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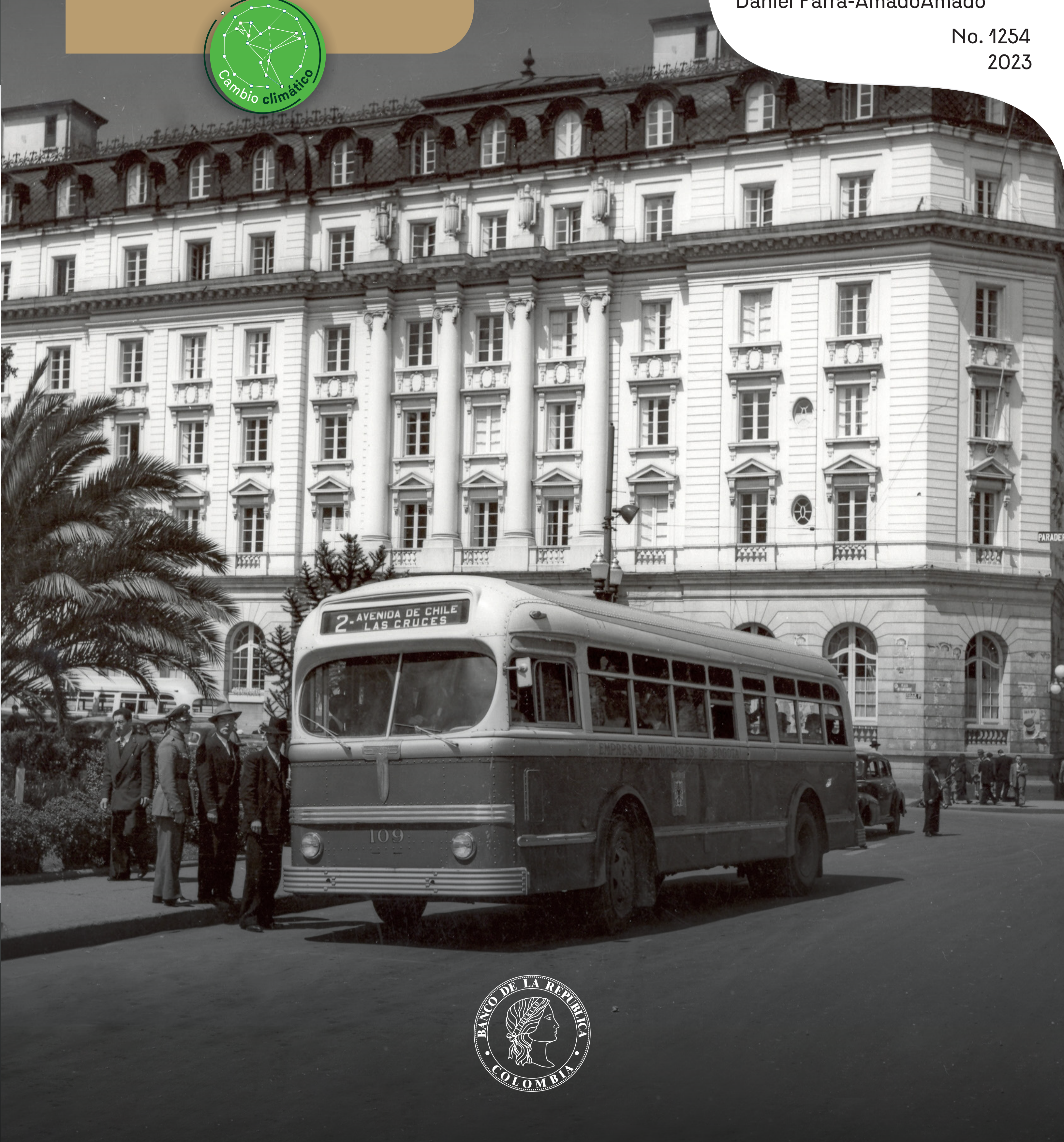

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Unveiling the critical role of forest areas amidst climate change: The Latin American case

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The results and opinions are exclusive responsibility of the authors and those do not commit Banco de la República nor its board of directors.

