that F_t is strictly stationary, which implies that the order of integration of the composite regression error z_{it} depends only on the degree of integration of the idiosyncratic disturbance v_{it}.

Thus, in each data-generating process, the relationship in (12) is cointegrated if $\phi_i < 0$ and it is spurious if $\phi_i = 0$. The null hypothesis to be tested is that all N units are spurious, while the alternative hypothesis is that the first N_1 panel units are cointegrated, whereas the remaining $N_0 = N - N_1$ are not. Equivalently, we test H_0: $N_1 = 0$ against H_1: $N_1 > 0$ The test statistics are:

$$Z_\phi(N) = \sqrt{N}\left(\overline{LM}_\phi(N) - E(B_\phi)\right) \qquad Z_\tau(N) = \sqrt{N}\left(\overline{LM}_\tau(N) - E(B_\tau)\right) \tag{17}$$

where $\overline{LM}_\phi = \frac{1}{N}\sum_i^N T\widehat{\phi}_i(\frac{\widehat{\omega}_i}{\widehat{\sigma}_i})$, $\overline{LM}_\tau = \frac{1}{N}\sum_i^N \frac{\widehat{\phi}_i}{SE(\widehat{\phi})}$, and $\widehat{\phi}_i$ is the estimate of ϕ_i in (16).

As for breaks, equation (12) encompasses three cases. Case 1: $\delta_i = \gamma_i = 0$ (no break); case 2: $\gamma_i = 0$ but δ_i is unrestricted, suggesting a model with a break in intercept (level break); case 3: δ_i and γ_i are unrestricted, so both intercept and slope may change (regime shift).[7] We also investigated whether common breaks properly represent the impacts of the critical events, from statistical F-tests.

5. DATA

5.1 MAIN VARIABLES

The data used comprises annual time series of general government total expenditure[8] and revenue[9] (both expressed as a percentage of GDP) from 1991 to 2022 for 18 Latin American countries. Figure 1 shows graphs of these variables for all countries in the sample, throughout the study period.[10]

5 In the present work, y_{it} is the series of expenditures and x_{it} is the series of revenue.

6 Although the condition (13) looks restrictive, it is necessary for the cointegration relationship, as can also be seen from equation (6) in Section 3. Therefore, it was investigated and verified for revenue, expenditures, and all control variables.

7 Note that case 3 (regime shift) is the relevant specification for our study as we test for the presence of structural breaks on the cointegration relationship.

8 Source: https://www.imf.org/external/datamapper/G_X_G01_GDP_PT@FM/ADVEC/FM_EMG/FM_LIDC.

9 Source: https://www.imf.org/external/datamapper/GGR_G01_GDP_PT@FM/ADVEC/FM_EMG/FM_LIDC.

10 Note that the series do not start at the same point, since not all countries had reliable data available from 1991 onwards. The methods used in this paper are applicable to unbalanced panels, that is, whose data are not available for some years.

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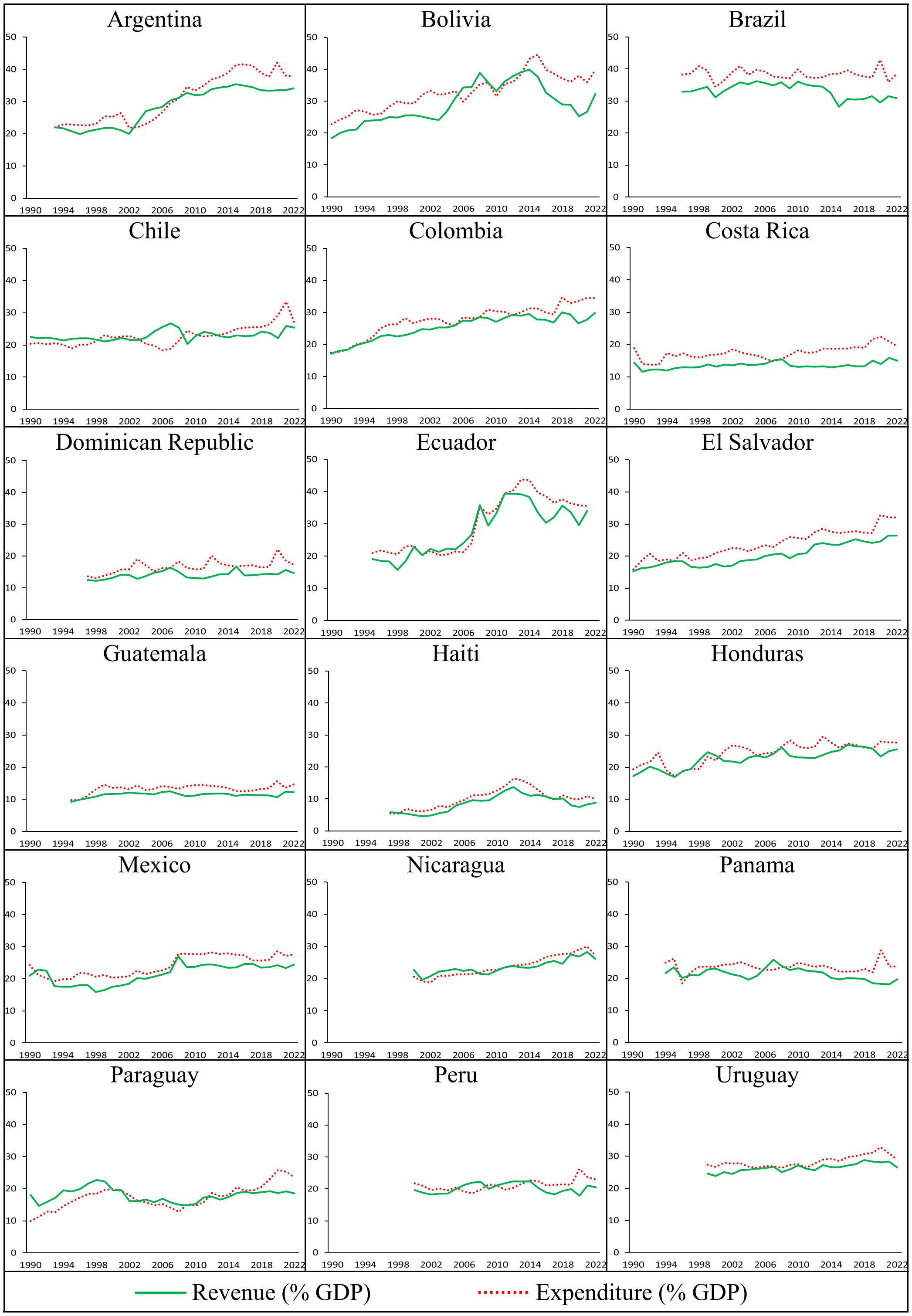

Figure 1 Revenue and expenditure of Latin American countries.

From Figure 1, we see that most revenue and expenditure series move in the same directions, even though expenditures are generally higher than revenue. In general terms, the most prominent changes occurred throughout three subperiods. The first one, from 2003 to 2007, corresponds to an increase in revenue, mainly due to the benefits of the commodity boom. The second subperiod, during and after the 2008 financial crisis, shows a decline in revenues and an increase in expenditures, which may be attributed to the countercyclical policies adopted by most Latin American countries to mitigate the effects of the crisis. Finally, the COVID-19 crisis (2020–2021) notably affected countries' accounts (CEPAL 2021). Over this period, tax revenue decreased due to economic activity declines from lockdowns and increased government expenditures, especially in healthcare, to face pandemic-related challenges.

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We also incorporated control variables as components of x_{it} in (12), to avoid incorrect estimation of both the cointegration coefficient and the effects of structural changes, by isolating indirect effects of critical events which could lead us to overidentify the breakpoints. The potential controls are reported in Annex III, Table A.[11] The selection process is reported in subsection 6.3.

6. RESULTS

6.1 CRITERIA FOR GROUPING COUNTRIES

Initially, the empirical strategy described in Section 4 was applied to the whole panel of 18 countries. The results are presented in Annex IV. The main conclusion (see Table G) was that the null hypothesis of no cointegration is not rejected. However, as we discussed in Section 1, there are some sources of heterogeneity amongst Latin American countries that may cast doubt on this conclusion. On the other hand, a specific-country analysis would overlook cross-sectional dependence and common factors, which leads to mistaken inferences, as well. As a solution, we group the countries, in order to capture these shared features, based on the classification provided by the International Monetary Fund, which takes into account economic performance, degree of external financing accessibility, and geographical location (IMF 2015). The IMF designates the AL-6 group as "major raw material exporters and financially integrated economies." These countries also exhibit higher values of per capita income and growth rate. The AS-4 group is classified as "other raw material exporters," comprising countries that export commodities but are not financially integrated and do not have economic indicators as strong as those of the AL-6 group. The third group, CAPRD, comprises economies of Central America and the Caribbean. These groups, here called A, B, and C, are reported in Table 1.

GROUP A (AL-6)	GROUP B (AS-4)	GROUP C (CAPRD)
Brazil	Argentina	Costa Rica
Chile	Bolivia	Dominican Republic
Colombia	Ecuador	El Salvador
Mexico	Paraguay	Guatemala
Peru		Haiti
Uruguay		Honduras
		Nicaragua
		Panama

Table 1 Groups of Latin American countries based on IMF.

This grouping seems appropriate when considering the objectives of this work. In fact, the countries in group A have Independent Fiscal Institutions, which have proven to be valuable as support to fiscal policies, besides other similarities with regard to fiscal instruments, tax systems, and debt payments. Countries in group B have a significant participation of raw materials in their exports,[12] a greater vulnerability to crises, and frequent internal economic and political issues. As for countries in group C, besides the geographic proximity, they share basically informal economies, which has made it hard to get an ample base of taxpayers as a source of income for the governments, thereby hampering a fiscal balance.

11 Previously, we applied stationarity tests to a wider set of potential control variables to verify (13), since it is a condition for the validity of the empirical model under the cointegration tests (see equations (6) and footnote 6). If the unit root hypothesis was rejected at the 0,05 level, they were discarded and, therefore, not reported in Table A. The results of the unit tests for the potential control variables are reported in Annex III, Table B.

12 Take Ecuador and Bolivia to illustrate the relationship between dependency on the exploitation of non-renewable natural resources and fiscal unsustainability. These countries prospered during the commodities boom, but they were not able to sustain their prosperity, depleting reserves accumulated by the government and expanding fiscal deficits.

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We now investigate the hypothesis of fiscal sustainability for each group reported in Table 1, following the steps presented in Section 4.

6.2 CROSS-SECTIONAL DEPENDENCE TESTS

The results of CD tests are showed in Table 2 and provide evidence of cross-dependence for the revenue and expenditures series across all groups.

