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Assessing the role of tax-benefit policies during the COVID-19 pandemic: Evidence from the Andean region

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Abstract

This paper aims to assess the role of tax-benefit policies in mitigating the effects of COVID-19 on the distribution of household disposable income in Colombia, Ecuador, and Peru. We exploit data from phone surveys collected during the pandemic combined with tax-benefit microsimulation techniques to nowcast the distribution of household disposable income. Our results show a sharp drop in household disposable income and a dramatic increase in poverty and inequality during the second quarter of 2020. By the end of 2020, the economy recovers but poverty and inequality remain above the pre-pandemic levels. COVID-related policies cushion the effect of the crisis at the bottom of the distribution, and their effect on poverty and inequality largely depends on the generosity of the benefits

implemented. By contrast, automatic stabilizers mitigate the impact of the income shock at the top of the distribution due to the effect of social insurance contributions and personal income tax, whereas social assistance programs in place before the pandemic fail to act as automatic stabilizers due to their design as proxy means-tested benefits. We validate our nowcasting estimates with actual survey data from the end of 2020 and show that our results match closely poverty and inequality indicators in all three countries.

KEYWORDS

Andean region, COVID-19, income distribution, nowcasting, tax-benefit policies

JEL CLASSIFICATION

D31, E24, H22, J38

1 | INTRODUCTION

The COVID-19 pandemic resulted in an international crisis with large socioeconomic effects and highlighted the lack of a safety net for vulnerable populations in the event of negative income shocks, in particular in Latin America and the Caribbean (LAC). As a result, governments in the region implemented a variety of policies to mitigate the impact of the crisis, but with important differences in coverage and generosity (ECLAC, 2021). For these reasons, it is essential to provide evidence on the effectiveness of government interventions to alleviate the economic impact of COVID-19 and on possible reforms to current social protection programs to ensure a sustainable and adequate social welfare systems in the long term in each country.

The aim of this paper is to assess the role of tax-benefit policies in mitigating the effects of the COVID-19 crisis on the distribution of household disposable income in three Andean countries: Colombia, Ecuador, and Peru. Before the pandemic, these countries were characterized by limited fiscal capacity, low spending in social protection and higher levels of poverty and inequality compared to other countries in the region, making them more likely to suffer more from the COVID crisis.[1] Our analysis compares changes in household disposable incomes between December 2019 and the second quarter of 2020, when the three economies were hit the hardest. To capture the recovery experienced in each country, we also estimate results for the last quarter of 2020. Considering the difficulties of obtaining detailed income information for these periods due to limitations in data collection during the lockdowns in each country, our COVID datasets (reflecting the drop in market income in the second and fourth quarter of 2020) are created using nowcasting techniques, which consist of adjusting labor market and earnings information in 2019 household survey data (e.g., moving individuals out of work based on their probability of earnings losses during the pandemic) to match the available information in phone surveys collected in 2020. Then, we use harmonized tax-benefit microsimulation models to calculate household disposable income for the three countries and decompose

changes in household disposable income into the effects of: (i) earnings losses due to COVID-19, (ii) pre-crisis tax-benefit policies (i.e., automatic stabilizers), and (iii) COVID-related tax-benefit measures implemented by the governments.

Our results show a sharp drop in mean household disposable income during the second quarter of 2020 compared to December 2019, representing a 19% decrease in Colombia, 41% in Ecuador and 45.8% in Peru. By the end of 2020, the economy slightly recovered, which translated into smaller drops in household income of 4.4% in Colombia, 12.2% in Ecuador and 17.1% in Peru, compared to December 2019. Our decomposition shows that COVID-related policies cushioned the effect of the crisis at the bottom of the distribution, although to different extents across countries depending on the generosity of the emergency cash transfers. As emergency transfers were targeted to poor households they failed to provide income protection to households in the middle of the income distribution, who were the most affected by the crisis. Moreover, despite the protection provided by the emergency policies to poor households, only Colombia maintained them throughout the year. Automatic stabilizers also played a role by cushioning the income shock at the top of the distribution. This is due to the progressivity of personal income tax and the larger prevalence of formal workers at the top of the distribution, who experience a drop in earnings during the pandemic and, as a result, are subject to lower social insurance contributions (SICs) and personal income tax payments. Poverty and inequality also rose sharply during the second quarter of 2020. The Gini coefficient increased by 0.061 points in Colombia, 0.124 points in Ecuador, and 0.1 points Peru. The poverty headcount increased by 14.3 percentage points (pp) in Colombia, 32.1 pp in Ecuador and 29.8 pp in Peru. Poverty and inequality decreased by the end of 2020 but remained above the levels observed before the pandemic.

Our study contributes to the literature in three main respects. First, we complement the growing literature assessing the impact of the COVID-19 pandemic on household incomes in developing countries. Second, while most studies for LAC focus on the role of expanded social protection in mitigating the impact of the COVID crisis, we use detailed tax-benefit models to consider also the role played by automatic stabilizers, which have received limited attention in the literature for the region. Third, we validate our nowcasting methodology and show that our nowcasted poverty and inequality estimates match closely those obtained with actual data for the end of 2020. Therefore, our approach proves useful to provide timely indicators capturing changes in the income distributions in the absence of detailed survey data.

This paper is structured as follows. Section 2 provides a brief overview of the literature on the distributional effects of the COVID-19 pandemic. Section 3 discusses the main characteristics of tax-benefit systems in the countries under analysis. Section 4 introduces our methodology: the microsimulation models as of 2019 and the COVID-19 policies implemented for 2020, the data, the details of the nowcasting exercise and the framework used to decompose the distributional effects during the pandemic. Section 5 presents the main results of the analysis. Finally, Section 6 concludes.

2 | AN OVERVIEW OF THE DISTRIBUTIONAL EFFECTS OF THE COVID-19 PANDEMIC IN LAC

Since the outbreak of COVID-19, several studies have focused on assessing the impact of the pandemic on the income distribution and the role of tax-benefit instruments in protecting

households in LAC. In many cases, the lack of household survey data covering the period of the pandemic prompted the use of microsimulation techniques and different approaches to nowcast incomes, based for instance on information about economic sectors shutdown by law, macroeconomic statistics, or adjusting household surveys before the pandemic with models estimated in (often limited) data collected during the pandemic.

For Colombia, Corredor et al. (2021), Cuesta and Pico (2020), and Nuñez (2020) quantify the effects of lockdowns and emergency policies on the income distribution. The studies report a strong impact of COVID-19 on employment and income, which translates into a dramatic increase in poverty. The emergency policies implemented in the country mitigated the impact on poverty although alternative policies might have been more efficient (Cuesta & Pico, 2020). For Ecuador, Jara et al. (2022) nowcast the impact of the pandemic on the income distribution, using pre-COVID data adjusted with information from phone surveys collected during the pandemic. Their results show that poverty more than doubled and the Gini coefficient increased by 28% between the end of 2019 and the second quarter of 2020. In Peru, poverty also increased sharply during the pandemic (INEI, 2020). However, there is limited evidence on the cushioning effect of emergency cash transfers.