Abstract

Although greenhouse gas emissions from the Latin America (LAC) region are not particularly significant, climate change is a worldwide challenge. Hence, we analyze the main factors that increase and mitigate emissions in LAC countries by emphasising the importance of preserving and safeguarding forested regions. To do that, we estimate a Panel Fully Modified Ordinary Least Square model for Argentina, Brazil, Chile, Colombia, Ecuador, Mexico, and Peru by using a sample period between 1970 and 2018. We find that an increase of 1 % in forested area leads to a reduction of CO2 (Kt per capita) emissions by 0.23 %. From the policy perspective, our findings draw attention towards the promotion of reforestation and afforestation initiatives. Furthermore, these long term policies will hold substantial significance, given the region's immense potential, with more than a fifth of the world's forest reserves.

JEL codes: C33, Q23, Q56, E20.

keywords: CO2 emissions, Forestry, Reforestation, Panel FMOLS

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Revelando el papel crítico de las áreas forestales en medio del cambio climático: el caso latinoamericano

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Resumen

Aunque las emisiones de gases de efecto invernadero de la región de América Latina (LAC) no son particularmente significativas, el cambio climático es un desafío mundial. En este documento analizamos los principales factores que aumentan y mitigan las emisiones en los países de LAC enfatizando la importancia de preservar y salvaguardar las áreas forestales. Para hacer eso, estimamos un modelo panel de mínimos cuadrados ordinarios completamente modificados para Argentina, Brasil, Chile, Colombia, Ecuador, México y Perú utilizando un período de muestra entre 1970 y 2018. Encontramos que un aumento de 1 % en el área forestal conduce a una reducción de las emisiones de CO2 (Kt per cápita) en un 0,23 %. Desde la perspectiva de las políticas públicas, nuestros hallazgos llaman la atención hacia la promoción de iniciativas de reforestación y forestación. Además, estas políticas a largo plazo tendrían una importancia sustancial, dado el inmenso potencial de la región, con más de una quinta parte de las reservas forestales del mundo.

Clasificación JEL: C33, Q23, Q56, E20.

Palabras clave: Emisiones de CO2, Áreas forestales, reforestación, Panel FMOLS

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1. Introduction

Over the past decades, climate change has emerged as a significant focal point of global concern. The establishment of the Framework Convention on Climate Change (UNFCCC) in 1994 at the United Nations (UN), the Kyoto Protocol (1997-2015), and the Paris Agreement (2016 to date) have all helped to put climate change on the development agenda. Nonetheless, recent data points to the insufficiency of efforts to address this challenge (Höhne et al. (2020), Lamb et al. (2021)). According to the World Resources Institute, Greenhouse Gas Emissions (GHG) increased by 24.4%, from 38.669 to 48.117 megatonnes of carbon dioxide equivalent (Mt CO2 eq) between 2005 and 2019. At the same time, we have seen during those same years the presence of the warmest years in the recent history of the planet.

The swift proliferation of economic activities and their repercussions on environmental deterioration due to carbon dioxide (CO2) emissions have captured the attention of researchers. There is an indisputable and growing awareness regarding the necessity to reduce GHG and understand their connection to climate change. Some studies are concerned about the relationship between economic development and environmental deterioration (Grossman & Krueger (1991),Kijima et al. (2010), Pablo-Romero et al. (2017)), while others evaluate the interaction between GHG and energy consumption (Apergis & Payne (2009), Pao & Tsai (2010), Doğan & Değer (2018), Salari et al. (2021)) and the impact of the globalization on pollution (You & Lv (2018), Shahbaz et al. (2019)). On the other hand, the primary factors that contribute to the reduction of CO2 emissions include the utilization and generation of renewable energy (Bengochea & Faet (2012), Bilgili et al. (2016), Jebli et al. (2020)), as well as the preservation of forest areas (Lochhead et al. (2019), Di Sacco et al. (2021), Selvanathan et al. (2023)).