	CD STATISTIC	*p*-VALUE	AVERAGE CORRELATION COEFFICIENT	ABSOLUTE CORRELATION COEFFICIENT[13]
Group A				
Revenue	13.56**	0.032	0.316	0.460
Expenditures	16.38**	0.021	0.381	0.501
Group B				
Revenue	10.97*	0.067	0.233	0.314
Expenditures	8.82*	0.058	0.257	0.366
Group C				
Revenue	16.03**	0.029	0.354	0.473
Expenditures	19.16**	0.016	0.412	0.548

Table 2 Cross-dependence test for groups of countries.

Note: (***), (**), and (*) denote statistical significance at the 0.01, 0.05 and 0.1 levels, respectively.

The results in Table 2 confirm the expected cross-sectional dependence amongst Latin American countries, as discussed in Section 1. Moreover, for groups A and C, the significance of the statistics is stronger than those obtained for the whole panel, since they became significant at the 0.05 level (0.1 in Table D), thereby indicating that the common features are strengthened within groups, although, for group B (maybe due to the smaller sample), the results remained significant only at the 0.1 level. In Section 9, we will demonstrate the serious consequences of not incorporating cross-dependence into the analysis.

6.3 SELECTED CONTROL VARIABLES

We employed 2 tests to select the set of control variables, based on the estimates of the long-term parameters from each model: the continuously updated fully modified (Cup-FM) (Bai & Kao 2006), and the continuously updated bias correction (Cup-BC) (Bai et al. 2009). The results are reported in Annex III, Table C. Only 4 out of the 9 potential control variables in Table A were selected: real GDP growth (g_{it}), trade openness (opn_{it}), commodity export price index ($cepi_{it}$), and net financial account (nfa_{it}). In subsection 9.4, we will investigate the effects of incorporating these variables on the results of the work.

The inclusion of g_{it} controls for the effects of fluctuations in GDP growth.[14] Regarding the controls for the fluctuation of commodities prices, the Commodity price indexes reflect the weight of these prices on the level of each country's exports ($cepi_{it}$) or imports ($cipi_{it}$).[15] The significance of $cepi_{it}$, but not of $cipi_{it}$, may be justified by the great majority of commodity exporters in the sample. The

13 Average absolute value of the N*(N-1) off-diagonal elements of the cross-sectional correlation matrix of residuals. This option is useful to identify cases of cross-sectional dependence where the sign of the correlations is alternating.

14 The rationale for the inclusion of g_{it} is that, for our purposes, fiscal variables are expressed as a percentage of GDP, so the oscillations of the GDP growth should be controlled to isolate their impact on the ratio-to-GDP indicators employed to analyze fiscal sustainability. Moreover, Latin America's economic growth in the 2000s is often attributed to the commodities boom, particularly between 2003 and 2007 (Ocampo 2007; Rosnick and Weisbrot 2014), and g_{it} is also supposed to control this indirect effect (see also our Figure 2).

15 Another possibility would be the prices of commodities. However, they do not show cross-sectional variation, thereby hindering the estimation of distinct effects across countries. Moreover, countries facing the same fluctuations in commodity prices can experience vastly different windfall gains or losses, depending on their export or import matrix.

commodities boom also led to a shock to economic openness (Gruss & Kebhaj 2019; Vianna & Mollick 2021), which explains the inclusion of opn_{it}.[16]

Some measures of financial linkages were also considered, to incorporate effects of economic and financial international transactions throughout crisis. The net financial account nfa_{it} performed better than the others.[17] The nfa_{it} variable represents the net acquisition and disposal of financial assets and liabilities, which is supposed to have been strongly affected during financial crises due to changes in investor confidence, risk aversion, and global liquidity conditions (see, e.g., Ocampo 2009).[18] In fact, both the 2008 and COVID-19 crisis led to a rapid reversal of capital flows as investors sought safety in response to heightened uncertainty, impacting countries' net financial accounts.

6.4 COINTEGRATION TESTS

Regarding stationarity analysis, we applied the panel unit root test by Carrion-i-Silvestre et al. (2005), which allows the incorporation of both cross-dependence and breakpoints (see Annex II for a description of this test). Since the unit root hypothesis were evidenced for both series, at the 0.05 level, across all groups (results in Annex V), we proceed with the investigation of a long-run relationship between revenue and expenditures by applying the Westerlund and Edgerton (2008) cointegration test,[19] which also enables the incorporation of cross-dependence and breakpoints. Table 3 reports the results.

		NO BREAK		LEVEL BREAK		REGIME SHIFT	
		STATISTICS	*p-VALUE*	STATISTICS	*p-VALUE*	STATISTICS	*p-VALUE*
A	$Z_\tau(N)$	–0,518	0,162	–1,269	0,129	–1,795*	0,074
	$Z_\phi(N)$	–0,434	0,168	–1,438	0,116	–1,613*	0,062
B	$Z_\tau(N)$	–0,615	0,263	–1,199	0,119	–1,135	0,153
	$Z_\phi(N)$	–0,644	0,269	–1,213	0,113	–0,902	0,169
C	$Z_\tau(N)$	–0,655	0,280	–0,547	0,239	–0,521	0,396
	$Z_\phi(N)$	–0,687	0,287	–0,755	0,203	–0,622	0,362

Table 3 Panel cointegration tests for groups.

Note: (***), (**), and (*) denote statistical significance at the 0.01, 0.05 and 0.1 levels, respectively.

The results from Table 3 suggest that, either for the "no break" or the "level break" model, the null hypothesis of no cointegration is not rejected for any subpanel, at the usual levels. Nevertheless, if a regime shift is allowed, both statistics evidence cointegration for group A, at the 0.1 level (groups B and C remain classified as fiscally unsustainable). This finding agrees with Westerlund and Edgerton (2008), who argue that cointegration tests tend to spuriously favor the hypothesis of no cointegration if the true process is subject to structural breaks. From the "no break" results, we see that if we did not incorporate the previously evidenced breakpoints into the cointegration

16 Although $cmtt_{it}$ (commodity terms of trade) was significant, it did not perform as well as opn_{it}, so we chose the latter to avoid collinearity. Moreover, the commodities boom between also led to investments in infrastructure (from the increasing revenue) and attracted foreign investment in the extraction and exploitation of natural resources. However, the effect of $finv_{it}$ (direct investment) resulted not significant (possibly represented by the other variables).

17 It makes sense, for example, that nca_{it} has resulted non-significant in the presence of nfa_{it}, since the latter better translates the financial flows. This account tracks short-term financial transactions, such as investments in securities, loans, and currency reserves, providing a more detailed picture of the liquidity and financial vulnerabilities from crisis. Other alternatives to account for this effect would be bal_{it} or nca_{it}, but they incorporate some other effects besides the flow of capital (see, e.g., Cavallo et al. 2018), which may explain the non-significant results found for both of them.

18 We also highlight that some effects in Table A may have been implicitly incorporated into the grouping criteria, which could explain a lower variability of the intra-group effects and their consequent non-inclusion in the final model.

19 This model was estimated incorporating the structural breaks identified into the equation (12). Nevertheless, the estimation and the rationale behind the effects of these breaks are separately assessed and discussed only in Section 7.

vector, or even under the "break in level" specification,[20] the analysis would lead us to a mistaken finding that group A is unsustainable. The final conclusion is that, under the correct specification of the structural breaks, the method applied in this work provides statistical evidence of fiscal sustainability for group A.

6.5 DISCUSSION

The finding for group A may be supported by the fact that most of these countries have made progress towards fiscal sustainability, implementing measures which improved their fiscal situation, as evidenced by S&P, Fitch, and Moody's rankings, for example.[21] Moreover, the Independent Fiscal Institutions created by these countries[22] have proven to be valuable as support to fiscal policies, by increasing transparency and evaluating tax reforms.

Countries in group B have high shares of raw materials in their exports, as well as frequent internal economic and political issues, which may have hampered an individual government's ability to pursue fiscal sustainability. A further rationale for the diagnosis of unsustainability may be the stronger impact of both the 2008 crisis and COVID-19 on these countries, as will be discussed in Section 7. As for countries in group C, the economic informality has made it hard for them to get a consistent means of income for their governments. Furthermore, the geographic proximity has driven these countries to compete among themselves for foreign investment, thus decreasing the extent to which they can collect taxes from international investors, besides increasing their vulnerability to constraints on international travel, like those imposed by COVID-19. Overall, the finding of fiscal sustainability for group A, but not for the others, seems to be coherent.

7. STRUCTURAL BREAKS

7.1 TESTING FOR BREAKPOINTS

The next step was to test for structural breaks and to identify the breakpoints. We do not reject the hypothesis of existing breaks, at the 0.05 level, for any group. The breakpoints were estimated using the method proposed by Ditzen et al. (2021), which not only enables their detection, but also determines their location, thereby allowing us to identify their relationship with atypical events over the study period (see subsection 4.2). The results are reported in Table 4.

		F(1|0)	F(2|1)	F(3|2)	F(4|3)	F(5|4)
Critical Values	1%	12.29	13.89	14.80	15.28	15.76
	5%	8.58	10.13	11.14	11.83	12.25
	10%	7.04	8.51	9.41	10.04	10.58
Test Statistic	Group A	10.14**	9.91*	9.56*	8.77	7.54
	Group B	11.89**	10.65**	9.03	8.84	8.29
	Group C	12.02**	9.18*	8.01	7.74	7.22

Table 4 Ditzen et al. (2021) Procedure for groups.

Note: (***), (**), and (*) denote statistical significance at the 0.01, 0.05 and 0.1 levels, respectively.

From Table 4, the number of breaks depends on the significance level. At the 0.05 level, we have 1 break for groups A and C, and 2 for group B. If we adopt the 0.1 level, an additional break is identified for group C and two for group A.

20 We highlight the crucial role of not only incorporating the structural breaks, but also setting a suitable specification for them. A clear illustration is that the "break in level" specification would lead to a mistaken inference for group A.

21 For example, Chile and Mexico introduced instruments to manage public assets resulting from fiscal surpluses; Peru implemented tax reforms inspired in the Uruguayan model; Brazil and Colombia maintained their government's fiscal revenue and expenditure as a percentage of GDP at stable levels throughout the past decades.

22 Countries that have a fiscal council can be found at: https://www.imf.org/en/Data/Fiscal/fiscal-council-dataset.

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7.2 ESTIMATED EFFECTS

The breakpoints were incorporated into the equation (12) of our empirical model, for each group. The estimates of the γ coefficients are in Table 5.[23]

BREAKS	GROUP A		GROUP B		GROUP C	
	COEF.	95% C.I.	COEF.	95% C.I.	COEF.	95% C.I.
$\gamma_{(2003-2007)}$	0.17*	[–0.05, +0.39]	–	–	–	–
$\gamma_{(2008-2009)}$	–0.20*	[–0.43, +0.03]	–0.29**	[–0.62, –0.04]	–0.07*	[–0.27, +0.13]
$\gamma_{(2020-2021)}$	–0.32**	[–0.56, –0.08]	–0.48**	[–0.82, –0.14]	–0.54**	[–0.75, –0.33)

Table 5 Estimated breakpoints for groups.

Note: (***), (**), and (*) denote statistical significance at the 0.01, 0.05 and 0.1 levels, respectively.