Evidence of the striking impact of the pandemic on household incomes has also been found for other countries in the region [see Brum and De Rosa (2021) for Uruguay and Huesca et al. (2021) for Mexico] and cross-country studies have focused on the role of emergency transfers during the pandemic. For instance, Lustig et al. (2021) find that expanded social assistance had significant effects in mitigating the impact of the economic shock in Brazil and Argentina, but only small effects in Colombia.

3 | TAX-BENEFIT POLICIES IN THE COUNTRIES UNDER ANALYSIS

This section briefly reviews the pre-COVID tax-benefit systems present in December 2019 in Colombia, Ecuador, and Peru, and the policies implemented by national governments to mitigate the impact of the COVID-19 crisis. The review focuses on direct taxes, SICs, and cash transfers as our analysis considers changes in household disposable income.

3.1 | Tax-benefit systems before the pandemic (2019)

Tables A1–A4 in Supporting Information presents a summary of the key parameters of employee and self-employed SICs, personal income tax and the main cash transfer programs in each country under analysis.

Employee SIC rates (Table A1 in Supporting Information) are similar across countries, ranging from 8% in Colombia to 13% in Peru. Self-employed contribution rates (Table A2 in Supporting Information) are higher than those of employees in Colombia (28.5% or 30.5%) and Ecuador (20.6%). However, in the former, they apply only to 40% of self-employment gains. In Peru, fixed amounts between 0.15 and 0.23 times the minimum wage depending on age apply to self-employed health insurance contributions. In all countries, employees and self-employed workers affiliated to social security pay SIC at least on the basis of the minimum wage, whereas maximum payments (i.e., ceilings) exist only in Colombia. Both employee and self-employed

SIC are deducted from labor income for the purpose of personal income tax payments in Colombia and Ecuador, but not in Peru.

The design of personal income tax (Table A3 in Supporting Information) shares some similarities across countries. The threshold below which incomes are exempt of tax payments (lowest tax band) is high, ranging from 2.3 annualized minimum wages in Peru to 3.8 annualized minimum wages in Colombia. The top tax rates are similar across countries, between 30% in Peru and 35% in Ecuador. However, the threshold at which these rates are applied varies from 14.4 annualized minimum wages in Colombia, to 24.4 annualized minimum wages in Ecuador. In addition, a number of tax deductions are available in the countries under analysis, which are mostly composed of expenditures in health, housing and education.

In terms of cash transfers (Table A4 in Supporting Information), two population groups are targeted in all countries: families with children and elderly adults. In addition, specific programs are in place in Ecuador for individuals with disabilities and their carers. A common trait of social assistance programs in the countries under analysis is their design as proxy means-tested benefits, meaning that eligibility is not assessed with respect to household income but with respect of a composite welfare index based on information about the dwelling and the household. As a result, the main social assistance programs in place before the pandemic do not provide automatic protection in the event of economic shocks, i.e. do not act as automatic stabilizers.

3.2 | COVID-related tax-benefit policies

To mitigate the impact of the COVID-19 pandemic in the economy, national governments implemented a variety of emergency policies. Table A5 in Supporting Information summarizes the key characteristics of each program in the countries under study.

All countries implemented emergency cash transfer programs aimed at providing income support to low-income families during the pandemic. In Peru, four emergency transfers were introduced, targeting different population groups living in poverty and extreme poverty: *Bono Independiente*; *Bono Rural*; *Bono Yo me Quedo en Casa*; and *Bono Familiar Universal*. In Colombia, two new cash transfer programs were introduced (*Ingreso Solidario* and *Devolución del IVA*) and, in addition, existing social assistance benefits (*Familias en acción*, *Jóvenes en Acción*, and *Colombia Mayor*) were made more generous and changes were made to contributory unemployment benefits (*Mecanismo de protección al cesante*). In Ecuador, a single emergency program, the Family Protection Grant (*Bono de Protección Familiar*), was implemented.

The generosity and duration of these programs varied across countries. The most generous transfers were introduced in Peru, representing up to 124% of median per capita household disposable income. However, they were designed as one-off lump sum payments. In Ecuador, the Family Protection Grant consisted of two monthly installments, whereas in Colombia the emergency transfers lasted the whole year.

In addition to cash transfers, Colombia introduced a transitory tax for government officials and pensioners (*Impuesto Solidario*) and a reduction in pension contribution rates. In Peru, the government authorized workers to withdraw part of their private pension fund from the AFP (*Administradoras de Fondo Pensiones*) and the CTS (*Compensación de Tiempo de Servicios*). In all countries, food baskets were also delivered by subnational governments and lines of credit were open to support small businesses.

4 | METHODOLOGY

This section starts by presenting the tax-benefit microsimulation models and data used in the analysis. Then, it discusses the nowcasting approach used to capture the labor market situation during the second and fourth quarter of 2020. Finally, we describe the method used to decompose changes in household disposable income into the contribution of earnings losses, automatic stabilizers and COVID-related policies.

4.1 | Tax-benefit models

Our study makes use of harmonized tax-benefit microsimulation models for Colombia (COLMOD), Ecuador (ECUAMOD), and Peru (PERUMOD). The models are computer programs that calculate direct taxes and SICs paid and cash transfers received by individuals in household survey data based on their reported market income and demographic characteristics, and following as close as possible the legislation of each policy instrument.[2,3] The models have been implemented in EUROMOD, a tax-benefit microsimulation platform which offers a standard set of modeling protocols and a common simulation language to ensure comparability across countries (see Decoster et al., 2019; Sutherland & Figari, 2013; UNU-WIDER, 2021). EUROMOD-based models are static in the sense that the simulation of the taxes and benefits does not consider possible behavioral reactions of individuals and there are no changes in the population composition over time. Simulation results for the models used in the analysis have been validated against official statistics [see Jara, Martín, et al. (2023) for Ecuador, Rodríguez et al. (2023) for Colombia, and Torres and Chang (2023) for Peru].

The models are used to simulate the main tax and benefit components of household disposable income in 2019 and 2020 in the countries under analysis. The 2019 and 2020 simulations include (i) employee SICs, (ii) self-employed SICs, (iii) personal income tax, and (iv) the main cash transfer programs in each country before the pandemic (see Section 3.1). SICs and personal income tax are simulated only for workers reporting affiliation to social security.[4] In addition, the 2020 simulations include the main COVID-related measures implemented in each country and summarized in Table A5 in Supporting Information (see Section 3.2).

4.2 | Data

Our analysis is based on official household survey data from Colombia, Ecuador, and Peru for 2019 and 2020. The datasets, listed in Table 1, contain detailed information on employment, earnings and nonlabor income, household and personal characteristics. The income concepts have been harmonized in the three datasets with the aim of allowing comparability in the simulations results. Our study contrasts the situation at the end of 2019 with that at the second quarter of 2020, when the economies were hit the hardest, and at the end of 2020. Figure B1 in Supporting Information depicts the impact of the pandemic on the labor market by presenting the evolution of the share of people who reported having positive earnings in the data relative to the working age population in the countries under analysis from December 2019 to December 2020.

TABLE 1 Data sources and microsimulation models.