According to the Intergovernmental Panel on Climate Change (IPCC), forests acted as powerful carbon dioxide (CO2) storers, retaining roughly twice the amount of CO2 than they released between 2001 and 2019. As reported by Centre for Science Environment, forests around the world absorb around 15.6 gigatonnes (Gt) of carbon dioxide equivalent, while emissions from activities such as deforestation and other disturbances average around 8.1 Gt per year. Thus, the world's forests are net carbon sinks, absorbing approximately 7.6 Gt (CSE (2022)). To provide context, the United States, second-largest emitter of greenhouse gases in the world, after China, emitted 5.98 Gt of CO2, accounting about 13% of global emissions.[1]

In the Latin American (LAC) case, there are certain features that should be highlighted for the analysis of GHG and the factors that worsen the environment and those that help to mitigate. First, the composition of the source of emissions in LAC differs from other regions (Lamb et al. (2021)). While globally the energy sector is the largest contributor to emissions, in LAC stand out the agriculture sector. According to FAO (2021), the contribution of agriculture to emissions is closely to 72% of total emissions in Latin America during 2019. This is explained by a greater prevalence of land-intensive activities, such as cattle farming and extensive agriculture. Second, LAC region possesses a more environmentally friendly energy composition in comparison to the global average. LAC produces approximately 60 percent of electricity generation from renewable sources (hydropower), in contrast to the global average of less than 40 percent (Cárdenas & Orozco (2022)). Third, in the region, certain countries possess expansive forest areas, including a substantial portion of the Amazon rain-forest, positioning them as potential agents for mitigating climate change. As outlined by Food and Agriculture Organization (FAO), about 22% of the Earth's forests are located within Latin America.

In light of the aforementioned, the objective of this article is to provide statistical and quantitative evidence that corroborates the significance of forest areas in mitigating the effects stemming from CO2 emissions and the use of non-renewable energies. This analysis is conducted by using data from a panel of countries in LAC region. The principal sources of pollution of the region, encompassing agricultural sector and the utilization of non-renewable energy, are also be considered, all within the context of economies that have evolved due to the forces of globalization. Our main contribution to the existing environmental economic literature is asserting the critical role that the conservation of forest areas plays. According to our estimations, an increase of 1% in forest area within the countries of LAC leads to a reduction of CO2e (Kt per capita) emissions by 0.23% in which helps counterbalance the negative effects arising from both agricultural sector and non-renewable energy consumption. It is worth emphasizing the importance to highlight the significance of maintaining and restoring forest areas, as well as implementing afforestation projects (Caravaggio (2020)).

The structure of this article is as follows: Next section present a brief literature review about the interconnectedness between GHG emissions and a set of factors such as forest area, energy consumption and agricultural production. In Section 3, we present the data and methodology and show the main results and findings. The final section summarizes the drawn conclusions, accompanied by pertinent policy implications.

2. Literature review

The environmental economics literature has focused its efforts on establishing the relationship between economic growth and pollution which is commonly assessed through the Environmental Kuznets Curve (EKC) hypothesis. [2] Empirical research

[1] https://www.epa.gov/climate-indicators/climate-change-indicators-us-greenhouse-gas-emissions

[2] The Environmental Kuznets Curve (EKC) is a theoretical framework that posits an inverted U-shaped relationship between environmental degradation and economic development, suggesting that as a country's income per capita rises, environmental quality first deteriorates, but then improves after a certain income level is reached.

produces varying outcomes concerning the EKC, while some studies confirm the hypothesis such as Jaunky (2011), Pablo-Romero et al. (2017), Olale et al. (2018), Destek et al. (2018) and Adzawla et al. (2019), other studies find evidence against its (Caviglia-Harris et al. (2009), Ajmi et al. (2015), Wang et al. (2016), Lawson et al. (2020), Frodyma et al. (2022)). In Latin American case, Sapkota & Bastola (2017) and confirmed the validity of the EKC hypothesis for CO2 emissions by examining the annual data spanning from 1980 to 2010 across 14 countries. Bibi & Jamil (2021) found the same results for 21 Latin American economies over the period 2000 to 2018,[3] where the institutional quality, education and the trade openness are controls in the regression. Under this hypothesis, although all countries emit CO2, as these nations achieve higher economic development, the rate of emissions growth tends to decrease.

Given that this has been analized for LAC, we do not evaluate the EKC in this study, and instead we use the agricultural sector as control in our model since, as we mentioned before, it is the main source of emissions in the region. For instance, Appiah et al. (2018) broke down agricultural production into crop and livestock production indexes and found that a 1% increase in these variables results in an average increase in CO2 emissions of 27.6% and 28.2%, respectively, for selected emerging countries. Moreno-Moreno et al. (2018) examine eighteen countries in LAC region and find that only six (Argentina, Belize, Bolivia, Brazil, Costa Rica, and Mexico) nations prioritize not only boosting agricultural production but also managing and reducing their agricultural emissions.

