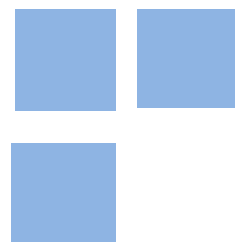


# **Environmental impacts and policy responses to Covid-19: A view from Latin America**

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### **Abstract:**

COVID-19 is currently having major short run effects with possible serious long run consequences on economic and social aspects, including several potential implications for the environment and the management of natural resources in Latin America. In this paper, we discuss the possible effects of the pandemic on air pollution, deforestation and other relevant environmental dimensions across the region. With contributions from environmental economists from eight countries, we give an overview of the initial and expected environmental effects of this health crisis. We discuss potential effects on environmental regulations and possible policy interventions, as well as an agenda for future research for those interested in the design and evaluation of environmental policies relevant for the Latin American context.

**Keywords:** Air pollution, COVID-19, coronavirus, deforestation, environmental impacts, environmental policy, Latin America, pandemic, SARS-Cov2-19

**JEL Codes:** H12, Q22, Q23, Q53, Q56

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### **Abstract:**

COVID-19 is currently having major short run effects with possible serious long run implications for the environment and the management of natural resources in Latin America. In this paper, we discuss the possible effects of the pandemic on air pollution, deforestation and other relevant environmental dimensions across the region. With contributions from environmental economists from eight countries, we give an overview of the initial and expected environmental effects of this health crisis. We discuss potential effects on environmental regulations, possible policy interventions, and an agenda for future research for those interested in the design and evaluation of environmental policies relevant for the Latin American context.

### **1 Introduction**

On February 25, 2020, the Brazilian Ministry of Health confirmed that a 61 year-old man, who had recently traveled to northern Italy, was positive for SARS-CoV-2: COVID-19 had arrived to Latin America (Rodriguez-Morales et al. 2020). There is of course no suitable time for a pandemic to arrive, but these are especially complicated times for Latin America. The region is in the midst of a difficult economic situation accompanied by rising social discontent (ECLAC 2020; OECD 2020a). Growth in the 2014–2019 period was the lowest level recorded since the 1950s (ECLAC 2020); growth in 2019 was null or even negative for some countries (Nicaragua - 3.9%, Argentina -2.2%, Mexico -0.3%, Paraguay 0%, World Bank, 2020). Brazil and Mexico are still living the aftermath of their highly polarized 2018-presidential elections, while Bolivia, Chile, Colombia, Ecuador and Venezuela had massive civil protests during 2019. Furthermore, the region is still characterized by high rates of informality (ECLAC 2020), health systems with limited and unequal capacity, and high levels of debt in most of the countries (OECD 2020a). All

these factors are likely to exacerbate the impacts of the crisis and will complicate adequate government responses. The environment will certainly be affected too.

Air pollution and deforestation are two of the most important environmental problems in Latin America. It has been estimated that about 146 million inhabitants are exposed to annual mean concentrations that are above the World Health Organization Air Quality Guidelines (Riojas-Rodríguez et al. 2016). Central and South America have historically been the highest net emitters of CO<sub>2</sub> from land use change, in particular due to deforestation (De Sy et al. 2015).

COVID-19 is currently having major short run effects with possible serious long run consequences on economic and social aspects, including several potential implications for the environment and the management of natural resources in the region. The immediate impacts of the pandemic include a significant reduction in economic activity and the increase in unemployment rates, with repercussions on poverty and social conditions. The environmental consequences are perhaps more uncertain but crucial for the sustainable development path in the region. In this paper, we discuss the possible effects of the pandemic on air pollution, deforestation and other relevant environmental dimensions across Latin America. With contributions from environmental economists from eight countries, we give an overview of the initial and expected environmental effects of this health crisis. We discuss potential effects on environmental regulations and possible policy interventions, as well as an agenda for future research for those interested in the design and evaluation of environmental policies relevant for the Latin American context.