Country	Data source	Period of data collection	Number of individuals	Microsimulation model
Colombia	Gran Encuesta Integrada de Hogares (GEIH)	Q4 2019	186,727	COLMOD
		May 2020	65,481	
		Q4 2020	184,790	
Ecuador	Encuesta Nacional de Empleo, Desempleo y Subempleo de Hogares Urbanos y Rurales (ENEMDU)	Dec 2019	59,183	ECUAMOD
		May/Jun 2020	37,406	
		Dec 2020	30,636	
Peru	Encuesta Nacional de Hogares (ENAHO)	Q4 2019	28,599	PERUMOD
		Q2 2020	27,614	
		Q4 2020	27,191	

Source: Authors' elaboration based on household surveys.

4.3 | Nowcasting 2020 incomes

The pandemic affected data collection in the countries under analysis, forcing statistical agencies to reduce sample sizes of official surveys and, in some cases, to resort to phone interviews. Household survey data before the pandemic contains detailed information on demographics, employment, earnings, income from capital and property, private transfers, pensions, and cash transfer programs. On the contrary, data for 2020 in most cases only contains demographic, employment, and earnings information.

To overcome this limitation, we use nowcasting techniques: we adjust the information on earnings and labor market status in the 2019 household survey data to create a modified dataset which reflects the labor market and earnings distribution during the pandemic based on phone surveys collected during the pandemic. More precisely, our approach to generate information on the drop in household disposable income during the pandemic consists of three steps. First, we estimate a probability model to determine if an individual reporting positive earnings in the 2019 database is predicted to remain as earner in 2020. We refer to this step as an adjustment at the extensive margin. Second, conditional on having predicted positive earnings, we update individual earnings to match those prevailing in 2020. We refer to this step as an adjustment at the intensive margin. Finally, the adjusted microdata is used as input of our tax-benefit simulations to obtain the distribution of household disposable income in the second and fourth quarter of 2020, considering the tax-benefit policies that were in place during these periods.

In our adjustment at the extensive margin, for each COVID scenario (second and fourth quarter of 2020), we estimate a probit model of the probability of having positive earnings pooling observations from 2019 and 2020 (i.e., two regressions per country with pooled data from Q4-2019 and Q2-2020, and Q4-2019 and Q4-2020). The dependent variable is equal to one if an individual in the working age population reports positive earnings, zero otherwise. We include as regressors a vector of demographics including age, age squared, dummies for woman, region, rural, head of the household, educational level, whether the observation is in education, and whether the observation has a partner in the household. We further include a dummy for 2020 and interactions between this dummy and the vector of characteristics. The estimation results are presented in Table B1 in Supporting Information.

The estimated coefficients are then used to predict the probability of being an earner in 2020 for individuals in the 2019 data. For this, the 2020 dummy is set to one for individuals in 2019 and the predictions are based on each person's characteristics multiplied by the coefficients plus a random component that accounts for unobserved factors that may tip people into being an earner or not. The addition of the random term means that we do not completely exclude groups with low (deterministic) probability from being earners (Li & O'Donoghue, 2014). Based on these predicted probabilities, we move individuals from being earners in 2019 to having zero earnings in 2020 to match the number earners by industry and formality status (formal or informal) observed in the 2020 data. Figure B2 in Supporting Information shows the total number of earners (top of the bars) per industry in December 2019 and the second or fourth quarter of 2020, distinguishing between formal (blue bars) and informal earners (red bars). Table B2 in Supporting Information compares the characteristics of earners in the observed 2020 data (Q2 and Q4) and those of our 2019 data adjusted by changes in the number of earners based on information from 2020.

In our second step (adjustment at the intensive margin), for those individuals that are predicted to remain as earners, we adjust their earnings so that the mean earnings per industry, employment status (employee vs. self-employed), and formality status (formal vs. informal) in the adjusted microdata reflects the information of mean earnings for these categories in the second and fourth quarter of 2020. Note that some workers within these categories might not have experienced changes to their earnings, however, the data does not allow us to identify these workers and a further disaggregation by individual characteristics (e.g., gender, education) reduces the number of observations in each category.[5]

In our third step, based on the adjusted microdata reflecting the employment and earnings situation in the second and fourth quarter of 2020, we run tax-benefit simulations to obtain the distribution of household disposable income before and during the pandemic, and we compare these distributions by means of decomposition techniques, which are detailed in the next section.

4.4 | Decomposing changes in the distribution of household disposable income

To compare the distribution of household disposable income before and during COVID-19, we follow the decomposition approach proposed by Bargain and Callan (2010) and extended by Paulus and Tasseva (2020). The method consists of simulating three counterfactual scenarios in each country and for each COVID scenario: (i) 2019 tax-benefit policies applied to 2019 data; (ii) 2019 policies applied to adjusted data reflecting the situation in the second (fourth) quarter of 2020; and (iii) 2020 policies, including COVID-related measures, applied to adjusted data reflecting the situation in the second (fourth) quarter of 2020. Based on these three scenarios, the decomposition allows isolating the distributional effects of: (i) earnings losses due to COVID-19, (ii) pre-crisis tax-benefit policies (i.e., automatic stabilizers), and (iii) COVID-related emergency measures implemented by the government.

Let y represent pre-crisis gross market income, $t(y)$ income tax and SICs, and $b(y)$ government cash transfers. Then, household disposable income in the pre-crisis baseline scenario is given by:

$$B = y - t(y) + b(y). \tag{1}$$

Now, let y' represent gross market income under the crisis reflecting a scenario with higher unemployment and lower earnings, $t'(y')$ denote income tax and SICs after the drop in earnings and tax and SIC reforms (e.g., newly introduced taxes and SICs), and $b'(y')$ represent government cash transfers after the earnings drop and benefit changes (e.g., newly introduced cash transfers). Then, the household disposable income under the crisis is given by:

$$D = y' - t'(y') + b'(y'). \tag{2}$$

A welfare index, I, such as mean income or a measure of inequality or poverty, can be calculated based on the distribution of disposable income under the pre-crisis and crisis scenarios. The total difference Δ in the welfare indicator I between the pre-crisis and crisis scenarios can be represented by:

$$\Delta = I[y' - t'(y') + b'(y')] - I[y - t(y) + b(y)]. \tag{3}$$

The difference in the distribution of disposable income, as summarized by index I, can be decomposed into the contribution of the change in the tax-benefit rules ("policy changes effect") and the contribution of "other effects" not directly linked to policy changes, such as the changes in the underlying gross market income distribution due to the economic shock. Formally, this can be represented as[6]:

$$\begin{aligned}\Delta = {} & \{I[y' - t'(y') + b'(y')] - I[y' - t(y') + b(y')]\}\,(\text{policy changes}) \\ & + \{I[y' - t(y') + b(y')] - I[y - t(y) + b(y)]\}\,(\text{other effects}).\end{aligned} \tag{4}$$

Following Paulus and Tasseva (2020), for additively decomposable measures only, such as mean incomes, we can further decompose the "other effects" into the effect of earnings changes and the effect of automatic stabilizers. Equation (4) can be rewritten as:

$$\begin{aligned}\Delta = {} & \{I[y' - t'(y') + b'(y')] - I[y' - t(y') + b(y')]\} && (\text{policy changes}) \\ & + \{I[y'] - I[y]\} && (\text{earnings changes}) \\ & + \{I[t(y)] - I[t(y')]\} && (\text{taxes and SICs as automatic stabilizers}) \\ & + \{I[b(y')] - I[b(y)]\} && (\text{benefits as automatic stabilizers})\end{aligned} \tag{5}$$

5 | DISTRIBUTIONAL EFFECTS OF THE COVID-19 PANDEMIC

This section presents our decomposition results. We first discuss the effects on mean household disposable income. Then, we present the results of the impact of the crisis on income poverty and inequality.