In terms of globalization and energy (control variables in our model), Pata (2021) show evidence of its significant role in driving CO2 emissions in BRIC countries.[4] You & Lv (2018) analyze CO2 emissions and economic globalization in 83 countries, finding that globalization's negative indirect effect on environmental quality outweighs the positive direct effect of increased production on pollution, although the latter is statistically insignificant. This net negative effect suggests that proximity to highly globalized countries may improve environmental quality. Acheampong (2018) conducted a study using panel data for 116 countries, including LAC region over the period 1990 to 2014. The evidence suggests that the energy consumption is associated with a reduction in CO2 emissions in LAC countries due to the composition of energy sources thanks to those containing a high proportion of low-emission hydroelectric and renewable. In a study for OECD countries (Mujtaba et al. (2022)), which include the three main LAC economies, suggests that a 1% increase in renewable energy leads to a 0.2% reduction in CO2 emissions, while a 1% increase in non-renewable energy results in a 1.08% increase in CO2 emissions. Additionally, although renewable energy helps to mitigate pollution in these countries, it is noteworthy that 46% of such production is hydroelectric (Pata (2021)). The authors point out that its mitigating effect is counteracted because dams cause extensive land use and depletion of resources during their installation and production phases.

Finally, the foremost challenges within the climate change agenda in LAC are intricately tied to the governance and management of forested regions. These challenges encompass a spectrum of activities, such as reforestation, afforestation, and land-use initiatives. Calvin et al. (2016) reveal significant uncertainties in both current and future emissions, regardless of the presence or absence of climate policies in Latin American countries. When climate policies are implemented, variations in the future agriculture sector emissions are primarily attributed to disparities in mitigation strategies. In particular, the author states that afforestation leads to substantial reductions in emissions. Boillat et al. (2017) stand out the importance of monitoring change in land systems, develop a framework that embrace social inclusivity and the concerns inherent not only to the environmental but also to economic develop of the communities, and managing the relationship between local and national government authorities.

Although governance plays an important role in designing, executing and evaluating Forest Landscape Restoration (FLR) initiatives, Chazdon et al. (2021) states that LAC encounters significant challenges: i) establish mechanisms to harmonize communication, both among differents government stakeholders (National and local authorities), and between them and the communities targeted by the policies and, ii) strengthened collaboration, coherence and synchronization of policy aims between the central government and local municipalities, and iii) establish a legal and institutional framework for negotiating conflicts regarding land use and the property rights of private individuals. In this context, the availability of accurate and openly accessible information is is crucial for effective monitoring (Schweizer et al. (2021), Evans et al. (2023)). In addition, the author emphasize the potential role of global organizations in facilitating knowledge exchange and promoting learning.[5] Schweizer et al. (2021) show that LAC have well-established and obligatory legal frameworks governing a range of FLR initiatives. The authors mention that despite the interviewed stakeholders held favorable views regarding the content of these legal frameworks, they expressed more critical perspectives regarding to the actual implementation of these regulations. For instance, commercial forestry activities are overseen by the Ministry of Agriculture, while environmental forest restoration falls under the purview of the Ministry of Environment. However, the pursuit of FLR measures would continue to pose significant challenges, as it might compete for land resources and posing a risk to essential

[3]This study included other five different areas including East Asia and the Pacific, Europe and Central Asia, South Asia, the Middle East and North Africa, and Sub-Saharan Africa.

[4]This phenomenon can be attributed to the rapid development experienced by these nations in recent decades, thanks to their active participation in international trade and foreign investment. This view of the influence of trade openness on the environment is consistent with Managi & Kumar (2009) and Dou et al. (2021).

[5]Evans et al. (2023) mention that Latin American ecological restoration network is joining to the Society for Ecological Restoration. Additionally, initiatives like the Bonn Challenge, the New York Declaration on Forest, and Latin American Initiative 20x20 have contributed to develop useful knowledge and framework policies and have promoted relevant program for restoration.

land uses, such as food production, habitat preservation, and biodiversity conservation (Kartha & Dooley (2016)).