## **2 The COVID-19 pandemic in Latin America**

At the beginning of the pandemic, Latin America accounted for a small share of COVID-19 cases and deaths. That is no longer the case. As of June 11, 2020, there have been 1.51 million confirmed cases in Latin America, compared to 1.19 million in the European Union and 2.02 million in the U.S.A. As Table 1 shows, Brazil is, by far, the country with the highest number of confirmed cases (802,828), while Uruguay is the country with the least. When comparing confirmed cases across countries or regions one needs to be aware that testing rates are not the same everywhere. This is clearly illustrated by the heterogeneity in testing across countries shown in Table 1; Chile is the country with the highest number of total tests per 1,000 people with 40.9, meanwhile, in Brazil and Mexico tests are relatively infrequent with 2.3 and 2.4 tests per 1,000 people, respectively. Figure 1 shows the trajectories followed by different countries and regions after its 100th case was confirmed. Brazil, even with its low level of testing, has a very steep slope that so far shows no sign of decreasing. Something similar can be said of Peru, Mexico and Chile, although Chile has a much higher rate of testing than the other two countries. On the other hand, Costa Rica, Cuba and Uruguay have very flat curves and seem to have the spread of the virus under control. The same figure shows that Brazil is the country with most confirmed deaths; it is in fact the third country in the world after the U.K. and the U.S.A., followed by Mexico (15,944) and Peru (6,088). Costa Rica and Paraguay are the countries with the lowest number of confirmed deaths by COVID-19 in the region (12 and 11, respectively). In terms of deaths adjusted by population, Panel (a) in Figure 2 shows that Ecuador is the country with the highest rate in the region with 217.7 per million people, followed by Brazil (195.3), Peru (190.3) and Chile (141.4). Nevertheless, as Panel (b) shows, these rates are still very far from what is happening in the U.K. (622.4), the U.S.A. (348.4) and the European Union (288.7).

One thing is clear from looking at the data: Latin America has been hit very hard by the COVID-19 pandemic with more than 75,000 deaths as of June 11, 2020. Unfortunately, the trends show that the first wave of the pandemic in the region is far from over. Latin America might soon become the region with the highest number of total deaths from COVID-19.

Countries in the region have implemented a variety of measures trying to slow the spread of the disease. These measures are having, as in the rest of the world, severe economic impacts. On March 11, El Salvador became the first country in the region to close its borders (OECD 2020a). By the beginning of May, nearly all countries in the region had closed schools, shut their borders (partially or completely), and implemented measures to close public spaces and limit social gatherings (OECD 2020b). Many countries have implemented curfews and quarantine orders with different levels of enforcement (ibid.). In addition to these local disruptions, the global chaos that the pandemic has brought to the economic system, including a decline in the price of commodities and a virtual halt to tourism, is affecting Latin America even more than other regions in the world (World Bank 2020). In order to cushion these effects, many countries are implementing significant fiscal stimulus plans, some of them even in spite of the limited fiscal space that they have due to being highly indebted (OECD 2020). As of June 11, Peru is the country with the most aggressive fiscal stimulus plan, followed by Brazil and Chile (see Table 1). Cuba, Mexico, Nicaragua and Venezuela are the only countries in Latin America not implementing income support programs, while Mexico and Nicaragua are the only ones without debt relief programs (Hale et al. 2020). In spite of these efforts, it is expected that in 2020 all the countries in the region will see their GDP decrease, in some cases by more than 5% (see Table 1). In addition to its economic impacts, the health crisis and the lockdown measures seems to be increasing gender violence (ECLAC 2020). Since lockdowns were implemented, emergency

calls for domestic violence cases have increased considerably in Argentina, Colombia and Mexico (ECLAC 2020; Bartels-Bland 2020).

### **3 Short run impacts on the environment and natural resources**

#### **3.1 Air pollution**

The negative health implications of both indoor and outdoor air pollution have been extensively documented. Although polluted air gains access to the body through the respiratory tract, it has systemic effects that can damage many other organs (Schraufnagel et al. 2019). Therefore, air pollution is linked to many health problems and can cause premature death in children and adults (Chay and Greenstone 2003; Curtis et al. 2006). However, exposure to air pollution, and hence its negative effects, is not distributed uniformly across the population. The continuing presence of air pollution is particularly problematic for a region in which a significant share of the economically active population belongs to the informal sector. The wealthy can move out of heavily polluted areas, either temporarily or permanently, to reduce their exposure (Shen et al. 2020). Many of them are also able to change jobs or buy high-quality equipment for protection (e.g., air masks and air purifiers). On the other hand, those in the lower end of the income distribution tend to live in areas of greater traffic density or near point sources of pollution (e.g., power plants and industrial facilities), they frequently walk long distances to take public transportation or might even work on the streets (Calderón-Garcidueñas and Torres-Jardón 2012; Neidell 2004; Schraufnagel et al. 2019). The same tends to be true for exposure to indoor air pollution since the use of biomass is negatively correlated with income; long-term exposure to

indoor pollution can be particularly high for women, who are more involved in cooking and household work (Jeuland et al. 2015).