5.1 | Changes in mean disposable income

Figure 1 presents the percentage change in mean household disposable income per capita by deciles of household disposable income and for the whole population in each country under

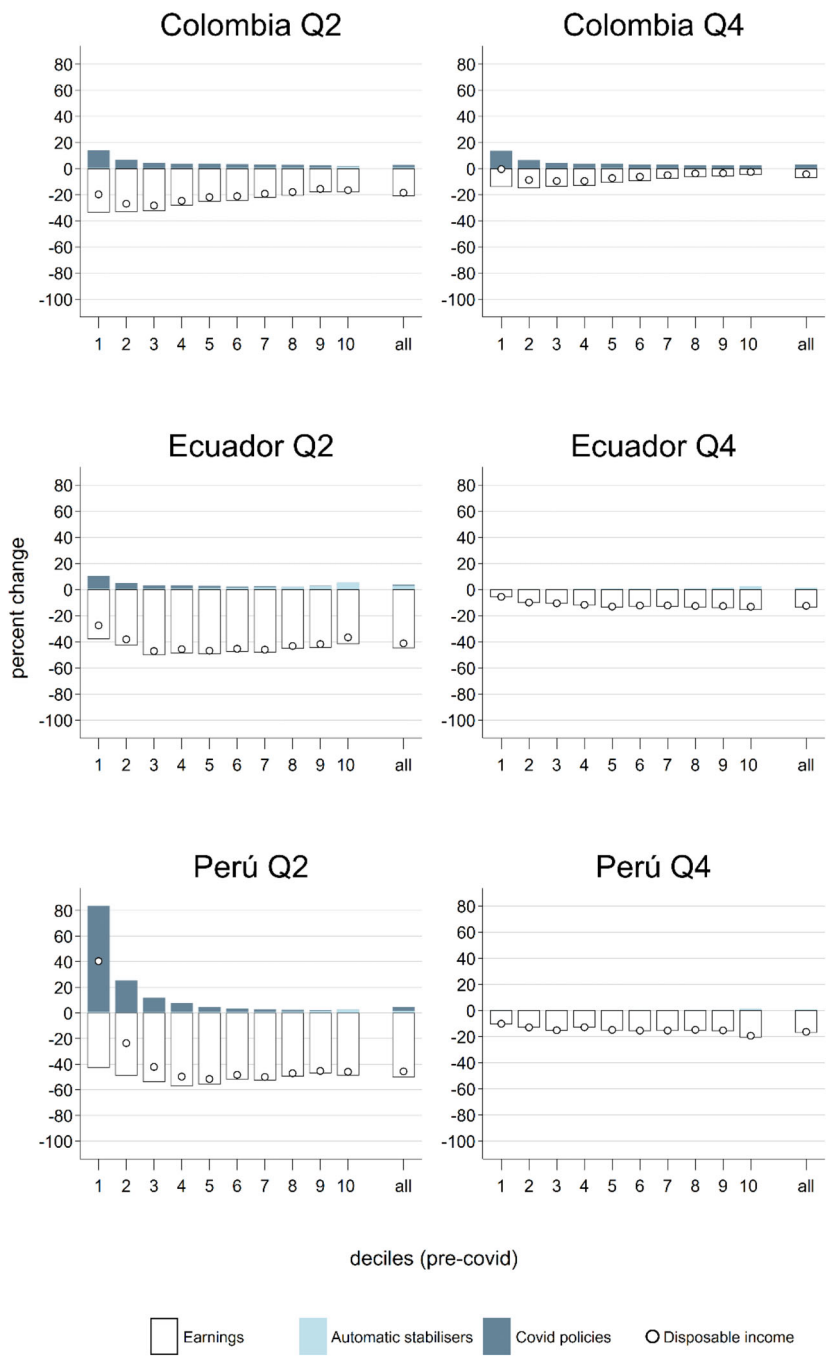

FIGURE 1 Decomposition of changes in mean household disposable income by income decile. Changes in income are based on per capita household disposable income before the pandemic. *Source*: Authors' elaboration based on microsimulation models COLMOD, ECUAMOD, and PERUMOD. [Colour figure can be viewed at wileyonlinelibrary.com]

analysis. Deciles are based on household disposable income per capita in the pre-COVID scenario (December 2019 baseline). The changes reflect the difference between the pre-COVID and the COVID scenarios. We present results for the second (Q2) and last quarter (Q4) of 2020 in the first and second column of the figure, respectively. The change in disposable income is decomposed into the effects of (i) earning losses, (ii) COVID-related policies, and (iii) automatic stabilizers.

For the second quarter of 2020, our results show that, on average, household disposable income (white circles) dropped sharply due to the COVID-19 pandemic. Mean household disposable income dropped by 19% in Colombia, 41% in Ecuador, and 45.8% in Peru. The fall in household income largely reflects the earnings losses (white bars) resulting from the crisis, which represent 21.9% of household disposable income in Colombia, 44.8% in Ecuador and 50.5% in Peru. Therefore, on average, COVID-related policies (dark blue bars) and automatic stabilizers (light blue bars) played a minor role in cushioning the impact of earnings reduction on household income, accounting together for an increase in household disposable income of 2.9% in Colombia, 3.7% in Ecuador and 4.7% in Peru. The effect of COVID-related policies is larger than that of automatic stabilizers in Colombia and Peru, accounting for 2% of baseline income compared to 0.9% in Colombia, and 3.2% compared to 1.5% in Peru. In Ecuador, automatic stabilizers played a larger role on average, representing 2.9% of baseline income, whereas COVID-related policies represented only a 0.8%. Differences in the effect of COVID-related policies and automatic stabilizers across countries are explained by differences in the design of tax-benefit instruments, which we discuss more in detail in the next sections.

Figure 1 also shows a U-shaped pattern in the change of mean household disposable income across the income distribution for all countries in the second quarter of 2020. The pattern implies that households in the middle of the pre-pandemic income distribution experienced larger drops in earnings compared to those at the bottom, and is consistent with results by Lustig et al. (2021). Regarding COVID policies and automatic stabilizers, we also find a similar pattern across countries but with varying magnitudes on the effects of these instruments. In all countries, the contribution of automatic stabilizers increased with income and they mitigated the effect of the economic shock mostly through their effect in the top decile of the distribution, where they represented 5.2% of baseline income for Ecuador, 2.5% for Peru, and 1.6% for Colombia. On the contrary, COVID-related policies played an important role at the bottom of the distribution.