Although we have evidence that these breaks affected the long-term relationship between revenue and expenditures within groups, their impacts proved not to be homogeneous across groups. We could relate the structural breaks to the following events: the commodities boom (2003–2007), the 2008 global financial crisis (2008–2009), and the COVID-19 pandemic (2020–2021). In what follows, we try to uncover what lies behind each of these breaks and their uneven effects.

7.3 COMMODITIES BOOM (2003–2007)

The positive value for $\gamma_{2003-2007}$ shows that the effect of this structural break on the cointegration coefficient was positive,[24] as expected, since the commodities boom greatly favored the revenues and the growth of international reserves of commodity-exporting countries (CAF 2021). The uneven impacts across groups may be supported by the distinct levels of commodity dependence among these countries. For example, in group C, no country is classified as commodity dependent by the United Nations,[25] which may explain the non-significance of the impact of the commodities boom for this group, even at the 0.1 level. One might wonder why the commodities boom had a significant impact on group A but not on B since both comprise commodity dependent countries. A possible explanation is that the countries in group A are *major* commodity exporters,[26] and therefore benefited more from the growth of Asian economies (Balakrishnan and Toscani 2018). Another factor that may justify the strongest effect of the commodities boom on group A is depicted in Figure 2, from which we see that, from 2003 to 2007, countries in group A experienced higher average economic growth rates compared to those in groups B and C.[27]

7.4 2008 FINANCIAL CRISIS (2008–2009)

The negative value of the estimate for $\gamma_{2008-2009}$ accounts for the harmful effect of the global financial crisis in 2008[28] on the cointegration coefficient. This crisis started in the United States with the collapse of the subprime mortgage market, and quickly spread around the world. Investors, faced with the prospect of a global recession and financial instability, reduced investments in emerging countries, leading to sharp falls in stock prices across the Latin American region, which depend heavily on foreign investment and global economic conditions (see, e.g., Hwang 2014).

23 For our purposes of fiscal sustainability analysis, the relevant breaks are only the regime-shift ones, given by γ, since they measure effects on the cointegration parameters. The level breaks only represent the effects on the expenditure.

24 Remember that, from equation (12), the γ coefficients measure the direct impact of the break on the cointegration coefficient. A positive (negative) sign for γ means that the break strengthens (weakens) the cointegration relationship.

25 A country is classified as commodity dependent if commodities are responsible for more than 60% of its total exports.

26 Major commodity exporters in Latin American countries refer to the primary nations in Latin America that heavily depend on commodity exports to enhance their economies.

27 Countries in group A have higher per capita income than those in group B, over the study period. The commodities boom appears to have further enriched the already wealthier countries of Latin America.

28 Financial and real mechanisms helped to spread the collapse of the US mortgage market turmoil to Latin America. First, equity markets felt the brunt of the global meltdown, collapsing the price of many assets. There was also a huge drop in external financing. According to estimates by the Institute of International Finance (https://www.iif.com), flows towards emerging economies slumped from US$423 trillion in 2007 to only US$4.5 trillion in 2008.

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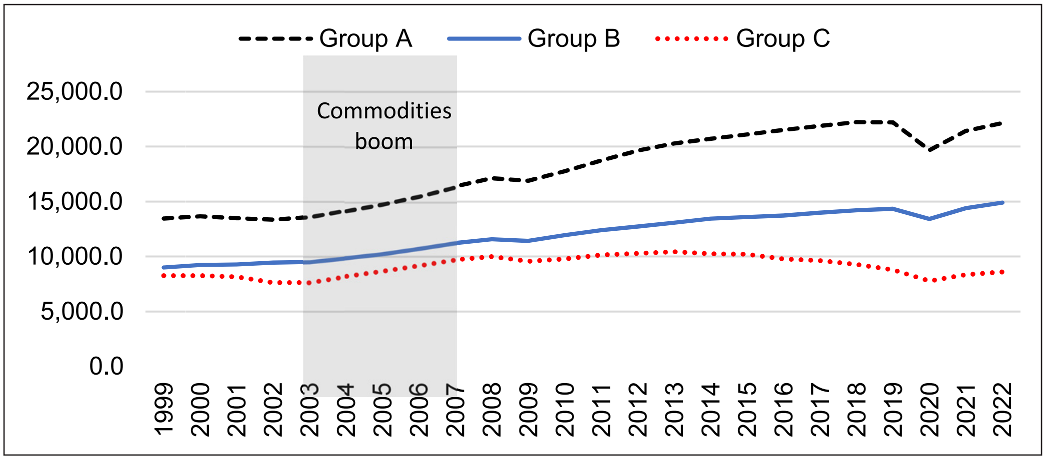

Figure 2 GDP per capita (2017 prices: US$ PPP) for groups.

Source: https://data.worldbank.org/indicator/NY.GDP.PCAP.PP.KD?view=chart.

The estimated impact on group B was stronger than on A. One explanation may be that the higher-income countries in A suffered milder effects than those in B due to a slightly greater economic stability. This break had even milder impacts on group C (with regard to the magnitude of γ estimates) since these countries are very dependent on imported products and tourism (see, e.g., Singer 2009).

7.5 COVID-19 PANDEMIC (2020–2021)

Finally, we discuss the COVID-19 pandemic, which strongly impacted countries' accounts. Increases in public spending aimed at mitigating health issues and economic damages, such as cash transfer programs and tax benefits, as well as losses in tax revenues resulting from declining global activity, translated into deteriorating budget balances and increasing public debt levels (Benítez et al. 2020).

In advanced countries, as interest rates are usually lower, governments were allowed to fund fiscal packages with less immediate concern for their sustainability. The opposite happens in most of the Latin American countries, though. The search for reserve assets led to unprecedented outflows from this region and a rise in sovereign spreads that offset the decline in international rates, further deteriorating budget balances (see, e.g., Yeyati and Valdés 2020). According to the Institute of International Finance (IIF 2020) the COVID-19 recession was even deeper for Latin American countries than that which resulted from the 2008 crisis, since, in 2008, most of them had benefitted greatly from the commodities boom (Brady and Magazzino 2020; Martins and Rodrigues 2022). It may explain the greater estimates of $\gamma_{2020-2021}$ in relation to those of $\gamma_{2008-2009}$ for all groups, not to mention the stronger significance level (0.05) for A and C.

The estimated impacts of COVID-19 varied across groups, although they were significant at the 0.05 level for all of them. The strongest effect on C may be explained by the fact that a large part of their economy is based on tourist services, which led them to be more affected by travel restrictions to contain the spread of the virus. The smoother effect on A and B may be attributed to the countercyclical fiscal measures aimed at mitigating the impacts of COVID-19.[29] Regarding the greater impact for the countries in B than for those in A, the IMF (2015) highlights the vulnerability of these lower-income countries, due to the high number of informal economies, as millions of people were left without jobs or state protection, following the implementation of social isolation measures.

8. A COMPARISON WITH LITERATURE

Table 6 present a comparative analysis of our findings with the related literature.

29 These policies were designed to stimulate the economy by increasing government spending or reducing taxes, thereby easing access to funds for the delivery of fiscal transfers, subsidies, and guarantees. Some examples were the renegotiation of external debt and international loans, support for households and businesses, strengthening the health system and tax relief and increased public spending.

Table 6 Comparison with literature for each Latin American country.

Note: "–": The country was not investigated by the authors. (*) Cevik & Nanda (2020) also found fiscal sustainability for HAI and Yersh (2020) also found fiscal sustainability for BOL, COL, ECU, PER.

AUTHOR	DATA	FISCAL SUSTAINABILITY?																	
		GROUP A						GROUP B				GROUP C							
		BRA	CHL	COL	MEX	PER	URY	ARG	BOL	ECU	PRY	CRI	DOM	ELS	GTM	HAI	HON	NIC	PAN
Our work	1990–2022	✓	✓	✓	✓	✓	✓	×	×	×	×	×	×	×	×	×	×	×	×
Country-Specific analysis																			
Issler & Lima (2000)	1947–1992	✓	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Chortareas et al. (2004)	1970–2000	✓	✓	✓	✓	×	–	✓	×	–	–	–	–	✓	✓	–	–	✓	✓
Kalyoncu & Ozturk (2010)	1980–2006	×	–	×	×	✓	–	×	–	–	–	–	–	–	–	–	–	–	–
Bertussi & Triches (2012)	1961–2007	✓		×	×	×	×	–	–	–	–	–	–	–	–	–	–	–	–
Donoso & Martin (2014)	1970–2010	×	×	✓	✓	✓	✓	×	✓	✓	×	✓	✓	✓	✓	–	✓	✓	✓
Del Cristo & Puig (2016)	2001–2013	–	–	–	–	–	–	–	–	✓	–	–	–	–	–	–	–	–	–
Tran (2018)	1999–2016	×	✓	×	×	–	–	×	–	–	–	–	–	–	–	–	–	–	–
Campos and Cysne (2019)	2003–2016	×	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Campos & Cysne (2021)	2001–2016	✓	✓	✓	✓	✓	×	×	–	✓	–	–	✓	–	–	–	–	–	–
Campos & Cysne (2022)	1997–2018	×	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Lozano-Espitia & Julio-Román (2020)	1980–2018	–	✓	✓	✓	✓	–	–	–	✓	–	–	–	–	–	–	–	–	–
Aquino et al. (2021)	1989–2017	–	–	–	–	–	✓	–	–	–	–	–	–	–	–	–	–	–	–
Panel Model Analysis																			
Holmes (2006)	1979–2001	×	✓	×	✓	✓	✓	✓	✓	✓	✓	–	–	✓	✓	–	✓	–	✓
Alagidede & Tweneboah (2015)	1990–2012	✓	–	–	–	✓	✓	–	–	–	–	–	–	–	✓	–	–	✓	–
Robledo & Velandia (2015)	1960–2010	–	✓	✓	–	✓	✓	✓	–	✓	✓	–	–	–	–	–	–	–	✓
Christophe & Llorca (2017)	1990–2012	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Cevik & Nanda (2020)	1980–2018	–	–	–	–	–	–	–	–	–	–	–	–	–	–	×*	–	–	–
Yersh (2020)	1984–2017	✓	✓	×*	✓	×*	✓	✓	×*	×*	✓	✓	✓	✓	✓	✓	✓	✓	✓

With regard to the countries in group A, the majority of the results are in line with ours, except for Brazil, which half of the studies classify as fiscally unsustainable. As far as the countries in groups B and C are concerned, the conclusions greatly vary and only a few of the results agree with ours. Some differences may be explained by differing study periods and methodologies. As for country-specific analyses, they fail to account for existing common factors among Latin American countries. Most of them also overlook structural breaks. Concerning studies based on panel models, we first highlight that the heterogeneity amongst Latin American nations should make it meaningless to identify a single relationship valid for all countries, as is clear from our whole panel analysis (Annex IV). Our grouping strategy proved to be advantageous, providing more accurate and reliable group-specific diagnostics. Furthermore, most previous studies neither incorporate structural breaks into the subjacent models, nor account for both cross-sectional dependence and control variables. All of them are also based on out of date samples, thereby not including the COVID-19 effects. With regard to the differences among conclusions for countries in groups B and C, one reasoning is that the fiscal situation of these countries has been deteriorating in recent years, mainly because some countercyclical measures have not been implemented so efficiently as to mitigate the harmful effects of the pandemic. Our updated sample, along with the proper modeling of breakpoints, may be behind some distinct diagnoses. Section 9 provides a further rationale for the role played by some contributions of the present work to avoid mistaken inferences, which may have led to more reliable conclusions regarding fiscal sustainability of Latin American countries.