Given that air pollution can be a significant cause of the pre-existing conditions associated with higher COVID-19 mortality, it has been argued that prolonged exposure to air pollution has made people more vulnerable to the disease (Wu et al. 2020). Furthermore, current exposure to air pollution could also contribute to its spread. This is based on the possibility that the SARS-CoV-2 virus might be present on particulate matter, as preliminary evidence suggests (Setti et al. 2020). If that is in fact the case, the virus could be carried deep into the lungs on the surface of particulate matter (Schraufnagel et al. 2019). Although the role of air pollution in the airborne transmission of the virus is still uncertain, results for China show that there is a positive relationship between ambient air pollutants and COVID-19 infection (Zhu et al. 2020). If extended periods of pollution exposure increase the risks associated with contracting COVID-19 (Wu et al. 2020; Zhu et al. 2020), informal workers might be one of the most vulnerable populations.

Restrictions to control and reduce the movement within and across urban areas of the region have reduced economic activity as well as the use of cars, trucks and other motorized vehicles. As a result, as has been the case in other large cities in the world, many Latin American megacities have experienced a short run decrease in air pollution. As Figure 3 shows, concentrations of NO<sub>2</sub> have decreased considerably in cities all over the region compared to the levels observed during the first 10 days of March (prior to any lockdown measures). Bogota shows the highest decrease (-83%), while the decrease in Guayaquil, Rio de Janeiro and Sao Paulo was below 30%. Furthermore, in Bogota emissions of PM<sub>2.5</sub> decreased by 60% (Bogota's



District Secretary of Environment, personal communication, June 3rd, 2020; Combo Dosmilseiscientos 2020), while levels of PM<sub>10</sub>, PM<sub>2.5</sub> and CO decreased at least 50% in Buenos Aires when compared to the same period in 2019 (Rocha 2020). Meanwhile, in Quito, the most populated city of Ecuador, concentrations of PM<sub>10</sub> and PM<sub>2.5</sub> had a substantial drop from a daily average of 25-50 µg/m<sup>3</sup> two months before the pandemic, to 4-7 µg/m<sup>3</sup> during the quarantine (Roa 2020).

However, in some cities in Latin America the changes in the observed concentrations of some pollutants were relatively small or even positive. These concentrations are the result of a complex process that in addition to the levels of emissions depend, among other things, on atmospheric conditions, topographic features, and the interaction between different pollutants and compounds. In Mexico City, although traffic congestion has decreased considerably (IADB & IDB Invest 2020), the reductions in SO<sub>2</sub>, PM<sub>2.5</sub> and PM<sub>10</sub> concentrations have been modest, and there has been no reduction in ozone. Meanwhile, in Rio de Janeiro, the partial confinement of the population led to an increase in ozone concentrations (Dantas et al. 2020).

Other events, like forest fires and weather conditions, could also have important effects on air quality. Bogota, and other cities in Colombia, experienced several peaks in poor air quality during the confinement apparently due to forest fires in Venezuela and other regions of the country. Even though mobility in the main cities of the central and southern regions of Chile has not diminished much under lockdowns, air quality may get worse during the winter months. Many households in these regions use firewood for heating, and as they spend more time inside dwellings there could be an increase in the concentration of particulate matter both indoors and outdoors (Encinas et al. 2020).

A similar effect is expected to be seen as the crisis deepens and the pandemic moves into the rural areas. In Mexico, approximately 28 million people live in households that use firewood as their primary or secondary fuel for cooking (INEGI 2019). As such, they are chronically exposed to indoor pollution and presumably particularly vulnerable to COVID-19. These households are located mainly in rural and peri-urban areas. As a result of the pandemic, the income of many of these households has been negatively affected, and those living in relatively isolated villages have suffered problems with the distribution of LP gas. As a response to this situation, households have increased the use of firewood (Masera et al. 2020), which in turn could result in an increase in health problems and might even make individuals in rural areas more susceptible to complications related to COVID-19.