Results for the last quarter of 2020 depict the extent to which the economy recovered. In all countries, we still observe a drop in mean household disposable income in the last quarter of 2020 relative to December 2019. However, the magnitude of the fall in earnings is smaller than that observed in the second quarter. For Colombia, we observe a drop of mean disposable income of 4.4%. In Ecuador and Peru, mean disposable income decreased, on average, by 12.2% and 17.1%, respectively. Compared to the second quarter, we observe that COVID-related policies play a role in mitigating the impact of the economic shock only in Colombia. This is because this is the only country where COVID policies were maintained until the end of 2020. In Ecuador, the *Family Protection Grant* was paid during the months of April to June 2020 with no additional emergency programs after that period. In Peru, all COVID-related benefits were designed as lump sum payments implemented during the second quarter of 2020 with no further emergency policies. The role of automatic stabilizers remained limited in all countries, driven by their effect at the top of the income distribution.

To demonstrate more clearly the income losses incurred by households across the income distribution, Tables B3–B5 in Supporting Information present transition matrices by

income decile groups between 2019 and 2020 (second and last quarters). The tables show that downward transitions are large in all countries. Between 28% and 40% of individuals living in households in the fourth, fifth, and sixth decile in 2019 end up in lower income deciles in the second quarter of 2020. An important share of individuals in the middle of the income distribution in 2019 end up in the bottom decile in 2020Q2. In Ecuador, income changes are even large enough to push 8.4% of individuals in the top decile of the income distribution in 2019 to the bottom decile in 2020Q2. As expected, the table shows that by the end of 2020, transitions are less pronounced in all countries. To complement the analysis, Figure B3 in Supporting Information presents the same information as Figure 1 but with deciles based on household disposable income per capita in the COVID scenarios. The figure depicts the huge drops in income for households who end up at the bottom of the COVID income distributions. Interestingly, the graph also shows that automatic stabilizers have an effect at the bottom of the distribution, but this is mainly due to downward transitions of individuals who were at the top of the distribution in 2019 and no longer pay taxes when they end up at the bottom of the distribution during the pandemic.

The remainder of this section now turns to the effect of specific income sources and tax-benefit instruments on changes in household disposable income. More precisely, we assess separately the effect of losses in employment versus self-employment earnings, and the contribution of taxes, SICs and benefits to changes in household disposable income, distinguishing between COVID-related policies and automatic stabilizers.

Earnings losses. Figure 2 shows the change in disposable income accrued to the change in earnings from four different sources: formal employment (black bar), informal employment (white bar), formal self-employment (dark blue bar), and informal self-employment (light blue bar). Relative to 2019, we observe a drop in all four income sources across countries and as a result, changes in earnings from these sources always contribute to a reduction in household disposable income.

For the second quarter of 2020, some similar patterns are observed across countries. On average, for the whole population in Ecuador and Peru, the income sources accounting for the largest reduction in disposable income are formal employment and informal self-employment earnings. The former (latter) accounts for a 14.5% (13.6%) reduction in household disposable income in Ecuador and 12.4% (17.1%) in Peru. In Peru, changes in informal employment earnings also contribute to the drop in disposable income (by 12.1%). In Colombia, the drop in informal self-employment earnings accounts for the largest reduction in disposable income (7.9%), followed by informal employment income (5.8%).

Figure 2 also shows similar patterns in the role of the different income sources across the income distribution in the second quarter of 2020. In all countries, losses in formal employment and formal self-employment earnings are larger at the top of the income distribution, which is explained by the concentration of informal work at the bottom of the distribution. In fact, changes in informal self-employment earnings account for a larger reduction of disposable income in the bottom half of the income distribution, whereas changes in informal employment earnings are more pronounced in the middle of the income distribution.

In the last quarter of 2020, the drop in earnings from all four sources reduces as the economy recovers. Some patterns across countries prevail. On average, in Ecuador and Peru, the income source accounting for the largest reduction in disposable income is formal employment earnings. In Colombia, changes in informal self-employment earnings contribute the most to the drop in disposable income. Some patterns observed across the income distribution also prevail. In all countries, the drop in formal self-employment earnings is larger at the top, and the