9. INVESTIGATING BENEFITS OF OUR CONTRIBUTIONS

9.1 ESTIMATION AND PROPER MODELLING OF STRUCTURAL BREAKS

The proper incorporation of the structural breaks was essential for the conclusions of this work. If the breaks had been neglected, or only incorporated into the intercept of equation (12), the results would have been different, which can be concluded from the comparison of the "regime-shift" results with the other columns of Table 3. In particular, it would have been impossible to identify fiscal sustainability for group A without incorporating the breaks into the cointegration vector. This is in accordance with the arguments that, under structural breaks, cointegration tests are prone to incorrectly rejecting the null hypothesis ("no cointegration"), as long as the breakpoints are not incorporated into the models (see, e.g., Campos et al. 1996; Westerlund and Edgerton 2008).

9.2 UPDATED SAMPLE (ADDING THE COVID-19 YEARS)

Some previous econometric studies indicate fiscal sustainability for some Latin American countries that we have identified as sustainable. However, while these studies do not incorporate the COVID-19 period, we found here that the COVID-19 has accounted for the strongest impact among the structural breaks. The question arises as to whether, despite some other differences between the approaches adopted in previous related works and ours (see Section 8), the effects of the pandemic may have made these countries fiscally unsustainable.

To check it out, we re-estimated the model for groups considering a sub-sample up to 2019, that is, excluding the pandemic period (2020–2021). The new results are reported in Table 7 (only for "regime shift," which is the only relevant case):

	GROUP A		GROUP B		GROUP C	
	STATISTICS	*p*-VALUE	STATISTICS	*p*-VALUE	STATISTICS	*p*-VALUE
$Z_\tau(N)$	−2.304**	0.033	−1.743*	0.087	−0.392	0.263
$Z_\phi(N)$	−2.473**	0.021	−1.899*	0.092	−0.415	0.232
Sustainability?	Yes (at the 0.05 level)		Yes (at the 0.1 level)		No	

Table 7 Sustainability tests ("regime-shift") without COVID-19 years.

Note: (***), (**), and (*) denote statistical significance at the 0.01, 0.05 and 0.1 levels, respectively.

Some conclusions clearly changed, in relation to Table 3. All p-values decreased, but only for group C did they remain above 0.1, thereby not changing the conclusion regarding the fiscal unsustainability of these countries. For group A, the overall findings from Table 3 (fiscal sustainability) remained, but now both $Z_{\phi}(N)$ and $Z_{\tau}(N)$ statistics provide evidence for sustainability at the 0.05 level, rather than only at the 0.1 level, as observed for the full period. For group B, however, the main conclusions would change. Both statistics showed sustainability at the 0.1 level, unlike observed in Table 3. The overall conclusion is that, by excluding the pandemic period, group B became classified as fiscally sustainable, indicating that this critical event may have led this group to a fiscal unsustainability condition, even if it is properly modeled as a structural break.[30]

9.3 CROSS-SECTIONAL DEPENDENCE

Finally, we estimated the model without cross-dependency terms, but with all the identified breaks and control variables. The effect of omitting cross-dependence was similar to disregarding the effects of COVID-19: It was not possible to identify fiscal sustainability for group A.[31] This may further explain why some studies in the literature come to different conclusions, specifically on some countries in our group A. By not incorporating cross-sectional dependence terms into the underlying models, the tests lose power to identify the cointegration relationship between the public revenues and expenditures for these countries, leading to erroneous inferences (Baltagi and Pesaran 2007)). This finding is also in line with Amba et al. (2017), according to which, under neglected cross-sectional dependence, panel cointegration tests may lead to mistaken inferences supporting fiscal unsustainability.

9.4 CONTROL VARIABLES

Next, we present the results of the estimated model without control variables, aiming to identify the effects that would have been hidden by their omission. The main objective here is to uncover the effective role of the control variables on both the conclusions regarding sustainability and the identification of structural breaks.

Table 8 shows the results of the cointegration tests conducted without the inclusion of control variables. The analysis reveals a very slight effect, which does not lead to changes in the main conclusions or the significance levels.

	GROUP A		GROUP B		GROUP C	
	STATISTICS	*p-VALUE*	STATISTICS	*p-VALUE*	STATISTICS	*p-VALUE*
$Z_{\tau}(N)$	−1.842*	0.068	−1.242	0.145	−0.542	0.385
$Z_{\phi}(N)$	−1.687*	0.059	−0.987	0.178	−0.647	0.345
Sustainability?	Yes (at the 0.1 level)		No		No	

Table 8 Sustainability tests (“regime-shift”) without control variables.

Note: (***), (**), and (*) denote statistical significance at the 0.01, 0.05 and 0.1 levels, respectively.

When it came to structural breaks, however, we can see that the control variables played a fundamental role. The results of the Ditzen test and the estimated breakpoints for each group without control variables are in Tables 9–10.

We conclude that, without control variables, the number of structural breaks identified would have been incorrectly higher. It leads us to conclude that the omission of these variables, although only slightly affected the cointegration relationship, would lead to an overidentification of the number of breakpoints. Annex VI presents a further discussion on these possible overidentified effects.

30 We also estimated a model with the full period, but disregarding the breakpoint referring to COVID-19. As argued by Campos et al. (1996) and Westerlund and Edgerton (2008), the method, in this case, fails to identify fiscal sustainability even for group A.

31 Results sent upon request.

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		F(1|0)	F(2|1)	F(3|2)	F(4|3)	F(5|4)
Critical Values	1%	12.29	13.89	14.80	15.28	15.76
	5%	8.58	10.13	11.14	11.83	12.25
	10%	7.04	8.51	9.41	10.04	10.58
Test Statistic	Group A	12.03**	12.98**	12.37**	11.96**	8.97
	Group B	14.65***	13.97***	12.95**	10.47*	9.31
	Group C	12.97***	9.98*	8.67	5.04	3.84

Table 9 Ditzen et al. (2021) procedure for groups (*without controls*).

Note: (***), (**), and (*) denote statistical significance at the 0.01, 0.05 and 0.1 levels, respectively.

BREAKS	GROUP A		GROUP B		GROUP C	
	COEF.	95% C.I.	COEF.	95% C.I.	COEF.	95% C.I.
$\gamma_{(2003-2007)}$	+0.48**	(0.11, 0.85)	+0.19*	(−0.25, 0.63)	–	–
$\gamma_{(2008-2009)}$	−0.37**	(−0.64, −0.10)	−0.65***	(−0.99, −0.31)	−0.09*	(−0.38, 0.20)
$\gamma_{(2013-2014)}$	−0.45**	(−0.87, −0.07)	−0.47**	(−0.89, −0.09)	–	–
$\gamma_{(2020-2021)}$	−0.66**	(−0.89, −0.33)	−0.80***	(−1.08, −0.52)	−0.85***	(−1.16, −0.44)

Table 10 Estimated breakpoints (*without controls*).

Note: (***), (**), and (*) denote statistical significance at the 0.01, 0.05 and 0.1 levels, respectively.

10. CONCLUSION

This work investigated whether the fiscal sustainability hypothesis is satisfied for 18 Latin American countries from 1991 to 2022. The sustainability condition is the long-term equilibrium relationship between government revenue and expenditures (as a ratio of the GDP). We applied panel cointegration test proposed by Westerlund & Edgerton (2008) that allow incorporating cross-sectional dependence and endogenously estimate structural breaks. Both features are expected to be present when analyzing fiscal and economic aspects of the Latin American countries over the study period, and neglecting them could lead to mistaken inferences and unreliable conclusions on sustainability.

Previous studies on fiscal sustainability for Latin American countries provide either country-specific or panel unified analysis. However, while the first approach omits common factors and cross-dependence effects among countries, which may affect the conclusions, a large panel analysis from the later approach overlooks differences amongst economies, locations, vulnerability, and revenue and expenditure structures of the countries. We propose a solution for this problem through grouping countries, based on similar features related to economic, geographical, and fiscal concerns. Our group-specific models proved to be more realistic than a unified one, as the heterogeneity amongst countries was accounted for, but without disregarding the incorporation of common features that integrate Latin American economies. This strategy enabled us to properly deal with the distinct economic and fiscal patterns among the Latin American economies, thereby leading to more specific and accurate findings. We identified a subpanel of six countries which meet sustainability conditions: Brazil, Chile, Colombia, Mexico, Peru, and Uruguay. In fact, these countries have made some progress towards fiscal sustainability, by implementing measures which improved their fiscal situation, such as the creation of Independent Fiscal Institutions—which have proven to be valuable for increasing transparency and assessing the effectiveness of tax reforms—as evidenced, for example, by their position in S&P, Fitch, and Moody's rankings.

Several authors in the literature argue that, if structural breaks are present, overlooking their effects may mislead us to not reject the hypothesis of "no cointegration," thereby inducing spurious conclusions supporting fiscal unsustainability. In this study, rather than impose the periods of structural breaks based on previously identified critical events, we estimate the breakpoints by a statistical criteria, and incorporate them into the empirical models underlying fiscal sustainability tests, thereby allowing the endogenous estimation of their direct impacts on the parameters of interest. This approach also made possible the assessment of specific subperiods over which each break affected the model, thereby easing their economic interpretation and the "*ex-post*" identification of the relevant critical events. We could relate the structural breaks to the following events: the commodities boom (2003–2007), the 2008 global financial crisis (2008–2009) and the COVID-19 pandemic (2020–2021). We also provided evidence that, as long as the identified breakpoints were not properly included into the cointegration models, all countries would have been classified as unsustainable, thereby confirming that the cointegration tests tend to spuriously favor the hypothesis of no cointegration if the true process is subject to structural breaks. We highlight that only under the specification of structural breaks as "regime-shift" effects, as appropriated, we were able to identify a fiscally sustainable group of countries.

Through a comparison with empirical studies for Latin America, we found that our results exhibit some new conclusions. However, in addition to some differences regarding study period, number of countries, use of control variables and, above all, methodology, most of these works do not properly take into account either the effects of cross-dependence or structural breaks. We also provided empirical evidence for the role played by each of our contributions by carrying out exercises in which each of these points was not taken into account. We found that, as expected, the results would have been different. To illustrate, if cross-dependence was not incorporated, the estimates would have been remarkably different. If structural breaks were not incorporated, all countries were found to be unsustainable. If the models had been estimated without controls, the number of breakpoints would have been overidentified and their effects overestimated, and another break would have been spuriously identified.