In any case, the air quality improvements that have been observed in some Latin American cities are unlikely to be sustainable. Pollution levels prior to the lockdown are likely to return gradually as the quarantine measures are relaxed, and cities regain their mobility and restart their economic activity. It is still uncertain if urban mobility measures (e.g., exclusive bike paths and wider pedestrian areas) implemented in cities like Bogota, Quito and Mexico City, will remain in the long run. The same is true for the increased use of bicycles that was observed in Costa Rica as a result of the government restriction to use private cars during certain hours of the day. Beyond air quality improvements, it is possible that some workers after being forced to use bicycles as an alternative means find this to be an attractive option even in the long run (e.g., due to health improvements or reductions in commuting time). One important factor that can increase and preserve this effect is the implementation of public policies that incentivize and even subsidize the use of bicycles as a transport mode. One example of this is a law that Costa Rica approved at the end of 2019. Although at the time of its approval it seemed that the law was going to have

minimal effects on changes in transport modes, the current context might change the status quo. It remains to be seen if subsidizing bicycles and their infrastructure might actually achieve a change in the long run equilibrium of personal transportation in Costa Rica and elsewhere.

### **3.2 Deforestation**

Forests are essential for biodiversity preservation and climate regulation. The Amazon rainforest in particular is crucial for maintaining planetary health due to its pivotal role in regulating the Earth's climate (Ellwanger et al. 2020). In addition to being a source of food, medicines and raw materials, forests can play many key roles in rural households' livelihoods (Angelsen and Wunder 2003). Extraction of non-timber forest products (e.g., wild animals, wild plants and mushrooms) can be a very important source of income for many poor households (Angelsen and Wunder 2003), alleviating poverty and reducing inequality (López-Feldman et al. 2007).

Furthermore, there is evidence that forests in Latin America provide a sort of natural insurance for households that are affected by negative shocks (López-Feldman 2014; Pattanayak and Sills 2001; Robalino et al. 2019; Takasaki et al. 2004). By partially removing ozone, PM<sub>10</sub>, PM<sub>2.5</sub>, SO<sub>2</sub>, CO, and nitrogen oxides from the air, trees can reduce the harm that these pollutants cause in human health (Baumgardner et al. 2012; Jones and Goodkind 2019). Conversion of natural habitats to managed or disturbed habitats has the opposite effect as it tends to increase disease prevalence (Dunn 2010, Bauch et al. 2015). Furthermore, deforestation and land-use changes can alter human-wildlife interactions, creating the potential for zoonotic infections to move from animal to human populations, as seems to have occurred with COVID-19; roughly 75% of emerging infectious diseases are zoonoses (Myers et al. 2013).

It is too soon to do a formal evaluation of the effects of the pandemic on deforestation and land use change in the region. Nevertheless, the available information suggests that COVID-19 is very likely to have negative effects on forest cover across the region. In Mexico, reports from different regions of the country (Hidalgo, Tlaxcala, Chihuahua and the Yucatan Peninsula) talk about an increase in illegal deforestation during the last couple of months. Early deforestation warnings from Peru show that, although deforestation decreased in the period between March 15 and April 15, after this date it increased surpassing the levels observed during the same period in 2018. In general, deforestation rates in the Amazon countries were increasing before the emergence of the COVID-19, a tendency that the pandemic and associated lockdowns are unlikely to reverse. On the contrary, the expected reduction in monitoring efforts across the region during the pandemic could be associated with an increase in forest clearing and carbon emissions due to new land use changes.

According to data from the Brazilian National Institute for Space Research (INPE), the first quarter of 2020 already evidenced a rise of 50% in deforested hectares compared to last year's figures (CNN 2020). The figures for April 2020 reinforce this pattern, with a 64% increase with respect to April 2019. From January to April 2020, deforestation alerts in indigenous territory increased 59% when compared to the same period of the previous year. Although at this point it cannot be claimed that the pandemic caused the observed increase in deforestation, it certainly does not seem to have provided incentives to halt it. Additionally, another concern for Brazil, and other countries in the area such as Colombia, is that the raise in deforestation rates during the pandemic could lead to even more forest fires than last year.

In Colombia, contrary to other countries in the Amazon region, the trend in 2019 showed a significant reduction in deforestation compared to 2018. However, 2020 started with an

increasing tendency and the quarantine seems to have worsened the situation. The absence of environmental monitoring during the pandemic seems to have encouraged illegal armed groups and regional mafias to take advantage of the situation, exacerbating deforestation with the possible intensification of illegal activities from which these actors derive income, such as illegal mining, land grabbing, and illicit crops (BBC Future 2020).