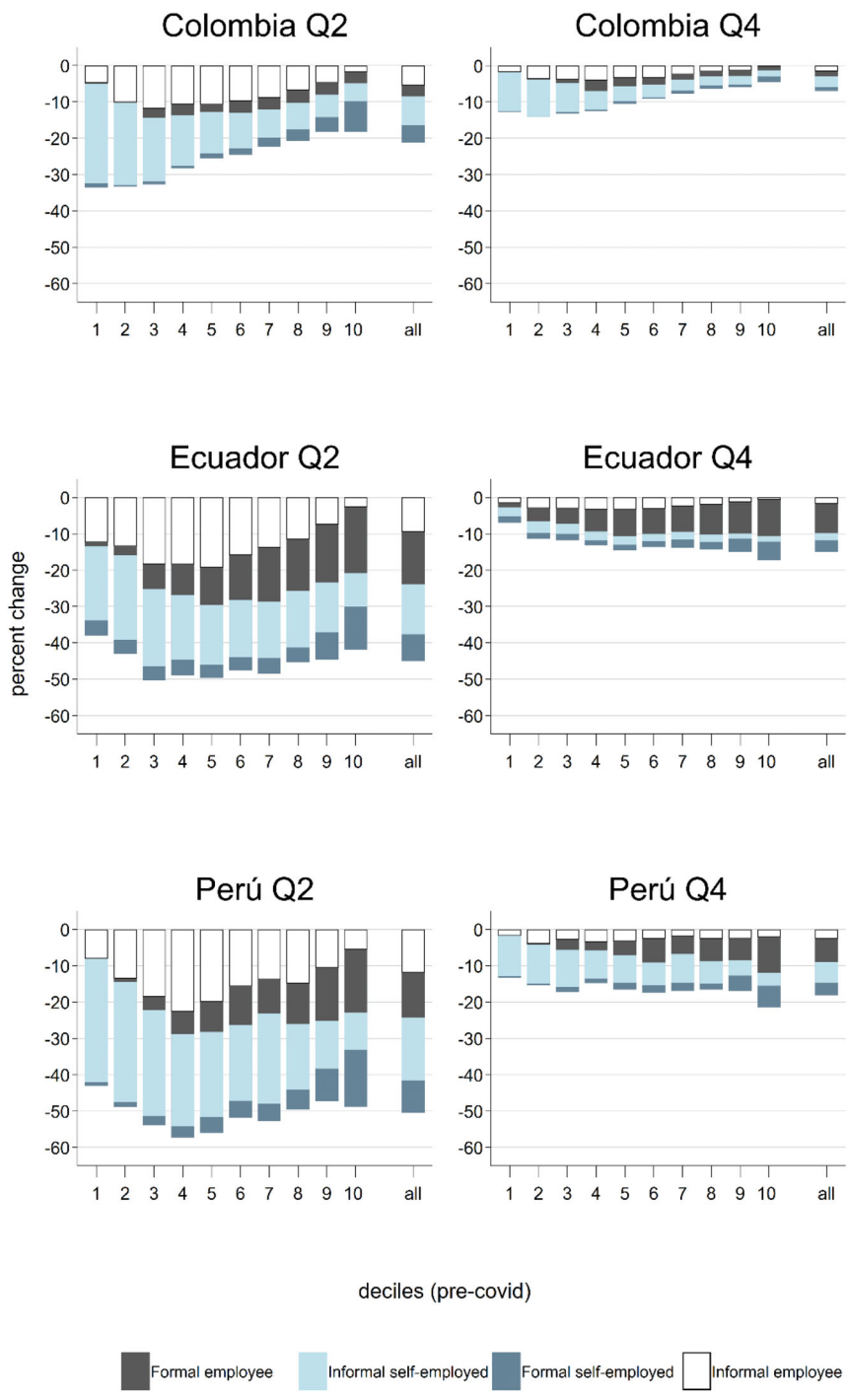

FIGURE 2 Change in mean disposable income due to earnings losses. Changes in income are based on per capita household disposable income before the pandemic. *Source*: Authors' elaboration based on microsimulation models COLMOD, ECUAMOD, and PERUMOD. [Colour figure can be viewed at wileyonlinelibrary.com]

same holds for formal employment earnings in Ecuador and Peru. At the bottom of the income distribution, the drop in informal self-employment earnings accounts the most for the drop of disposable income.

Automatic stabilizers. Figure 3 presents the change in mean household disposable income due to automatic stabilizers (i.e., automatic reductions in personal income tax, SICs, and automatic increases in benefits due to changes in earnings) under our COVID scenarios. Our results show that in all three countries and for the two COVID periods analyzed, SICs provide the largest automatic stabilization. SICs account for a 0.7% (0.2%) increase in disposable income in the second (last) quarter of 2020 in Colombia, a 2.2% (1.1%) increase in Ecuador, and a 0.9% (0.3%) increase in Peru. In Colombia and Ecuador, the contribution of SICs as an automatic stabilizer increases along the income distribution. In Peru, the contribution of SICs also increases with income but a large effect is observed in the first decile. The latter is explained by the design of self-employed health insurance contributions as fixed payments (i.e., not proportional to earnings), which are assumed to stop when self-employed workers enter unemployment. The increasing role of SICs along the income distribution is explained by the larger prevalence of formal employment in higher income deciles and by the lager drop of formal earnings at the top (see Figure 2).

The effect of personal income tax as an automatic stabilizer is smaller than that of SICs. The contribution of personal income tax also increases with income, and it plays a role mostly at the top. In Peru, personal income tax accounts for a larger increase in disposable income than SICs in the top decile. The cross-country pattern holds for the second and fourth quarters of 2020, with a smaller role of SICs and personal income tax in the last quarter due to the smaller drop in earnings. Note that, as in the case of SICs, the larger contribution of personal income tax in the top decile is explained by the larger drop in formal earnings for this group (see Figure 2) but also by the progressivity of this policy instrument, as a higher marginal tax rate applies to higher incomes. However, overall, the contribution of personal income tax as an automatic stabilizer remains modest not only due to the prevalence of informal employment but also due to the design of personal income tax in these countries, which is characterized by high exempted thresholds and the presence of deductions for personal expenditures (see Table A3 in Supporting Information).

Finally, Figure 3 provides evidence of the lack of benefits acting as automatic stabilizers in the countries under analysis. In particular, the main social assistance programs in each country (see Table A4 in Supporting Information) fail to provide automatic stabilization at the bottom of the income distribution due to their design as proxy means-tested benefits. In fact, eligibility for the main social assistance programs in the countries under analysis is based on composite indices including information about housing and household characteristics and therefore do not depend directly on income to react automatically to earnings shocks.

COVID-related policies. By design, COVID-related policies have a greater effect at the bottom of the income distribution, as they were mostly aimed at providing income protection to poor households in each country. This pattern holds for all countries in the second quarter of 2020 as depicted in Figure 1 (above). In the second quarter, COVID-related policies increase mean disposable income of the first income decile group by 13.5% in Colombia, 10.2% in Ecuador and 83% in Peru. Note, however, that the shock absorber effect of COVID-related policies drops largely for the second decile group (and onwards), where it accounts for a 6.4%, 4.4%, and 24.7% increase in disposable income for Colombia, Ecuador, and Peru, respectively. The large effect observed in Peru, particularly in the first decile, is due to the design of COVID-related benefits as generous one-off lump sum payments during the months of April and May 2020. Only in this