3. Data, empirical estimation and results

3.1. Data and methodology

We gather a set of information for Argentina, Brazil, Chile, Colombia, Ecuador, Mexico, and Peru. Given the availability of data for all countries in the study, we use data from the sample period between 1970 and 2018. While our primary focus is to assess the role of forest area (FOR) as a climate deterioration mitigator, we incorporate specific control variables commonly employed in regressions of this nature. These variables encompass both renewable or low greenhouse gas emitting energies (LOWENER) and non-renewable energy consumption (NONREN). Furthermore, variables related to agricultural activity (AVA) and a globalization index (KOFGI) have been integrated into the analysis. Table 1 presents the units of measurement for each variable and their sources. The variables were transformed with natural logarithm, in such a way that the estimated coefficients are elasticities.

Table 1: Units of measurement for each variable and their sources

Variable	Units of measurement	Source
CO2	CO2 per cápita (kiloton, Kt)	Paris reality check
NONREN	(as % of total energy)	Our World in data
LOWEREN	(as % of total energy)	Our World in data
FOR	Forest Areas (Ha) (% Total)	FAO
AVA	Agriculture sector (as %GDP) per capita	World Bank
KOFGI	Globalization index	ETH-Zurich Institute

3.2. Unit root analysis and cointegration test

Before estimating the panel data model, it is necessary to verify the order of integration for each variable in order to chack if the series are cointegrated. As an initial step, panel unit root tests are conducted for each variable in both levels and first differences. The results of the Hadri LM panel test (Hadri (2000)) are illustrated in 2 and 3. They suggest that all variables in the set of information have a unit root at 5% level of significance. Furthermore, it indicates that once the first difference is applied, the six variables are stationary.[6]

[6]The Schwarz's Bayesian criterion (BIC) is used to determine the optimum number of lags in the Hadri LM panel test.

Table 2: Unit root test (in levels)*

Variable	P-value Hadri LM test
CO2	0,000
NONREN	0,000
LOWENER	0,000
FOR	0,000
AVA	0,000
KOFGI	0,000

*Ho: Stationarity, Ha: Unit root

Table 3: Unit root test (in first differences)*

Variable	P-value Hadri LM test
CO2	0,175
NONREN	0,755
LOWENER	0,488
FOR	0,329
AVA	0,327
KOFGI	0,936

*Ho: Stationarity, Ha: Unit root

Given above, we use two panel tests to verify if the variables are cointegrated. Specifically, the Westerlund and Pedroni tests are employed, in the latter, the modified t-statistic value is used (Westerlund (2005), Pedroni (2004)). As shown in Table 4, the results from the two cointegration tests imply that the series are cointegrated at 5% level of significance.[7]

Table 4: Cointegration test*

Variables	Westerlund	Pedroni Modified Phillips-Perron t
CO2, NONREN LOWENER, FOR AVA, KOFGI	0,0984	0,4996

*This table shows the P-value associated with the Westerlund and Pedroni. Ho: No cointegration and Ha: Cointegration.

3.3. Methodology, model and results

Next, we estimate the long-term relationships between CO2 emissions and the factors that deteriorate the environment (NONREN, AVA, KOFGI) as well as those that help mitigate emissions (LOWENER, FOR). For this purpose, the "Panel Fully Modified OLS" (PFMOLS) methodology proposed by Pedroni (2000) is utilized. To do this, we start from the usual estimators of FMOLS which provide consistent parameter estimates in small samples while accounting for endogeneity of the predictor variables and serial correlation. Then, the PFMOLS estimators are constructed as:

$$\hat{\beta} = N^{-1} \sum_{i=1}^{N} \hat{\beta}_{FM,i} \tag{1}$$

[7]Notably, both the panel unit root and cointegration tests used in this study take into consideration cross-sectional effects.

Where $\hat{\beta}_{FM,i}$ represents the FMOLS estimator associated with the regressor vector of the i−th individual of the panel ($i = 1, \dots, N$).[8] Furthermore, the t-statistic linked to this estimator is defined as follows:

$$t_{\hat{\beta}} = N^{-1/2} \sum_{i=1}^{N} t_{\hat{\beta}_{FM,i}} \quad (2)$$

Given the above, the model to be estimated has the following form:

$$CO2_{it} = \beta_0 + \beta_1 NONREN_{it} + \beta_2 LOWENER_{it} + \beta_3 FOR_{it} + \beta_4 AVA_{it} + \beta_5 KOFGI_{it} + \epsilon_{it} \quad (3)$$

The results obtained are shown in the Table 5. It can be seen that all the estimated coefficients ($\hat{\beta}_i$) are statistically significant for the proposed model in 3. The signs of the elasticities of GHG emissions in agriculture (AVA), globalization (KOFGI) and non-renewable energy consumption (NONREN) are positive. On the contrary, we observe that the coefficients for renewable or low greenhouse gas emitting energies (LOWENER) and forest area (FOR) are negative which implies that these factors help to mitigate CO2 emissions.