Furthermore, these previous works also do not include the COVID-19 years, which here were responsible for the strongest impact among structural breaks.

When we estimate the model without the COVID-19 period (i.e., with data up to 2019), we find that the 4 countries in group B would have become classified as fiscally sustainable, which suggests that the pandemic may have been at least partially responsible for leading these countries to a fiscal unsustainability condition, even if it is properly modeled as a structural break. In addition, if the whole study period is considered, but only the pandemic years are not modeled as breakpoint (unlike other critical events), all countries are classified as fiscally unsustainable, reinforcing that it is not enough to include the pandemic period to update findings on fiscal sustainability. It is also crucial to properly model its impacts, in order to avoid mistaken inferences and achieve reliable conclusions.

Overall, this study offers valuable insights into the fiscal landscape of the Latin American countries by refining methodological approaches to handle clearly identified features such as cross-dependence structure and structural changes, as well as properly incorporating the remarkable impacts of the COVID-19 on the study period and underlying econometric models. The strategy of grouping countries was also essential to handle heterogeneity and discriminate fiscal patterns, allowing us to identify a set of 6 countries which meet fiscal sustainability conditions. As some practical applications, these updated findings offer actionable insights for policy-makers in fiscally unsustainable countries, which should focus on not only following most of the successful measures implemented by the sustainable ones, but also on proposing additional adjustments in order to improve fiscal resilience, ensure a proper debt management, and attenuate the vulnerability to critical events, among other possible benefits.

ANNEX I: STUDIES ON THE SUSTAINABILITY OF LATIN AMERICAN FINANCES

AUTHOR	COUNTRIES AND PERIOD	ECONO-METRICS	EMPIRICAL TESTS AND VARIABLES	KEY FINDINGS	FISCAL SUSTAINABILITY?*
Issler & Lima (2000)	Brazil 1947–1992	Times series	Expenditures and revenues. Unit-root, cointegration tests and impulse–response function.	The results show that debt is sustainable in econometric tests, with the budget being balanced almost entirely through changes in taxes, regardless of the cause of the initial imbalance	Yes [BRA]
Chortareas et al. (2004)	12 LAC (ARG, BOL, BRA, CHL, COL, ESL, GTM, MEX, NIC, PAN, PER, VEN) 1970–2000	Times series	Debt An investigation of current account solvency in Latin America using nonlinear nonstationarity tests.	The nonstationarity tests of debt mensures was only reject for BOL and PER	Yes [ARG, BRA, CHL, COL, ESL, GUA, MEX, NIC, PAN, VEN] No [BOL, PER]
Holmes (2006)	16 LAC (ARG, BOL, BRA, CHI, COL, ECU, ESL, GTM, HND, MEX, PAN, PRY, PER, SUR, URY, VEN) 1979–2001	Univariate and panel data unit root tests	Tests for the stationarity of current account deficits, employing a new test, advocated by Breuer et al. (2002), that allows one to test for unit roots in heterogeneous panel data sets	Vast majority of the sample has sustainable current account, only two countries have unsustainable current account deficits.	No [BRA, COL] Yes [14 others]
Kalyoncu & Ozturk (2010)	6 LATAM (ARG. BRA, COL, MEX, PER, VEN) 1980Q1–2006Q2 [ARG, BRA, MEX, PER]; 1996Q1–2006Q2 [COL]; 1994Q1–2006Q2 [VEN]	Time series	From intertemporal borrowing constraint, tested for a long-run relationship between exports and imports plus net transfer payments and net interest payments. In our empirical analysis of the sustainability of current account, cointegration approaches.	Unique long run or equilibrium relationship among real exports and imports for Peru. For the others, results suggest that these countries' current accounts are not sustainable in the long run.	Yes [PER] No [5 others]
Bertussi & Triches (2012)	6 LATAM (ARG, BRA, MEX, PER, URY, VEN) 1961–2006 [ARG] 1997–2007 [BRA] 1990–2007 [MEX] 1991–2007 [PER] 1983–2006 [URY] 1998–2007] [VEN]	Time series	Multicointegration relationship among government revenues, expenditures, and debt, or alternatively analyzing the fiscal sustainability of the budgetary process.	Brazil and Venezuela exhibited sustainable fiscal policies, with Brazil demonstrating a faster adjustment speed compared to Venezuela. Argentina, Mexico, and Uruguay show unsustainable fiscal policies where deficits have been the norm. Peru does not satisfy the intertemporal budget constraint; but demonstrates the generation of budget surpluses.	Yes [BRA, VEN] No [4 others]
Donoso & Martin (2014)	18 LATAM (ARG, BOL, BRA, CHL, COL, CRI, DOM, ECU, ESL, GTM, HND, MEX, NIC, PAN, PRY, PER, URY, VEN) Various periods spanning from 1970s to 2010	Time series	Balances as share of GDP. Traditional unit root tests, considering possibility of structural breaks. Test for linearity in and analysis of current account stationarity by means of nonlinear unit root tests	Sustainable path for all except for ARG, BRA, CHL and PRY. The current account of several countries follows a nonlinear adjustment	No [ARG, BRA, CHL, PRY] Yes [14 others]
Alagidede & Tweneboah (2015)	6 LAC (BHS, BRA, GTM, NIC, PER, URY) 1990–2012	Panel data	Expenditure and revenue as share of GDP.	Application of a battery of panel unit root and stationarity tests to analyze the properties of the data generation process and verify whether the properties are integrated. Tests for cointegration between government expenditure and revenue in the panel	Yes

(Contd.)

AUTHOR	COUNTRIES AND PERIOD	ECONO-METRICS	EMPIRICAL TESTS AND VARIABLES	KEY FINDINGS	FISCAL SUSTAINABILITY?*
Del Cristo & Puig (2016).	Ecuador 2001:01–2013:03	Time series	Log of government spending net of interests, and also including interests, the log of non-oil tax revenues, and the log of oil revenues, the log of Economic Activity Index (EAI), the log of the total debt-to-GDP ratio, and the inflation rate. Assessment of the effects of dollarization on fiscal sustainability, application of a cointegrated VAR approach.	A dollarized country that cannot benefit from the 'seignorage' revenues, the reliance on volatile oil revenues and on smoothing tax revenues leaves the economy's fiscal sustainability vulnerable.	Yes
Robledo & Velandia (2015)	8 LATAM (ARG, CHL, COL, ECU, PAN, PER, PRY, URY) 1960–2009	Panel data	Revenues and primary expenditures as share of GDP Second-generation cointegration panel data model	Empirical evidence of fiscal sustainability for all the studied countries, but only in a weak sense.	Yes
Christophe & Llorca (2017)	20 LAC (ARG, BOL, BRA, CHL, COL, CRI, CUB, DOM, ECU, ESL, GTM, HTI, HND, MEX, NIC, PAN, PRY, PER, URY, VEN) 1990–2012	Panel data	Budget deficit and public debt as share of GDP Panel cointegration tests	Long-run relationship between government revenue and spending. The estimate of the panel cointegrating regression in an error correction model indicates that the budget deficit turns out to be weakly sustainable.	Yes
Tran (2018)	14 emerging economies 1999–2016	Time series	EMBI spreads, Debt and Volatility Index (VIX) Threshold analysis to the determination of debt limit	Fiscal sustainability is far more challenging for most Latin-American economies. This is indicated by their debt accumulation beyond the threshold level of roughly 35% of GDP which is relatively lower than that estimated for the other countries.	Yes [CHL] No [BRA, COL, MEX, ARG]
Campos & Cysne (2019)	2003–2016 Brazil	Time series	Net debt, primary surplus, output gap, interest rate, debt risk, inflation, deficit in the current balance of payments and terms of trade. Fiscal reaction functions with time-varying coefficients. Three estimation methods are considered: Kalman filter, penalized spline smoothing and time-varying cointegration.	Brazilian public debt reached an unsustainable trajectory in the last years of the sample.	No
Cevik & Nanda (2020).	16 Caribbean countries 1980–2018	Panel data	Debt-to-GDP ratio, output gap primary balance, real GDP per capita, inflation, trade openness and financial development. Fiscal reaction function	The results indicate that fiscal policy in the Caribbean takes corrective actions to counteract an increase in the debt-to-GDP ratio. Nonlinear estimations indicates that fiscal policy response is not adequate to ensure sustainability at higher levels of debt	Yes [linear model] No [nonlinear model]
Lozano-Espitia & Julio-Román (2020)	5 LAC (CHL, COL, ECU, MEX, PER) 1980–2018	Times series	Primary balance, debt GAP GDP, GAP Gov. Spending, IMF Arrangement, Fiscal Rule, Openness, Dependent Population and Inflation Fiscal Reaction Function	The paper finds that Peru (50% of GDP) and Chile (39%) seem to have the highest fiscal space while Ecuador (13%) has the lowest. Fiscal space for Mexico, in turn, looks like Colombia´s (16%).	Yes

(Contd.)

AUTHOR	COUNTRIES AND PERIOD	ECONO-METRICS	EMPIRICAL TESTS AND VARIABLES	KEY FINDINGS	FISCAL SUSTAINABILITY?*
Yersh (2020)	24 LAC (ARG, BHS, BLZ, BOL, BRA, CHL, COL, CRI, DOM, ECU, SLV, GTM, HTI, HND, JAM, MEX, NIC, PAN, PRY, PER, TTO, URY, VEN) 1984–2017	Panel data	A framework that involves estimating a cointegrating relationship between domestic saving and investment instead of conducting unit root testing of current account deficit or cointegration analysis of imports and exports.	Current account deficit weakly sustainable in the Latin American and Caribbean region, MERCOSUR, and SICA while it's strongly unsustainable in the Andean Community	Yes [LAC, MERCOSUR, SICA groups] No [Andean Community group]
Aquino et al. (2021)	Uruguay 1989–2017	Time series	Analysis of the balance sheet dynamics of the consolidated public sector and using a more comprehensive data set in institutional coverage, debt structure and higher frequency data. Then, we conduct a prospective analysis, where fiscal variables are determined within a macroeconometric model including an empirical fiscal reaction function	The main debt dynamics drivers come from the fiscal-financing perspective (interest payments, primary deficit, monetary base) and the macroeconomic framework (inflation, currency depreciation, real GDP growth).	Yes
Campos & Cysne (2021)	18 emerging countries 2001–2016	Time series	debt limits based on a non-linear econometric model.	The authors found that those countries whose debt-to-GDP ratio exceeded their limits had problems to get new loans.	Yes [BRA, CHL, COL, DOM, ECU MEX, PER, URY] No [ARG, URY]
Campos & Cysne (2022)	Brazil 1997–2018	Time series	Multicointegration with structural breaks	The unsustainability of the debt/GDP ratio	No

ANNEX II: PANEL UNIT ROOT TEST (CARRION-I-SILVESTRE ET AL. 2005)