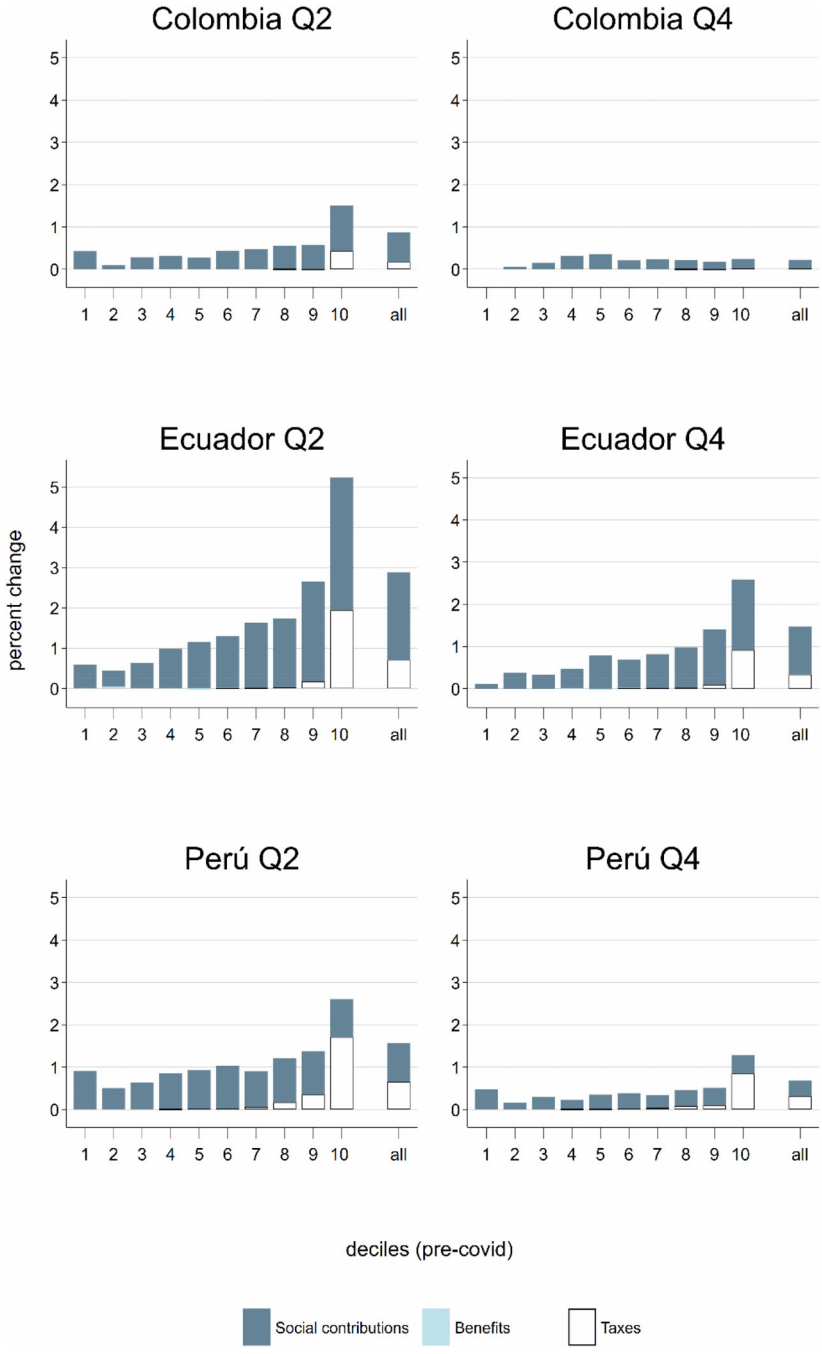

FIGURE 3 Change in disposable income due to automatic stabilizers. Changes in income are based on per capita household disposable income before the pandemic. *Source*: Authors' elaboration based on microsimulation models COLMOD, ECUAMOD, and PERUMOD. [Colour figure can be viewed at wileyonlinelibrary.com]

country, losses in earnings for households in the first income decile are fully compensated and additional income protection is provided. The small effect observed in Ecuador is explained by the relatively low monthly payment of the Family Protection Grant (i.e., US$60 each month),

which was paid during 2 months over the second quarter of 2020. COVID-related reforms in Colombia encompassed a variety of policies and were in place throughout the second, third and fourth quarters of 2020. For instance, in addition to the cushioning effect of COVID-related benefits, the reduction in SICs rates in Colombia also increases household disposable income, especially at the top of the distribution as depicted in Figure B4 in Supporting Information. By contrast, the emergency tax (*Impuesto Solidario*) decreases mean disposable income of the top income decile, counteracting the effect of the personal income tax as an automatic stabilizer.

For the last quarter of 2020, the effect of COVID-related policies in Colombia remains the same, as all COVID-related reforms were kept in place since the start of the pandemic. In contrast, no effect is observed in Ecuador and Peru at the end of 2020, as COVID-related policies in these countries were limited to the second quarter of 2020 and our simulations assume that the additional resources from COVID emergency policies are fully consumed during the second quarter.

From a policy perspective, two important findings can be drawn from this section. First, there is a lack of benefits acting as automatic stabilizers in the event of a negative income shock in the countries under analysis. Social assistance benefits do not act as automatic stabilizers due to their design as proxy means-tested benefits, which is a characteristic of most cash transfer programs in the region. Second, COVID-related policies contributed to cushioning the effect of the crisis at the bottom of the income distribution. However, no emergency policies were put in place to absorb the negative income shock for the middle class, which suffered the most from the reduction in earnings, implying that emergency transfers did not compensate income losses of households vulnerable to economic shocks (e.g., households slightly above the poverty line) and consequently a large group of them fell into poverty as presented in the next section.

5.2 | Impact on income poverty and inequality

We now turn to the effect of COVID-19 on income inequality and poverty. Table 2 presents inequality and poverty indicators in 2019 (pre-COVID scenario) and in the second (2020 Q2) and last quarter (2020 Q4) of 2020. Poverty and inequality indicators are based on per capita household disposable income. For comparability, we use a US $5 a day poverty line and a US $1.9 a day extreme poverty line (at purchasing power parity for 2019).[7]

In the second quarter of 2020, inequality increased sharply in all countries. The country experiencing the largest rise in inequality is Ecuador, with an increase of 0.124 points in the Gini coefficient. A sharp rise in inequality is also observed in Peru, with an increase of 0.1 points in the Gini. In Colombia, the increase in inequality was also sizeable but smaller than in the other two countries, representing 0.061 points rise in the Gini coefficient. As the economy recovered, inequality decreased in the last quarter compared to the second quarter of 2020, but the Gini coefficient remained higher than in 2019. For robustness, Table 2 presents results based on the Theil index, another common inequality indicator. The pattern of changes in inequality remains broadly similar when the Theil index is used.

In terms of poverty, the impact of the crisis was also large. Table 2 compares statistics on absolute poverty and extreme poverty headcounts (FGT0) and gaps (FGT1). Our results show significant increases in poverty during the second and fourth quarter of 2020. In Ecuador and Peru poverty headcounts increased by 32.1 and 29.8 pp, respectively, in the second quarter. Despite the recovery by the end of 2020, the poverty headcounts in Ecuador and Peru remained higher than at the end of 2019. Colombia's poverty headcount increased by 14.3 pp in the

TABLE 2 Changes in income inequality and poverty during the COVID-19 pandemic.

	Colombia			Ecuador			Peru		
	Pre-COVID scenario	2020 Q2	2020 Q4	Pre-COVID scenario	2020 Q2	2020 Q4	Pre-COVID scenario	2020 Q2	2020 Q4
Inequality									
Gini	0.508	0.569	0.532	0.458	0.582	0.486	0.458	0.558	0.499
Theil	0.500	0.564	0.538	0.389	0.583	0.448	0.375	0.521	0.459
Poverty									
FGT0 (%)	26.8	41.1	31.9	26.0	58.1	34.9	22.1	51.9	31.9
FGT1 (%)	10.9	22.7	13.8	9.5	33.9	14.3	10.5	30.8	14.9
Extreme poverty									
FGT0 (%)	5.4	16.9	7.4	3.1	24.9	6.0	6.7	24.0	9.2
FGT1 (%)	2.2	9.8	3.4	1.3	14.6	2.5	3.2	14.8	4.7

Note: Poverty and inequality indicators are based on per capita household disposable income. The PPP US $5 a day is used as poverty line the PPP US $1.9 a day as extreme poverty.
Source: Authors' elaboration based on microsimulation models COLMOD, ECUAMOD, and PERUMOD.

second quarter and by 5.1 pp in the fourth quarter of 2020, relative to the pre-COVID scenario. Extreme poverty also increased strikingly in all three countries, with a rise of 11.4 pp (1.9 pp) in Colombia, 21.8 pp (2.9 pp) in Ecuador and 17.3 pp (2.5 pp) in Peru during the second (last) quarter of 2020. A similar pattern is observed in terms of the poverty gap.

Table B6 in Supporting Information presents the results of decomposing the total change in inequality and poverty into the contribution of COVID-related policies and other effects. "Other effects" include the combined impact of earning changes and automatic stabilizers. Our analysis shows that for all three countries in the two periods considered, other effects explained most of the total change in income inequality and poverty. COVID-related policies played a mild role in mitigating the effect of the shock on inequality during the second quarter of 2020, contributing to a 0.01 pp decrease in the Gini coefficient in Colombia, 0.012 points in Ecuador and 0.04 points in Peru.