Table 5: Estimaciones de Largo Plazo

Variables	Coeficientes	t-stat
NONREN	1,4348	5,6361
LOWENER	-0,0034	-3,7226
FOR	-0,2313	-15,177
AVA	0,1931	6,6424
KOFGI	0,1292	12,8886

In terms of the coefficients, we find that the use of non-renewable energy sources has a significant and disproportionately higher impact on pollution increase for LAC countries. Specifically, a 1% increase in the share of this energy source in the total lead to a rise of 1.43% in CO2 emissions (Kt per capita). Fortunately, a proportion of the analyzed countries generate renewable energy primarily from hydroelectric sources. On the other hand, an increase of 1% in forested area within the countries of LAC leads to a reduction of CO2 (Kt per capita) emissions by 0.23% that helps to counterbalance the negative effects arising from both agricultural sector and non-renewable energy consumption. The reader can infer something similar with the rest of the coefficients.

Additional exercises were conducted to incorporate GDP and GDP squared into the model to assess environmental Kuznets hypothesis. However, these coefficients yielded non-significant results. Likewise, variables such as economic openness and foreign direct investment were tested as proxies for economic development and globalization, but they did not yield significant results.

Lastly, it is important to note that the variable used for forested areas includes current reserves, but it is not possible to determine what portion of its variation corresponds to deforestation, reforestation, or afforestation. This becomes relevant since LAC primarily confronts issues related to deforestation, causing a significant decrease in reserve stocks due to illegal mining, extensive agriculture and livestock, and in some countries, issues associated with drug trafficking.[9]

On the other hand, although the environmental consequences of reforestation and afforestation are commonly perceived as positive, the main trade-off involves a reduction in water supply (Whitehead (2011)). In our study, we lack variables that would allow us to control and evaluate the aforementioned factors, but we have confidence the positive benefits remain intact according to the consensus among international analysts and policymakers who believe that reforestation and afforestation lead to heightened carbon storage, diminished erosion, enhanced flood control, improved water quality, and extended habitat provision for enriched biodiversity (Silver et al. (2000), Busch et al. (2019), Di Sacco et al. (2021), Zhang et al. (2023)).

4. Final remarks

Despite relatively low CO2 emissions in Latin America, it is crucial for the region to implement economic and environmental policies that prioritize sustainable and nature-friendly development, given the adverse consequences of climate change and extreme weather events in recent years. Within this context and aligned with global objectives and commitments, such as the Patris agreement, certain nations have set highly ambitious targets for reducing their emissions. For instance, Brazil, Colombia, Mexico and Peru committed to significantly reduce their emissions about (37% and 50%), 51%, (22% and 36%) and (30% and 40%), respectively, compared to the business as usual scenario and depending on the availability of financial resources. Chile is projected to hit its peak emissions by the year 2025 and is committed to maintain a GHG emissions budget not exceeding 1,100 million metric tons of CO2 equivalent for the period spanning from 2020 to 2030. Argentina aims to achieve an emissions reduction equivalent to 19% compared to the highest historical peak recorded in 2007.

Our findings indicate that emissions in LAC primarily stem from the agricultural sector and the use of non-renewable energy sources. Conversely, renewable energies and forested areas play a substantial role in mitigating pollution. Although LAC should continue its efforts in clean energy generation, it is relatively well-positioned in this regard, given its substantial hydroelectric

[8]The FMOLS methodology is explained in detail in Phillips (1995).

[9]For example, some studies show the changes in land uses and deforestation process in LAC (Armenteras et al. (2017)), Mexico (Barbier & Burgess (1996),Alix-Garcia et al. (2005)), Colombia (Etter et al. (2006)), Brasil (Vieira et al. (2008), Caballero et al. (2022)),Ecuador (Mosandl et al. (2008), Van der Hoek (2017))

energy production. Therefore, its primary focus lies on addressing challenges related to agricultural activities and land use.