For Bolivia, Brazil, Colombia, Ecuador and Peru, the Amazon region is also very important in cultural terms for its ethnic diversity. The same is true for some of the forests located in Costa Rica, Guatemala, Honduras, Mexico, Nicaragua and Panama. Recent studies have documented the impact of indigenous and ethnic reserves reducing deforestation and carbon emission in the Amazon (Blackman et al. 2017; Blackman and Veit 2018, Herrera et al. 2019) and other forests of the region (Vélez et al. 2020b). The impact of the pandemic in indigenous communities of these and other regions is also an important source of concern and the spread of the virus in indigenous communities is shocking. According to the Pan American Health Organization, there are 20,000 COVID-19 confirmed cases in the Amazon basin (Martín 2020). Illegal gold miners and loggers are exposing indigenous communities to substantial health risks, a situation that could have severe consequences given the low provision of hospitals and health services across the region. In Colombia, most, if not all, departments of the Amazon region do not have intensive care units (El Tiempo 2020, Cárdenas and Montoya 2020). Thus, the spread of the virus in these communities could imply a tragedy that, in addition to the human losses, could affect the traditional knowledge, having negative impacts on the governance of the region. This could lead to even more deforestation processes in the future. Therefore, differential policies for ethnic populations in the region are an urgent necessity.

### **3.3 Other impacts on the environment and natural resources**

COVID-19 has caused a disruption in the national and international trade of nature-based goods and services. Tourism has come to a halt, affecting the economy of almost all of the countries in the region. In countries like Costa Rica, where the touristic industry is intertwined with nature, the shock to the sector could have negative effects for biodiversity and forests. Without income from tourism, the incentives to protect forests are expected to decrease in the short and medium run. The loss of jobs in the sector might lead unemployed workers to search for alternative sources of income inside the forest. In general, extractive activities, such as mining inside protected areas, could easily increase due to the necessity of people nearby. Furthermore, alternative land uses (e.g., agriculture or cattle raising) might generate highly needed sources of income.

Fishing and aquaculture are other industries that have been negatively affected. Information for the case of the Chilean salmon aquaculture industry suggests two types of different consequences of the pandemic thus far. First, a reduction in demand from international markets due to restrictions, closing borders, and a general increase in costs of transportation (Chávez et al. 2020). Second, restrictions imposed by some coastal communities to the movement of workers, due to concerns of potential COVID-19 transmissions, could result in a shortfall in labor supply and services to manage and properly care for the biomass of salmon (Soto et. al. 2020). There has also been a reduction in both domestic and international demand for the case of fisheries. Beyond the negative effects that this has had in terms of employment, the silver lining of the decrease in demand, if indeed it is transitory, would be the recovery of the overexploited fisheries.

#### **4 Potential effects on environmental policies and regulations**

The economic crisis can end up having long-run negative consequences for the environment if, as a result, regulations and environmental policies are relaxed or if institutions are weakened. Although at this point there is no evidence of any country in the region relaxing environmental regulations to promote growth, it is certainly a possibility, especially under the pressure of the private sector. What has been observed is that, in order to fund measures to reduce the economic and social impacts of the pandemic, some countries have decided to reallocate funds across the public administration. Ecuador, announced cuts in most of the government ministries, including the Ministry of Environment and Water, responsible for enforcing the environmental and natural resource management regulations and the national system of protected areas. Something similar is happening in Mexico, where the plan announced by the President is to reduce the operational budget of almost all government entities by 75%. The National System of Protected Areas in Costa Rica has also lost a significant amount of resources coming from entrance fees. These cuts imply that the entities related to the management of natural resources might not be able to fulfill their mission. Even if countries have a relatively strong environmental legal framework, without a budget to support the existing institutions this framework is worthless.

Countries in the region will very likely incur in fiscal deficits and increase their debts in order to fight the crisis. It remains to be seen how the service of the increased debt by future generations will impact economic growth and the environment. In the meantime, it seems that the short-run legitimate demands to recover employment levels, while improving the health systems and addressing the social inequalities that characterize Latin America, might very well push aside the necessary investments to successfully tackle climate change and biodiversity loss. If this indeed

happens, it would certainly be the most serious effect of the COVID-19 pandemic in both environmental and social terms.

## **5 Discussion and research agenda**

The pandemic and lockdown measures seem to be having an initial and temporal positive effect on reducing urban pollution in many Latin American cities. The challenge now is how to intervene to prevent an immediate return to the same or even higher pre-quarantine emission levels. This is an opportunity to rethink the urban environmental policies while trying to recover from an unprecedented social crisis. At the same time, the observed increase in deforestation reopens political and academic debates about the role of national parks, indigenous reserves and other protection categories in a context of deteriorated livelihoods, illegal economies and a lack of state presence.

