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COVID-19 and the Informality-driven Recovery: The Case of Colombia's Labor Market

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Abstract

This paper documents the impact of the COVID-19 pandemic and associated lockdowns on the Colombian labor market using household micro-data. About a quarter of employment was temporarily disrupted at the height of the first pandemic-induced lockdown in 2020. Women, the young, and the less educated were the most affected groups. Since then, a remarkable recovery, led by a rebound in informal employment, has taken place. By adjusting both employment levels and hours faster, the informal sector acted as an important margin of adjustment, particularly in those industries most affected by the first lockdown. The informal sector also appears to have played a role in decreasing the sensitivity of aggregate employment to more recent lockdowns in 2021, as the economy has learned to cope with pandemic restrictions, although the possibility of higher informality rates becoming embedded remains an substantial downside risk for long-term productivity.

Contents

I. INTRODUCTION

Through mandatory lockdowns, restrictions in mobility, and shifts in consumption behavior, COVID-19 severely disrupted labor markets throughout the world. In Colombia, the pandemic induced the deepest recession on record, with about a quarter of total employment being temporarily lost at the height of mandatory lockdowns in the spring of 2020. Using micro-data from a national household survey, this paper documents the magnitude, structure, and distributional impact of the COVID-19 shock on the labor market in Colombia, its main channels, the role of social protection policies, and the informal nature of the subsequent recovery.

As in other Latin American economies, the pandemic and associated containment measures had a heterogeneous impact on a highly informal labor market. Women, the young, and those with low levels of education were the most adversely affected groups in terms of income and employment lossess, which were only partly offset by social policies. Moreover, informality played a fundamental role both in the downturn and during the ongoing intermittent recovery. When the pandemic first struck, the informal sector experienced greater employment losses—particularly among women—not only because of the intrinsic vulnerability of informal employment but also because highly informal economic sectors were to a degree more sensitive to lockdown measures. This meant that the informal economy did not accommodate the adverse employment shock to the degree that it did in past recessions (Levya and Urrutia, 2020), leading to record total employment losses. On the upside, informal jobs rebounded towards pre-COVID employment levels faster than formal jobs. Although pandemic restrictions hit several traditionally informal activities harder, the lack of regulation oversight and rigidities of formal employment seems to have helped the informal sector to adapt labor prices and quantities quicker, aiding the economic bounceback.

Going forward, informality presents a double-edged sword as the recovery progresses. On the one hand, the increase of informality in lockdown-sensitive sectors during the second half of 2020 appears to have boosted the adaptability of these industries during subsequent lockdowns—decreasing the correlation of employment losses with both stringency measures and workplace mobility in later lockdown waves. On the other hand, there are lags in the recovery of formal employment and unemployment rates, and increases in informality rates—both overall and within sectors—remain at risk of becoming permanent. Although a discussion of the long-term implications of more highly informal markets are beyond the scope of this paper, the informality-driven recovery presents risks of potential losses in medium-term productivity and average incomes, as highlighted by a wide literature on informality shortfalls (see Ulyssea, 2021, for a recent review).[1]

Our work contributes to the growing literature on the impact of COVID-19 on labor markets. Unlike early studies, which focused on the early impact of the first pandemic wave (Adams-Prassl et al., 2020; Alon et al., 2020; Montenovo et al., 2020; Shibata, 2020), we join a more recent literature focusing on the structure, magnitude, and composition of the recovery

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[1] See also Quiros-Romero et al. (2020) and IMF (2021) for a recent discussion in the context of the pandemic.

(Fabrizio et al., 2021). As others in the literature (Caselli et al., 2021), we also make use of high-frequency indicators on mobility to track the impact of different lockdown waves. Our paper is most closely linked to recent studies from Eslava et al. (2020), who link lockdowns to employment losses in Colombia through a semi-structural approach, and Morales et al. (2020), who use micro-data to document employment changes in Colombia. Empirical evidence in both of these studies focuses on employment losses during the downturn, using data from just before or just after the height of the first lockdown. Conversely, we employ a different empirical framework to study both the downturn, the upturn, and the impact of the subsequent lockdown in January 2021 using data up to March 2021.

The rest of the paper is structured as follows. Section II describes the Colombian data. Section III provides an overview of the pandemic's initial impact on aggregate labor market variables and the subsequent recovery, placing Colombia in a regional perspective. Section IV documents the distributional impact and the role of social protection policies using Colombian micro-data. Section V documents the role of the informal sector as a crucial margin of adjustment for aggregate dynamics. Section VI documents the effect of lockdowns on mobility and the increased resilience of the labor market to more recent lockdown waves. Section VII concludes.

II. DATA DESCRIPTION

The analysis for Colombia uses data from the *Gran Encuesta Integrada de Hogares (GEIH)*, which consists of monthly samples of households representative of the national population.[2] The survey contains information for both households and individual workers, including: i) a vector of demographic characteristics (e.g. age, gender, and education level); ii) employment status questions through which workers are classified as employed, unemployed, or out of the labor force, and iii) employer characteristics like economic sector, size, and self-employment status, from which an informality indicator is constructed following the definition from the Colombian National Statistical Office (DANE).[3] Other data sources include mobility indicators from the Google Community Mobility Reports, the Stringency Index of COVID-19 national containment measures from the Oxford Government Response Tracker (OxGRT), and data on daily reported COVID-19 cases from Colombia's Ministry of Health and Social Protection. For the analysis of labor markets in other Latin American countries, we use aggregate statistics reported by the respective national statistical offices and micro-data for Chile (*Encuesta Nacional de Empleo*) and Peru (*Encuesta Nacional de Hogares*).