From the policy actions, the region is pursuing long-term strategies, including initiatives to curtail emissions stemming from deforestation and forest degradation in developing countries (REDD+), as well as policies geared towards promoting and facilitating the shift to low-carbon practices in cattle raising and agriculture (See Appendix A). According to Cárdenas & Orozco (2022), the funding needed to achieve climate goals in the LAC region is estimated to be around 7-11% of the Gross Domestic Product (GDP) per year and there is uncertainty regarding how they will secure this financing.

To address this challenge worldwide, countries should elevate their efforts, comprising both national policy actions and global teamwork to provide financial and technological support to developing nations. Combining adaptation and mitigation within forestry projects and policies would optimize local co-benefits and enhance the region's resilience in dealing with climate change-related risks (Locatelli et al. (2011)). Nevertheless, the pursuit of FLR measures would continue to pose significant challenges, as it might compete for land resources and posing a risk to essential land uses, such as food production, habitat preservation, and biodiversity conservation (Kartha & Dooley (2016)). To guarantee the smooth operation of these initiatives and maintain policy development coherence, it is imperative for local and national governments to: i) align incentives correctly, ii) establish direct communication channels for monitoring, and iii) strengthen public-private partnerships to fund select projects, while actively seeking international assistance.

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Appendix A. Summary of the long-term strategies of LAC-6 countries

Country	Sector				General
	AFOLU	Energy	Industry	Residues	
Argentina	- Changes in agricultural technology and increases in crop productivity - Reforestation and native forestry management - Prevention of forest fires - Integration of environmental services in forest management	- Promotion of energy efficiency - Promotion of renewable energy - Sustainable mobility, including light-duty electric vehicles, heavy-duty fleet renewal and shifting to rail-based freight transportation	- Replacement of carbon-intensive technologies	- Promotion of a circular economy	- Elaboration of a territorial diagnosis to allow the construction of climate policies (including gender perspective) - Strengthening sustainable employment - International cooperation for capacity-building, financing and technology transfer
Brazil	- Implementation of the Low-Carbon Agriculture Plan, including recovering degraded land, integrating forest management with , crops, cattle breeding, agroforestry and forest planting - Enhancement of sustainable native forest management systems - Implementation of REDD+ initiatives	- Increase in the share of sustainable biofuels in the energy mix - Expansion of the use of renewable energy sources other than hydropower in the total energy mix	- Promotion of new clean technology standards and further enhancement of energy-efficiency measures and low-carbon infrastructure		- International cooperation for capacity-building, financing and technology transfer
Chile	- Sustainable management, recovery and reforestation of native forests - Reduction of forestry sector emissions (due to deforestation and degradation of native forests) by 25% - New protected oceanic areas and creation of management plans for previously protected oceanic areas	- Implementation of renewable energies to replace thermal power plants - Sustainable buildings, efficient heating and distributed generation - Electromobility, including electric vehicles, in public transportation. Commercial and private electric vehicle penetration of 60% - Hydrogen use in freight transportation, blending of hydrogen with natural gas	- Sustainable industry, including energy efficiency, electrification and renewable thermal processes	- Biogas capture and use in urban landfills, efficient use of fertilizers	- Development of the Strategy of Development of Capabilities and Climate Empowerment, which includes institutional capability building, research and development, and education for climate action - Development and implementation of the Strategy of Technological Development and Transfer for Climate Change - Development of a strategy for climate financing
Colombia	- Sustainable cattle raising - Consolidation of commercial forest planting - Expansion of ecological restoration - Deforestation reduction (including REDD+ programmes) - Payment for environmental services - Management of protected areas	- Diversification of the energy matrix, promoting self-generation of energy from alternative sources - Regulatory and financial framework to accelerate the transition to light-duty electric vehicles - Replacing commercial and residential fridges	- Promotion of energy-management and energy-efficiency projects in the industrial sector, especially brick and cement production	- Creation of the National Strategy for Circular Economy	- Development of the National Climate Change Information System - Carbon tax - International cooperation for capacity-building, financing and technology transfer
Mexico	Non-specific actions on: - Nature-based solutions and protection of the oceans - Circular economy - Energy efficiency - Emissions market				- Development of financing strategy - Capability building
Peru	Not defined in the NDC				

Figure A.1: Source: Cárdenas & Orozco (2022)