The economic projections suggest that the region will experience a crisis whose magnitude has no precedent in modern history. In order to overcome this apparently insurmountable challenge, Latin American countries will need well-designed policies that should reconcile economic objectives with social and environmental goals. The social unrest manifested recently in the social mobilizations in the region, should make clear that the apparent tradeoff between economic, social and environmental objectives, is the result of a false dichotomy between short and long run objectives. If environmental objectives are put aside, as has so often happened with social objectives, the economy might recover in the short run but at a very high price.

Latin American countries could see this moment as an opportunity to improve regional cooperation in order to design and implement coordinated policy responses not only to the



economic crisis but also to the challenge that climate change poses. Countries from the Amazon basin, as well as those in Central America, should coordinate efforts to increase monitoring and presence in the region to effectively reduce deforestation.

Considerations about food security and autonomy, articulation with traditional health systems and good practices for commercialization of products with nearby urban centers will be decisive in preventing and containing COVID-19 in remote regions (Vélez et al. 2020a). In this context, for those traditional communities, when feasible it is important to consider voluntary community isolation. Thus, it is necessary to implement protocols that include coordination between government and ethnic authorities (Kaplan et al. 2020). Environmental, security and health policies must work together to strengthen governance processes in the Amazon and other regions with ethnic communities.

Mitigation and adaptation to climate change is another area where cooperation could prove decisive in order for the countries of the region to fulfill their Nationally Determined Contributions under the Paris Agreement.

We have presented an account of some of the most evident environmental effects that the COVID-19 pandemic is having in Latin America at this point. Considering that we are in the midst of the health crisis and in the beginning of an economic one, it is natural to expect that the trends that we see now could change in the coming months and that other environmental impacts will become evident. Research that contributes to a better understanding of the environmental impacts and the effectiveness of different policy responses to the pandemic in Latin America will be invaluable. There are many potential paths for future research, here we mention just a few.

The consequences of the interactions between poor air quality and COVID-19 on human health are clearly worth studying. This is particularly relevant in the Latin American context, characterized by health systems with very limited capacity and by high numbers of population without formal employment. Results from studies in this area could help us provide better guides to set environmental quality goals, as well as to implement policy interventions that can reduce pollution in the region's context of income inequality, heterogeneous pollution sources, and spatial segregation.

The observed short run environmental effects of COVID-19 show early warnings of an increase in the pressure on forest and related ecosystems across Latin America. It is not clear at this point the magnitude of the impact and if it is only temporary. The answers to these questions can help us better understand the roles that forests play for different agents under diverse circumstances, and how that is reflected in deforestation and land use change. This information has the potential to contribute to the design of policies which can improve management and conservation. Studying the impacts of the pandemic on the conservation of marine resources, as well as on livelihood opportunities for local coastal communities, is another area of relevant research.

The pandemic is opening new research questions regarding the impacts of global shocks on natural resource-based industries that participate in international markets. This crisis has shown that these industries are vulnerable to unknown threats, but it is not clear what explains different degrees of vulnerability. Furthermore, the paths that different countries take to get out of the economic crisis might have profound impacts on international trade. If, for example, the world transitions to more reliance upon local production, or if emissions-related tariffs are imposed, large exporters of commodities in the region will be highly affected. The impact that these potential trade changes will have on the environment is unknown.

It also unknown how, if at all, will emissions of greenhouse gases change in the long run as a result of the pandemic. Furthermore, if developed countries implement recovery plans that include provisions to reduce emissions in significant ways, as has been discussed in the European Union, will Latin American countries be able to respond in the same way? In any case, Latin American countries are highly vulnerable to the effects of climate change and some of these effects could result in future health crises. If, for example, climate change spurs migration, it could result in additional interactions between animal species and humans, increasing the likelihood that new infectious diseases could emerge. A better understanding of the ways in which individuals might adapt to a changing climate, as well as of the barriers that they face to adopt adaptation measures, will be a very valuable tool for the design of adaptation policies that prevent future health crises.

The distributional and gender-differentiated impacts of the pandemic, and the related environmental policy responses, is another area that deserves attention, especially because there is early evidence showing that the more vulnerable segments of the population in the region are the ones that are being hit hardest. Finally, as has been recently pointed out by Helm (2020), the experience of the COVID-19 pandemic might lead to permanent changes in both behavior and personal choices. It remains to be seen if this is in fact the case, and if so, how are these changes in behavior modulated by the local context. An even more important issue to consider is what could these changes imply for the design of behavioral-based policy instruments aiming to change consumption and production patterns, transport and land use decisions.