Conventional unit root tests are inappropriate in the presence of cross dependence (Barbieri 2009) or structural breaks (Campos et al. 1996; Westerlund & Edgerton 2008). Carrion-i-Silvestre et al. (2005) proposed a unit-root test to properly incorporate these features. The underlying model is:

$$y_{it} = \alpha_i + \sum_{k=1}^{m_i} \theta_{ik} DU_{ikt} + \beta_i t + \sum_{k=1}^{m_i} \gamma_{ik} DT^*_{ikt} + \varepsilon_{it} \qquad \text{(II.1)}$$

The dummy variables DU_{ikt} and DT^*_{ikt} are defined as follows:

$$DU_{ikt} = \begin{cases} 1, \text{if } t > T^i_{bk} \\ 0, \text{otherwise} \end{cases} \quad ; \quad DT^*_{ikt} = \begin{cases} t - T^i_{bk}, \text{if } t > T^i_{bk} \\ 0, \text{otherwise} \end{cases}$$

where T^i_{bk} denotes the breakpoint k for the unit i, $k = 1, 2, \ldots m_i$; $m_i \geq 1$, α_i is a constant, β_i is a time trend and ε_{it} is the error term. The null hypothesis is stationarity (contrary to most of the traditional unit root tests). The statistic is:

$$LM(\lambda) = \frac{1}{N} \sum_{i=1}^{N} \hat{\omega}_i^{-2} T^{-2} \sum_{i=1}^{N} \hat{S}^2_{it} \qquad \text{(II.2)}$$

where $\hat{S}_{it} = \sum_{j=1}^{t} \hat{\varepsilon}_{ij}$ is obtained from residuals of (II.1) and $\hat{\omega}_i$ is a consistent estimate of the variance of ε_{it}. Further details in Carrion-i-Silvestre et al. (2005).

ANNEX III: CONTROL VARIABLES

VARIABLES	SOURCE	DEFINITION
Current account balance (*bal*)	WB[a]	Sum of net exports of goods and services, net primary income, and net secondary income.
Commodity Export Price Index (*cepi*)	IMF[b]	The Commodity Export Price Index (individual commodities weighted by the ratio of export to GDP) captures variations in commodity prices relative to exports by combining international price data with country-level export data for 45 commodities.
Commodity Import Price Index (*cipi*)	IMF[b]	The Commodity Import Price Index (individual commodities weighted by the ratio of import to GDP) captures international variations in commodity prices relative to imports by combining international price data with country-level import data for 45 commodities.
Commodity terms-of-trade index (*ctti*)	IMF[b]	Country-specific commodity price indices, including export, import, and terms-of-trade indices. For each country, the change in the international price of up to 45 individual commodities is weighted using commodity-level trade data.
Foreign direct investment, net inflows (*finv*)	WB[a]	Foreign direct investment is the amount of capital invested in an economy by foreign investors. It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the balance of payments, minus the capital invested by residents abroad (net inflows = investment inflows less disinvestment).
Net capital account (*nca*)	WB[a]	Net capital account records acquisitions and disposals of nonfinancial assets, such as land sold to embassies and sales of leases and licenses, as well as capital transfers, including government debt forgiveness.
Net financial account (*nfa*)	WB[a]	Net financial account shows net acquisition and disposal of financial assets and liabilities. It measures how net lending to or borrowing from nonresidents is financed.
Real GDP growth (*g*)	IMF[c]	Growth rate of the total value at constant prices of final goods and services produced within a country during a specified time period, such as one year.
Trade openness (*opn*)	WB[a]	Sum of exports and imports of goods and services.

Table A Potential control variables.

Note: All variables are measured as a share of GDP, except for Real GDP growth (*g*).

[a] https://databank.worldbank.org/source/world-development-indicators#.

[b] https://data.imf.org/?sk=2cddccb8-0b59-43e9-b6a0-59210d5605d2.

[c] https://www.imf.org/external/datamapper/NGDP_RPCH@WEO/ARG/BOL/BRA/CHL/COL/CRI/DOM/SLV/GTM/HTI/HND/MEX/NIC/PAN/PRY/PER/URY/ECU.

	VARIABLES	CONSTANT		CONSTANT AND TREND		BREAK IN CONSTANT	
		STATISTICS	PROB	STATISTICS	PROB	STATISTICS	PROB
Levels	*g*	9,13	0,001	6,68	0,021	3,47	0,044
	opn	8,14	0,002	7,66	0,002	5,24	0,006
	nca	6,86	0,001	5,02	0,016	2,61	0,033
	nfa	6,39	0,001	4,68	0,015	2,43	0,031
	cepi	6,54	0,002	6,16	0,002	4,21	0,005
	cipi	9,15	0,002	8,62	0,002	5,90	0,007
	ctti	5,97	0,001	4,37	0,014	2,27	0,029
	bal	5,89	0,001	4,31	0,014	2,24	0,028
	finv	4,12	0,000	3,02	0,009	1,57	0,020
First differences	*g*	1,79	0,212	1,29	0,336	–0,65	0,651
	opn	1,62	0,281	3,43	0,012	0,52	0,356
	nca	1,35	0,159	0,98	0,252	–0,49	0,489
	nfa	1,25	0,148	0,91	0,235	–0,46	0,456
	cepi	1,30	0,226	1,96	0,090	0,42	0,286
	cipi	1,83	0,316	3,06	0,078	0,59	0,400
	ctti	1,17	0,139	0,85	0,220	–0,43	0,426
	bal	1,16	0,137	0,84	0,217	–0,42	0,420
	finv	0,81	0,096	0,59	0,152	–0,29	0,294

Table B Unit root tests for control variables (Carrion-i-Silvestre et al. 2005).

VARIABLES	FULLY MODIFIED		BIAS CORRECTED	
	COEFFICIENT	T-STATISTICS	COEFFICIENT	T-STATISTICS
g	–0,305**	–2.123	–0,289**	–2.420
opn	0,122**	2.852	0,151**	2.185
nca	0,217*	0.685	0,329*	0.774
nfa	–0,305**	–2.410	–0,289**	–2.412
cepi	–0,283**	–2.312	–0,268**	–1.954
ctti	0,035**	1.964	0,049**	2.211
bal	0,217*	1.190	0,329**	2.102
finv	0,023*	0.963	0,038*	0.854

Table C Cup-FM and cup-BC tests for long-run estimations.

Note: (*), (**), and (***) denote statistical significance at the 0,01, 0,05 and 0,1 levels, respectively.

ANNEX IV: UNIFIED ANALYSIS FOR THE WHOLE PANEL

Table D reports the results of CD test for the whole panel of 18 countries.

	CD TEST	*p*-VALUE	AVERAGE CORRELATION COEFFICIENT	ABSOLUTE CORRELATION COEFFICIENT
Revenue	6.33*	0.087	0.144	0.225
Expenditures	4.91*	0.069	0.231	0.317

Table D CD tests (whole panel).

Note: (***), (**), and (*) denote statistical significance at the 0.01, 0.05 and 0.1 levels, respectively.

The hypothesis of cross-sectional independence was rejected for both series (at the 0.1 level). As for structural breaks, the Ditzen test led to not reject the null hypothesis of common breaks at the 0.05 level (p-value of F-statistic = 0.062).[32] Table E reports these breaks.

		F(1|0)	F(2|1)	F(3|2)	F(4|3)	F(5|4)
Critical Values	1%	12.29	13.89	14.80	15.28	15.76
	5%	8.58	10.13	11.14	11.83	12.25
	10%	7.04	8.51	9.41	10.04	10.58
Test Statistic		13.67***	11.54**	8.67	4.94	2.24

Table E Ditzen et al. (2021) Test for structural breaks (whole panel).

Note: (***), (**) and (*) denote statistical significance at the 0.01, 0.05 and 0.1 levels, respectively.

There are only two breakpoints affecting the cointegration relationship, which are at the 0.05 level. The first one, in 2008–2009, may be attributed to the consequences of the global financial crisis. The other break, in 2020–2021, may be explained by the COVID-19 pandemic. We then applied the panel unit root test by Carrion-i-Silvestre et al. (2005), incorporating these breakpoints. Results in Table F.

		CONSTANT		CONSTANT AND TREND		BREAK IN CONSTANT	
		STATISTICS	PROB	STATISTICS	PROB	STATISTICS	PROB
Levels	Revenue	9.131***	0.001	6.687**	0.021	3.470**	0.044
	Expenses	8.143***	0.002	7.668***	0.002	5.244***	0.006
First differences	Revenue	1.792	0.212	1.299	0.336	–0.653	0.651
	Expenses	1.625	0.281	3.436	0.012	0.528	0.356

Table F Unit root test (Carrion-i-Silvestre et al. 2005) (whole panel).

Note: (***), (**), and (*) denote statistical significance at the 0.01, 0.05 and 0.1 levels, respectively.

32 Since the common breaks were not evidenced at the 0.05 level, we also implemented, for robustness, the model with the individual breaks for each country, by the Bai and Perron (1998) procedure. However, the results were similar (the estimated breaks and results may be sent by request), thus leading to the same conclusions as the constrained model.

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From Table F, the null hypothesis of stationarity[33] is rejected for both series at the 0.05 level, whichever the adopted specification, suggesting that both series are nonstationary even when structural breaks are incorporated into the model.

Finally, since cross-dependence and structural breaks were evidenced, we proceed with the investigation of the long-run equilibrium relationship between revenue and expenses by applying the Westerlund and Edgerton (2008) test, which incorporate both features. Table G reports the results.

Table G Panel cointegration test (Westerlund and Edgerton 2008).

Note: (***), (**), and (*) denote statistical significance at the 0.01, 0.05, and 0.1 levels, respectively.

	NO BREAK		LEVEL BREAK		REGIME SHIFT	
	STATISTICS	*p*-VALUE	STATISTICS	*p*-VALUE	STATISTICS	*p*-VALUE
$Z_\tau(N)$	0.322	0.563	−0.437	0.395	−0.913	0.227
$Z_\phi(N)$	0.337	0.569	−0.331	0.414	−0.787	0.258

Since both p-values are higher than 0.1, we do not reject the null hypothesis of no cointegration, whichever structural breaks are considered or not. Therefore, the panel of 18 Latin American countries was found to be fiscally unsustainable. As for the effects of structural breaks, the γ coefficients are in Table H.[34]

Table H Estimated breakpoints (and 95% CIs) (whole panel).

Note: (***), (**), and (*) denote statistical significance at the 0.01, 0.05, and 0.1 levels, respectively.