The effect of COVID-related policies in mitigating the impact of the crisis on income poverty is the largest in Peru, where COVID-emergency benefits contribute to a 3.9 pp reduction in the poverty headcount and a 6 pp reduction in the extreme poverty headcount, during the second quarter of 2020. The large effect of COVID-related policies in Peru is explained by the generous lump sum payments of the benefits implemented to by the national government. During the second quarter, COVID-related policies contribute to a 1.6 pp (1.5 pp) reduction in the (extreme) poverty headcount in Colombia, whereas the effect of the COVID Family Protection Grant was limited in Ecuador, representing a 0.7 pp (1.5 pp) reduction in the (extreme) poverty headcount.

In the last quarter of 2020, COVID-related policies remain in place only in Colombia. The contribution of COVID-related policies in the last quarter of 2020 is similar to that observed in

the second quarter, accounting for a 1.8 pp reduction in the poverty headcount and a 1.6 pp reduction in the extreme poverty headcount.

5.3 | Validation

As previously mentioned, we had to rely on nowcasting techniques to simulate changes in the distribution of household disposable income during the second quarter of 2020 because phone surveys collected during this period contained limited information. However, household surveys collected at the end of 2020 can be used directly to produce poverty and inequality estimates. Therefore, to assess the performance of our nowcasting approach, we compare poverty and inequality indicators obtained with our nowcasted distribution of disposable income to those obtained using actual data for the last quarter of 2020.

Table B7 in Supporting Information presents poverty and inequality measures obtained with nowcasted and actual data in each country. In both cases we use the tax-benefit policies as of the last quarter of 2020, that is, they include emergency policies still in place at the end of the year.

The results show that our nowcasted estimates closely match those obtained with actual data for the last quarter of 2020. In all three countries, there is less than a 5% difference between the nowcasted Gini coefficients and those obtained based on actual data. Differences are also small for the Theil index. In terms of poverty, differences are also relatively small. In Colombia, the nowcasted poverty headcount is 3% lower than the actual one. In Peru, the underestimation of the poverty headcount is of around 7.5%, whereas in Ecuador, the poverty headcount is overestimated by around 6.7%. As expected, differences are larger in terms of extreme poverty which is most likely since small differences in household disposable income between the two approaches might tip more people above/below the extreme poverty line.

Overall, results from our nowcasting exercise provide a good picture of changes in the distribution of household disposable income during the first year of the pandemic. This highlights the advantages of using detailed tax-benefit microsimulation models to provide timely indicators of poverty and inequality in low- and middle-income countries where data collection is often not regular and might be disrupted more easily in periods of economic crisis.

6 | CONCLUSIONS

This paper aimed to assess the cushioning effect of tax-benefit policies during the COVID-19 pandemic in Colombia, Ecuador, and Peru, by means of nowcasting techniques combined with tax-benefit microsimulations. Our results show that mean household disposable income fell dramatically in the second quarter of 2020 compared to December 2019. As lockdowns were relaxed, household incomes recovered by the end of 2020, but remained below their pre-pandemic levels. Decomposing changes in the distribution of household disposable income, our analysis shows that COVID-related policies helped mitigate the impact of the pandemic at the bottom of the distribution, although to different extents across countries depending on the generosity of the emergency cash transfers. By contrast, automatic stabilizers cushioned incomes at the top of the distribution due to automatic reductions in SICs and income tax payments. The large drop in household disposable income translated into a sharp increase in income inequality

and poverty in all countries. The extent to which COVID-related policies mitigate the effect of the shock on income poverty and inequality varied depending on the generosity of the benefits.

From a policy perspective, our analysis provides several relevant findings. First, in terms of social protection before the pandemic in the countries under analysis, there are no benefits acting as automatic stabilizers in case of economic shocks due to their design as proxy means-tested benefits. As a result, these countries need to rely on national governments implementing emergency policies to provide income protection in the event of crisis, as it was the case under the pandemic. The implementation of emergency transfers was challenging because, overnight, governments had to reach populations who had not previously received social assistance benefits and were not included in governments registers. This highlights the need to rethink and enhance social protection in the region. Second, the COVID-19 pandemic and lockdown measures implemented to contain the spread of the virus had long-term economic consequences, with poverty and inequality indicators remaining higher than before the pandemic by the end of 2020. However, the only country which maintained COVID-related policies throughout the year was Colombia, meaning that households in Ecuador and Peru were left largely unprotected to face the effect of the crisis after lockdown measures were relaxed. Third, households in the middle of the income distribution were the most affected by the economic impact of the pandemic. However, no emergency cash transfers were implemented to mitigate the effect of the crisis for this population group. As the pandemic has unveiled the limitations of social protection in Latin American countries, efforts should be made to rethink and redesign social protection in the region to develop a sustainable welfare system in the long term. These efforts necessarily require increasing fiscal capacity in the region to finance social spending and should consider a broad scope of reforms. As previously mentioned, personal income tax in the countries under study is characterized by large exemption thresholds and generous deductions. Therefore, reforms aimed at making personal income tax more progressive should be considered to increase fiscal revenue. However, reforms to reduce tax expenditures and fight tax evasion should also be implemented as they represent important revenue losses (Gómez Sabaini & Morán, 2020). Corporate and wealth taxation reforms should also be discussed in a highly unequal region such as Latin America. Finally, nowcasting techniques combining rapidly deployed surveys (e.g., phone surveys) with detailed tax-benefit microsimulations could provide governments in the Global South with tools to assess changes in poverty and inequality in a timely manner. Moreover, such tools could also allow assessing potential reforms to socio-fiscal policies in view of providing income protection to households in the event of future crises.

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CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding authors upon reasonable request.

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ENDNOTES

[1] Government spending in social protection in 2018 represented 5.5% of GDP in Colombia, 2.5% of in Ecuador and 2.9% in Peru, compared to 4.1% of GDP on average in LAC, which remains low compared to 12% of GDP in OECD countries (ECLAC, 2021). In terms of taxes, the average tax-to-GDP ratio in 2019 was 19.7% in Colombia, 20.1% in Ecuador and 16.6% in Peru, which is below the 22.9% average in LAC, which in turn remains substantially low compared to 33.8% in the OECD (OECD et al., 2021).

[2] The models also simulate indirect taxes. However, for the purpose of this study, we focus on changes in household disposable income. Household disposable income is defined as market income minus social insurance contributions minus direct taxes plus cash transfers (including pensions).

[3] See Appendix SA of Jara, Deza, et al. (2023) for a formal description of tax-benefit microsimulation models for Latin America.

[4] More precisely, workers are considered formal if they report contributing to the social security system in the data in Ecuador, and if they report contributing to the pension system in Colombia and Peru.

[5] In practice, adjustments at the intensive margin are made only for categories where mean earnings have changes by more than 5% between December 2019 and the second and fourth quarter of 2020.

[6] Note that for the decomposition, the pandemic distribution of market income has been taken as basis to apply pre-pandemic tax-benefit policies to it. However, an alternative decomposition where the pre-pandemic market distribution is taken as basis is also possible and the results from a Shapley decomposition can be obtained (Bargain & Callan, 2010). The Shapley decomposition results are similar to those presented in the paper and can be made available by the authors upon request.

[7] We use US$ PPP from the World Bank-World Development Indicators: https://databank.worldbank.org/source/world-development-indicators.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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