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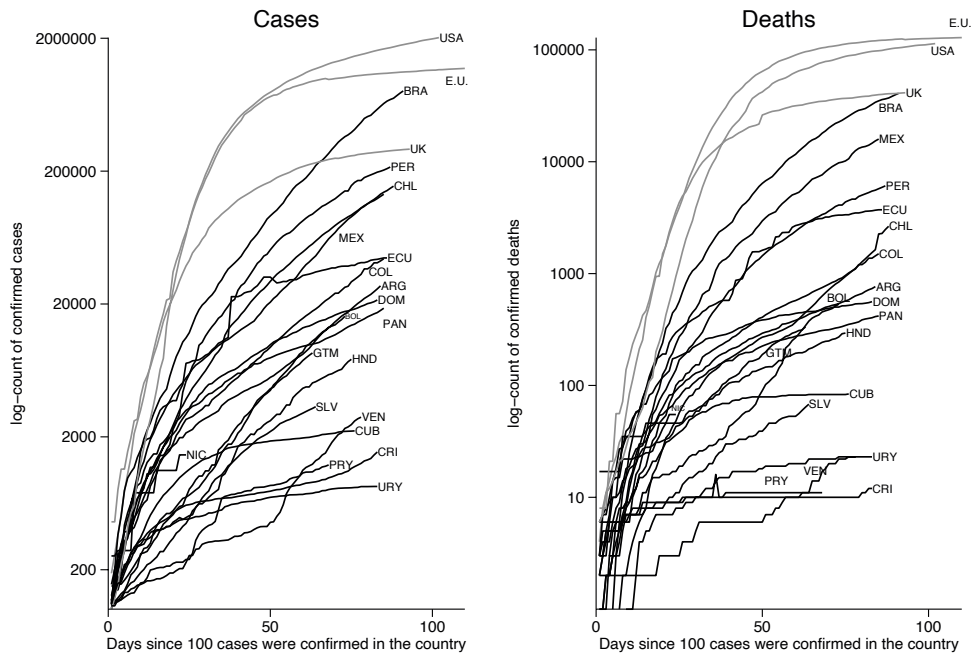
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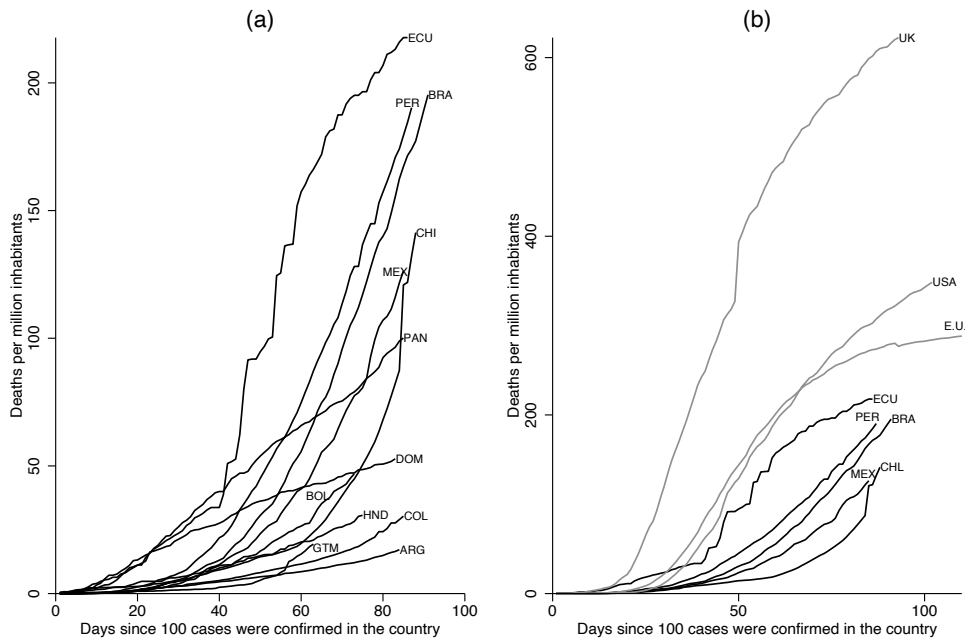
Figure 1: Confirmed COVID-19 cases and deaths



Source: Own estimations using data from JH-CSSE (2020), data updated 11th June.