STRUCTURAL BREAKS	COEFFICIENTS	95% CONFIDENCE INTERVALS
$\gamma_{(2008-2009)}$ (regime)	−0.26**	(−0.37, −0.15)
$\gamma_{(2020-2021)}$ (regime)	−0.45***	(−0.54, −0.36)

ANNEX V: UNIT ROOT TEST WITHIN GROUPS (CARRION-I-SILVESTRE ET AL. 2005)

	VARIABLE[35]	LEVEL						FIRST DIFFERENCES					
		CONSTANT		CONSTANT AND TREND		BREAK IN CONSTANT		CONSTANT		CONSTANT AND TREND		BREAK IN CONSTANT	
		stat	prob	stat	prob	stat	prob	stat	prob	stat	prob	stat	prob
A	revenue	9.13	0.001	6.69	0.021	3.47	0.044	1.79	0.212	1.299	0.336	−0.653	0.651
	expenditures	8.14	0.002	7.67	0.002	5.24	0.006	1.62	0.281	2.436	0.112	0.528	0.356
B	revenue	10.16	0.001	7.44	0.023	3.86	0.049	1.99	0.236	1.45	0.374	−0.73	0.725
	expenditures	9.06	0.002	8.53	0.002	5.84	0.007	1.81	0.313	2.71	0.125	0.59	0.396
C	revenue	11.31	0.001	8.28	0.026	4.30	0.045	2.22	0.263	1.61	0.416	−0.81	0.806
	expenditures	10.09	0.002	9.50	0.002	6.50	0.007	2.01	0.348	3.02	0.139	0.65	0.441

ANNEX VI: OVERIDENTIFIED BREAKPOINTS WITHOUT CONTROL VARIABLES

Here we try to identify which breaks would have been misidentified if the control variables were absent. By comparing Tables 9 and 10 to 4 and 5, we see that the most remarkable difference is that a new structural break, corresponding to the years 2013–2014, would appear for groups A

33 Note that the null hypothesis is no longer rejected if we differentiate the series, thus confirming only one unit root.

34 For our purposes of fiscal sustainability analysis, the relevant breaks are the regime-shift ones since they measure effects on the magnitude of the cointegration parameters. The level breaks only represent the effects on the expenditure.

35 Remember that the H_0 here is different from that of the usual unit root tests, as explained in Annex II. Note also that the null hypothesis is no longer rejected if we differentiate both series, thus confirming only one unit root for all groups.

and B. It may be explained by the Fed (Federal Reserve) tapering in 2013,[36] which heavily impacting the international bond flows and the balance of payments to Latin American countries (Bussiere and Phylaktis 2016; Góes et al. 2017; Julio et al. 2013), thereby leading to a reversal in capital flows. The control variable nfa_{it} seems to have been the most important one for controlling for the Fed tapering impacts, thereby avoiding its misidentification as a structural break. As for the breaks that had already been identified, there also have been changes. The effect of the commodities boom and 2008 financial crisis would have been overestimated without control variables. The level of exports and the capital flows, g_{it}, opn_{it}, $cepi_{it}$ and nca_{it} must have played a role to avoid the overestimation of the impact of the commodities boom.[37] The impact of the 2008 crisis on public accounts was through the effect on the flow of capital and, maybe to a lesser extent, the degree of openness, the inclusion of opn_{it} and nca_{it} seem to have partially controlled its effect. With regard to the impact of COVID, we see from Table 10 that it would be identified as a break even in the absence of controls, thus not isolating the indirect effects through variables such as g_{it} and nca_{it}. Nevertheless, it would have showed a stronger significance level for B and C.

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COMPETING INTERESTS

The authors have no competing interests to declare.

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REFERENCES

Alagidede, Paul, and **George Tweneboah.** 2015. "On the sustainability and synchronization of fiscal policy in Latin America." *Latin American Journal of Economics* 52(2): 213–240. DOI: https://doi.org/10.7764/LAJE.52.2.213

Alberola, Enrique, José María Montero, Matías Braun, and **Tito Cordella.** 2006. "Debt Sustainability and Procyclical Fiscal Policies in Latin America." *Economía* 7(1): 157–193. DOI: https://doi.org/10.1353/eco.2007.0000

36 As the US economy recovered from the 2008 crisis, the Fed reduced its asset purchases, leading to higher US interest rates and a stronger dollar. It led investors to redirect capital from emerging markets towards the US in anticipation of higher returns, thereby leading to currency depreciations, reduced liquidity, and increased borrowing costs for the Latin American countries, mainly because of their large current account deficits, high levels of external debt, and weak domestic financial systems. This impact was reduced in service-based small economies, such as those included in group C, whose terms of trade moved in the opposite direction than those of their Latin American counterparts—upwards, instead of downwards—in the two-to-three years following this event. In fact, even an opposite trend could be expected for these countries, since they are net importers rather than net exporters of commodities.

37 We also estimated the model only with g_{it} variable, without the other three, and observed that the structural break referring to the commodities boom showed the same significance levels as in Table 7, which confirms that its impact would still have been overestimated if we did not incorporate other control variables.

Amba, Marius, Taoufiki Mbratana, and **Kane Quentin.** 2017. "Assessing the Current Account Sustainability in ECCAS Economies: A Dual Cointegration Analysis." *Economics Bulletin* 37(3): 1873–1894.

Aquino, Alejandro, Verónica España, Rosanna Fernández, and **Leonardo Vicente.** 2021. Fiscal Sustainability in Uruguay: a Balance Sheet Dynamics Approach. *Center for Latin American Monetary Studies (CEMLA)*. Available at: https://www.cemla.org/PDF/ic/2021-jrp-05/Uruguay_JRP2019-old20210917.pdf.

Bai, Jushan, and **Chihwa Kao.** 2006. "On the Estimation and Inference of a Panel Cointegration Model with Cross-Sectional Dependence." *Contributions to Economic Analysis* 274: 3–30. DOI: https://doi.org/10.1016/S0573-8555(06)74001-9

Bai, Jushan, Chihwa Kao, and **Serena Ng.** 2009. "Panel Cointegration with Global Stochastic Trends." *Journal of Econometrics* 149(1): 82–99. DOI: https://doi.org/10.1016/j.jeconom.2008.10.012

Bai, Jushan, and **Pierre Perron.** 1998. "Estimating and Testing Linear Models with Multiple Structural Changes." *Econometrica*, 47–78. DOI: https://doi.org/10.2307/2998540

Baltagi, Badi Hani, and **Mohammad Hashem Pesaran.** 2007. "Heterogeneity and Cross Section Dependence in Panel Data Models: Theory and Applications Introduction." *Journal of Applied Econometrics* 22(2): 229–232. DOI: https://doi.org/10.1002/jae.955

Barbieri, Laura. 2009. "Panel Unit Root Tests Under Cross-Sectional Dependence: An Overview." *Journal of Statistics: Advances in Theory and Applications* 1(2): 117–158.

Bertussi, Luiz Alberto Scudeler, and **Daniel Triches.** 2012. "Multicointegração e políticas fiscais: uma avaliação de sustentabilidade fiscal para Argentina, Brasil, México, Peru, Uruguai e Venezuela." *Revista Economía* 13(2): 303–325.

Balakrishnan, Ravi, and **Federico Toscani.** 2018. Como o boom das commodities ajudou a reduzir a pobreza e a desigualdade na América Latina. Fundo Monetário Internacional online. Available at: https://www.imf.org/pt/News/Articles/2018/06/20/blog-how-the-commodity-boom-helped-tackle-poverty-and-inequality-in-latin-america.

Blanchard, Olivier Jean, Peter Diamond, Robert Ernest Hall, and **Kevin Murphy.** 1990. "The Cyclical Behavior of the Gross Flows of US Workers." *Brookings Papers on Economic Activity* 2: 85–155. DOI: https://doi.org/10.2307/2534505

Benítez, María Alejandra, Carolina Velasco, Ana Rita Sequeira, Josefa Henríquez, Flavio M. Menezes, and **Francesco Paolucci.** 2020. "Responses to COVID-19 in Five Latin American Countries." *Health Policy and Technology* 9(4): 525–559. DOI: https://doi.org/10.1016/j.hlpt.2020.08.014

Brady, Gordon L., and **Cosimo Magazzino.** 2020. "Fiscal Sustainability in the EU." *Atlantic Economic Journal* 46(3): 297–311. DOI: https://doi.org/10.1007/s11293-018-9588-4

Bussiere, Matthieu, and **Kate Phylaktis.** 2016. "Emerging Markets Finance: Issues of International Capital Flows—Overview of the Special Issue." *Journal of International Money and Finance* 60: 1–7. DOI: https://doi.org/10.1016/j.jimonfin.2015.09.007

CAF. 2021. "O desafio do desenvolvimento na América Latina. Políticas para uma região mais produtiva, integrada e inclusiva." Caracas: CAF. Retrieved from http://scioteca.caf.com/handle/123456789/1743.

Campos, Eduardo Lima, and **Rubens Penha Cysne.** 2019. "A Time-Varying Fiscal Reaction Function for Brazil." *Estudos Econômicos (São Paulo)* 49(1): 5–38. DOI: https://doi.org/10.1590/0101-41614911ecr

Campos, Eduardo Lima, and **Rubens Penha Cysne.** 2020. "Sustainability of the Brazilian Public Debt: an Analysis Using Multicointegration." *Estudios Económicos* 37(75): 5–25. DOI: https://doi.org/10.52292/j.estudecon.2020.1944

Campos, Eduardo Lima, and **Rubens Penha Cysne.** 2021. "Estimating Debt Limits for Emerging Countries." *International Review of Economics & Finance* 76: 836–855. DOI: https://doi.org/10.1016/j.iref.2021.07.014

Campos, Eduardo Lima, and **Rubens Penha Cysne.** 2022. "Sustainability of Brazilian public debt: a structural break analysis." *International Journal of Emerging Markets* 17(3): 645–663. DOI: https://doi.org/10.1108/IJOEM-11-2019-0936

Campos, Julia, Neil R. Ericsson, and **David F. Hendry.** 1996. "Cointegration Tests in the Presence of Structural Breaks." *Journal of Econometrics* 70(1): 187–220. DOI: https://doi.org/10.1016/0304-4076(94)01689-5

Carrion-i-Silvestre, Josep Lluis, Tomas del Barrio-Castro, and **Enrique Lopez-Bazo.** 2005. "Breaking the Panels: an Application to the GDP Per Capita." *The Econometrics Journal* 8(2): 159–175. DOI: https://doi.org/10.1111/j.1368-423X.2005.00158.x

Cavallo, Eduardo, Barry Eichengreen, and **Ugo Panizza.** 2018. "Can Countries Rely on Foreign Saving for Investment and Economic Development?" *Review of World Economics* 154: 277–306. DOI: https://doi.org/10.1007/s10290-017-0301-5

Celasun, Oya, Jonathan D. Ostry, and **Xavier Debrun.** 2007. "Primary Surplus Behavior and Risks to Fiscal Sustainability in Emerging Market Countries: A 'Fan-Chart' approach." *IMF Staff Papers* 53(3): 401–425. DOI: https://doi.org/10.2307/30035919

Cepal, NU. 2021. Financing for Development in the Era of COVID-19 and Beyond. *ECLAC*. Available at: https://hdl.handle.net/11362/46711.