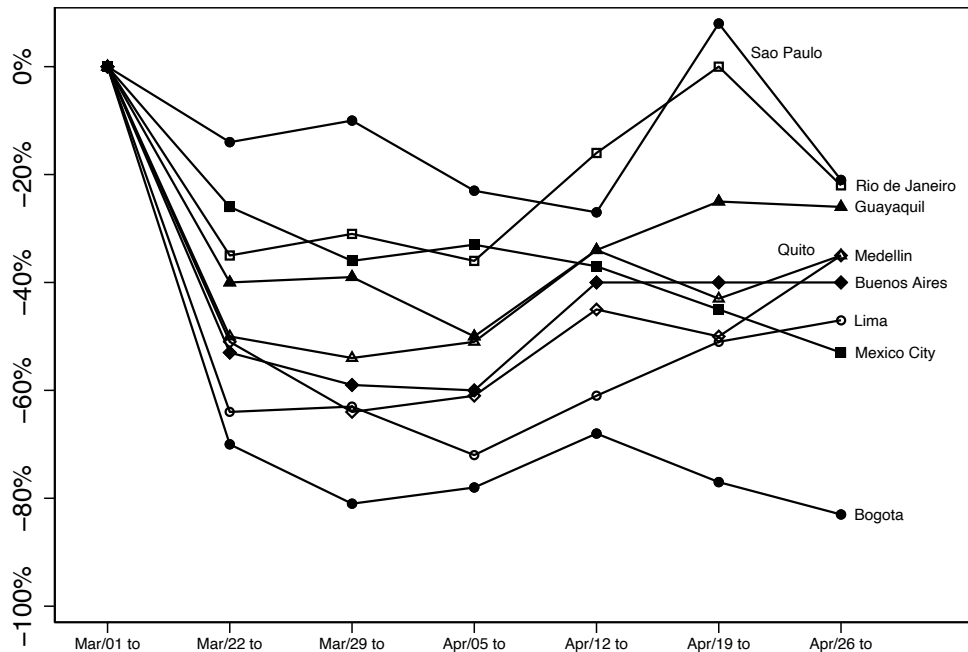


Figure 2: Confirmed COVID-19 deaths adjusted by population



Source: Own estimations using data from JH-CSSE (2020), data updated 11th June.  
 Note: Only countries with more than 100 confirmed deaths are shown.

Figure 3. Change in NO<sub>2</sub> concentration levels  
 (First ten days of March 2020 versus ten-day periods)



Source: Own estimation with data from IADB and IDB invest (2020)

Table 1: COVID-19 and economic information for Latin American countries

Country	Confirmed cases <sup>a</sup>	Confirmed deaths <sup>a</sup>	Total tests per 1,000 people <sup>b</sup>	Expected rate of GDP growth in 2020 <sup>c</sup> (%)	Fiscal stimulus <sup>d</sup> (%GDP)
Argentina	27,373	765	17.2	-7.3	4.0
Bolivia	16,165	533	46.9	-5.9	1.0
Brazil	802,828	40,919	195.3	-8.0	10.0
Chile	154,092	2,648	141.4	-4.3	6.7
Colombia	43,810	1,505	30.3	-4.9	2.8
Costa Rica	1,538	12	2.4	-3.3	0.5
Cuba	2,219	84	7.4	-	-
Dominican R.	21,437	561	52.8	-0.8	0.8
Ecuador	44,440	3,720	217.7	-7.4	0.5
El Salvador	3,373	68	10.6	-5.4	1.3
Guatemala	8,561	334	19.4	-3.0	3.4
Honduras	7,669	294	30.7	-5.8	7.2
Mexico	133,974	15,944	126.3	-7.5	1.0
Nicaragua	1,464	55	8.5	-6.3	0
Panama	18,586	418	100.1	-2.0	6.4
Paraguay	1,230	11	1.6	-2.8	2.5
Peru	214,788	6,088	190.3	-12.0	7.0
Uruguay	847	23	6.7	-3.7	0.7
Venezuela	2,814	23	0.8	-	-

Notes: <sup>a</sup> Own estimation using information from JH-CSSE (2020). <sup>b</sup> Roser et al. (2020). <sup>c</sup> World Bank (2020).

<sup>d</sup> Elgin et al. (2020). There are different sources for the levels of fiscal stimulus, we decided to use a single source that had information for all the countries in Latin America.

Information presented in <sup>a</sup>, <sup>b</sup> and <sup>d</sup> is based on updates available on June 11<sup>th</sup>, 2020.