Cevik, Serhan, and **Vibha Nanda.** 2020. "Riding the Storm: Fiscal Sustainability in the Caribbean." *International Review of Applied Economics* 34(3): 384–399. DOI: https://doi.org/10.1080/02692171.2020.1749241

Checherita-Westphal, Cristina, Andrew Hughes Hallett, and **Philipp Rother.** 2014. "Fiscal Sustainability Using Growth-Maximizing Debt Targets." *Applied Economics* 46(6): 638–647. DOI: https://doi.org/10.1080/00036846.2013.861590

Chortareas, Georgios E., George Kapetanios, and **Merih Uctum.** 2004. "An Investigation of Current Account Solvency in Latin America Using Non Linear Nonstationarity Tests." *Studies in Nonlinear Dynamics & Econometrics* 8(1). DOI: https://doi.org/10.2202/1558-3708.1200

Chortareas, Georgios E., George Kapetanios, and Merih Uctum. 2008. "Nonlinear Alternatives to Unit Root Tests and Public Finances Sustainability: Some Evidence from Latin American and Caribbean Countries." *Oxford Bulletin of Economics and Statistics* 70(5): 645–663. DOI: https://doi.org/10.1111/j.1468-0084.2008.00511.x

Christophe, Ehrhart, and **Matthieu Llorca.** 2017. "Fiscal Sustainability in Central and Latin America Countries: Evidence from a Panel Cointegration Approach." *Economics Bulletin* 37(4): 2292–2300.

Del Cristo, María Lorena Marí, and **Marta Puig.** 2016. "Fiscal Sustainability and Dollarization: the Case of Ecuador." *Applied Economics* 48(23): 2139–2155. DOI: https://doi.org/10.1080/00036846.2015.1114580

Ditzen, Jan, Yiannis Karavias, and **Joakim Westerlund.** 2021. "Testing and Estimating Structural Breaks in Time Series and Panel Data in Stata." ArXiv Working Paper No. arXiv:2110.14550. Available at: https://arxiv.org/abs/2110.14550.

Donoso, Vicente, and **Victor Martin.** 2014. "Current Account Sustainability in Latin America." *The Journal of International Trade & Economic Development* 23(5): 735–753. DOI: https://doi.org/10.1080/09638199.2013.775322

Duran-Vazquez, Rocio, Arturo Lorenzo-Valdes, and **Antonio Ruiz-Porras.** 2011. Valuation of Latin-American Stock Prices with Alternative Versions of the Ohlson Model: An Investigation of Cointegration Relationships with Time-Series and Panel-Data. *MPRA Paper Num 32043*. University Library of Munich, Germany.

Engle, Robert F., and **Clive W. Granger.** 1987. "Co-Integration and Error Correction: Representation, Estimation, and Testing." *Econometrica: Journal of the Econometric Society* 55(2): 251–276. DOI: https://doi.org/10.2307/1913236

Fournier, Jean-Marc, and **Falilou Fall.** 2015. "Limits to Government Debt Sustainability." *OECD Economics Department Working Papers*, No. 1229, OECD.

Hakkio, Craig S., and **Mark Rush.** 1991. "Cointegration: How Short is the Long Run?" *Journal of international Money and Finance* 10(4): 571–581. DOI: https://doi.org/10.1016/0261-5606(91)90008-8

Hartlyn, Jonathan. 2019. Latin American Political Economy: Financial Crisis and Political Change. New York: Routledge. DOI: https://doi.org/10.4324/9780429036316

Góes, Carlos, Hakan Kamil, Mercedes Garcia-Escribano, Richard A. Perrell, and **Jonathan Zook.** 2017. "Spillovers from US Monetary Policy Normalization on Brazil and Mexico's Sovereign Bond Yields." *IMF Working Paper WP/7/50*, 1–38. Washington, DC. DOI: https://doi.org/10.2139/ssrn.2958201

Gruss, Bertrand, and **Suhaib Kebhaj.** 2019. Commodity Terms of Trade: A New Database. *International Monetary Fund*. Available at: https://www.imf.org/en/Publications/WP/Issues/2019/01/24/Commodity-Terms-of-Trade-A-New-Database-46522.

Holmes, Mark J. 2006. "Do Latin American Countries have an Incentive to Default on Their External Debts? A Perspective Based on Long-Run Current Account Behavior." *Emerging Markets Finance and Trade* 42(1): 33–49. DOI: https://doi.org/10.2753/REE1540-496X420102

Hwang, Jae-Kwang. 2014. "Spillover Effects of the 2008 Financial Crisis in Latin America Stock Markets." *International Advances in Economic Research* 20: 311–324. DOI: https://doi.org/10.1007/s11294-014-9472-1

IIF. 2020. "GMV: China and the EM Positioning Overhang." https://www.iif.com/Research/lapg-840/63.

International Monetary Fund – IMF. 2015. Perspectivas económicas. Las Américas. Estudios económicos y financieros. (ISBN: 978-1-51350-820-7), Washington, DC.

Issler, Joao Victor, and **Luiz Renato Lima.** 2000. "Public Debt Sustainability and Endogenous Seigniorage in Brazil: Time-Series Evidence from 1947–1992." *Journal of Development Economics* 62(1): 131–147. DOI: https://doi.org/10.1016/S0304-3878(00)00078-X

Julio, Juan Manuel, Ignacio Lozano, and **Ligia Alba Melo.** 2013. "Global Risk Appetite and EMBI-Colombia: Evidence on a Structural Break and the Fiscal Policy Role." *Ensayos Sobre Política Económica* 31(72): 67–73. DOI: https://doi.org/10.1016/S0120-4483(13)70005-8

Kalyoncu, Huseyin, and **Ilhan Ozturk.** 2010. "Sustainability of Current Account for Latin America and Caribbean Countries." *Applied Economics Letters* 17(8): 781–785. DOI: https://doi.org/10.1080/13504850802359937

Khadan, J. 2019. *Fiscal Sustainability in the Caribbean: An Econometric Analysis (No. IDB-WP-1014)*. IDB Working Paper Series. DOI: https://doi.org/10.18235/0001758

Lozano-Espitia, Ignacio, and **J. Manuel Julio-Román.** 2020. "Debt Limits and Fiscal Space for Some Latin American Economies." *Latin American Journal of Central Banking* 1(1–4): 100006. DOI: https://doi.org/10.1016/j.latcb.2020.100006

Maddala, Gangadharrao S., and **Shaowen Wu.** 1999. "A Comparative Study of Unit Root Tests with Panel Data and New Simple Test." *Oxf. Bull. Econ. Stat.* 61: 631–652. DOI: https://doi.org/10.1111/1468-0084.0610s1631

Martins, Luis F., and **Paulo M. M. Rodrigues.** 2022. "Tests for Segmented Cointegration: an Application to US Governments Budgets." *Empirical Economics* 63(2): 567–600. DOI: https://doi.org/10.1007/s00181-021-02156-7

Martorano, Bruno. 2018. "Cyclicality of Fiscal Policy in Latin America Over the Period 1990–2015." *Review of Development Economics* 22(1): 67–90. DOI: https://doi.org/10.1111/rode.12329

McCoskey, Suzanne, and **Chihwa Kao.** 1998. "A Residual-Based Test of the Null of Cointegration in Panel Data." *Econometric Reviews* 17(1): 57–84. DOI: https://doi.org/10.1080/07474939808800403

Ocampo, José Antonio. 2007. La macroeconomía de la bonanza económica latinoamericana". Revista de la cepal, N° 93 (LC/G.2347-P). DOI: https://doi.org/10.18356/10ea5b8d-es

Ocampo, José Antonio. 2009. The Impact of the Global Financial Crisis on Latin America. *CEPAL Rev* 97, 9–32. DOI: https://doi.org/10.18356/9b28fc47-en

Pedroni, Peter. 1999. "Critical Values for Cointegration Tests in Heterogeneous Panels with Multiple Regressors." *Oxford Bulletin of Economics and Statistics* 61(S1): 653–670. DOI: https://doi.org/10.1111/1468-0084.0610s1653

Pedroni, Peter. 2004. "Panel Cointegration: Asymptotic and Finite Sample Properties of Pooled Time Series Tests with an Application to the PPP Hypothesis." *Econometric Theory* 20(3): 597–625. DOI: https://doi.org/10.1017/S0266466604203073

Pesaran, M. Hashem. 2004. "General Diagnostic Tests for Cross Section Dependence in Panels." University of Cambridge, Faculty of Economics, Cambridge Working Papers in Economics No. 0435. DOI: https://doi.org/10.2139/ssrn.572504

Quintos, Carmela E. 1995. "Sustainability of the Deficit Process with Structural Shifts." *Journal of Business & Economic Statistics* 13(4): 409–417. DOI: https://doi.org/10.1080/07350015.1995.10524615

Robledo, Jacobo Campo, and **Luis F. Melo-Velandia.** 2015. "Sustainability of Latin American Fiscal Deficits: A Panel Data Approach." *Empirical Economics* 49(3): 889–907. DOI: https://doi.org/10.1007/s00181-014-0905-8

Rosnick, David, and **Mark Weisbrot.** 2014. "Latin American Growth in the 21st Century: The 'Commodities Boom' that Wasn't (No. 2014-09)." Center for Economic and Policy Research (CEPR).

Singer, Paul. 2009. A América Latina na crise mundial. *Estudos Avançados* 23: 91–102. DOI: https://doi.org/10.1590/S0103-40142009000200008

Tran, Ngan. 2018. "Debt Threshold for Fiscal Sustainability Assessment in Emerging Economies." *Journal of Policy Modeling* 40(2): 375–394. DOI: https://doi.org/10.1016/j.jpolmod.2018.01.011

Vianna, Andre C., and **Andre V. Mollick.** 2021. "Threshold Effects of Terms of Trade on Latin American Growth." *Economic Systems* 45(4): 100882. DOI: https://doi.org/10.1016/j.ecosys.2021.100882

Westerlund, Joakim. 2005a. "A Panel CUSUM Test of the Null of Cointegration." *Oxford Bulletin of Economics and Statistics* 67(2): 231–262. DOI: https://doi.org/10.1111/j.1468-0084.2004.00118.x

Westerlund, Joakim. 2005b. "New Simple Tests for Panel Cointegration." *Econometrics Reviews* 24(3): 297–316. DOI: https://doi.org/10.1080/07474930500243019

Westerlund, Joakim, and **David L. Edgerton.** 2008. "A Simple Test for Cointegration in Dependent Panels with Structural Breaks." *Oxford Bulletin of Economics and statistics* 70(5): 665–704. DOI: https://doi.org/10.1111/j.1468-0084.2008.00513.x

Yersh, Valeryia. 2020. Current Account Sustainability and Capital Mobility in Latin American and Caribbean Countries. *MPRA Paper No. 105440*. Available at: https://mpra.ub.uni-muenchen.de/105440/.

Yeyati, Eduardo, and **Rodrigo Valdés.** 2020. COVID-19 en Latinoamérica: Diferencias respecto a las economías desarrolladas. International Development Policy| Revue internationale de politique de développement, (12.2).

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