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[2] Over fifteen thousand households are sampled each month with a population of about 60 thousand.

[3] Annex C reports the DANE definition of informality and compares it to that by the ILO. Overall, the DANE definition emphasizes the precarious nature of working conditions while the ILO definition is focuses on participation in the social security and tax systems of the workers and their employers. Despite the differences, the two definitions present a large overlap in the workers they cover, and both broadly capture a condition of greater vulnerability of informal workers to macroeconomic and idiosyncratic economic shocks.

III.   THE COVID-19 SHOCK FROM A REGIONAL PERSPECTIVE

A.   *The Initial Impact*

The strictest lockdown measures to contain the spread of COVID-19 in Latin America occurred between March and April of 2020, when most national authorities implemented mobility restrictions and mandatory business closures. In Colombia, the first COVID-19 case was confirmed on March 6, the government declared a state of emergency on March 17, and the first mandatory quarantine began on March 25. This included school closures which remined during 2020, with a gradual hybrid mode return covering less than 15 percent of the student population only starting in February of the following year.[4] Relative to pre-pandemic employment levels, about a quarter of employment had been temporarily lost by April 2020, with historical job losses pushing an already high unemployment rate of 12 percent above 20 percent—a historical record (Figure 1).

Figure 1. Employment dynamics in Colombia
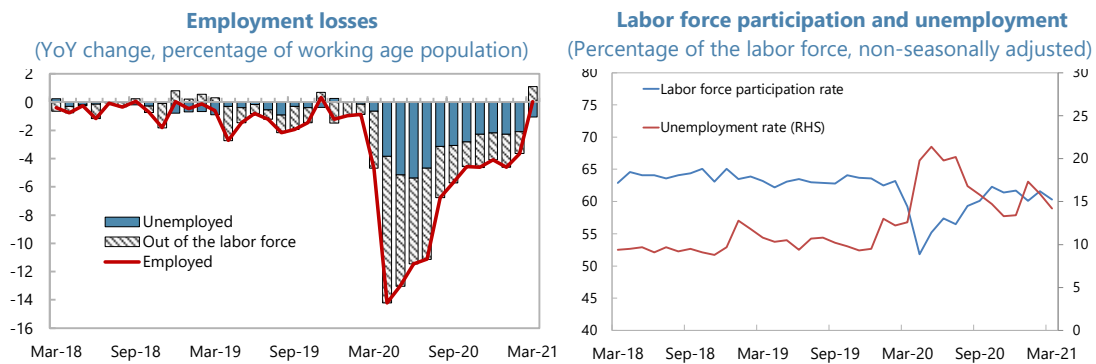
Sources: DANE, and authors' calculations.
Note: Employment losses as a share of working age population (age 10 and above in rural areas and 12 and above in urban ones) taking December 2019 as the reference period. Out of the labor force defined as those not employed or unemployed who are of working age.
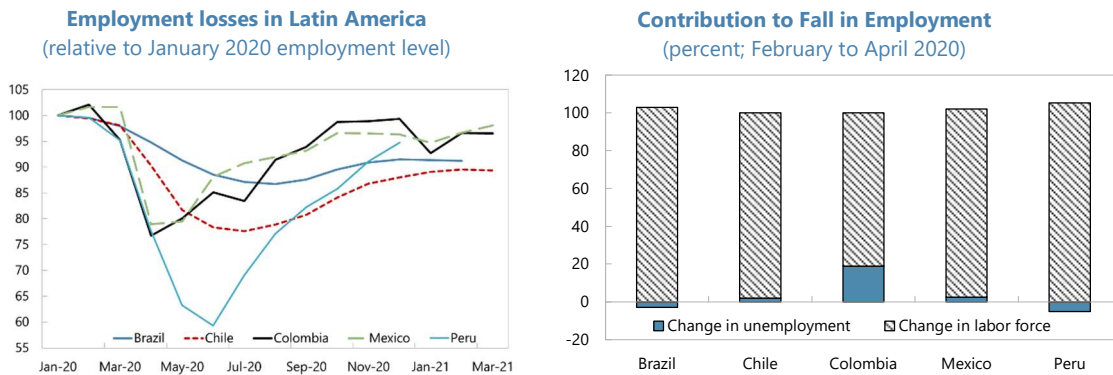
Unemployment rate movements alone, however, understate the total impact of lockdowns, as the majority of those who lost their jobs transitioned directly out of the labor force. Consequently, the labor force participation rate collapsed from 63 percent to a low of 52 percent. To illustrate this, Figure 1 decomposes total employment losses into movements into unemployment and out of the labor force as a share of the working age population using aggregate net flows. This suggests that around 7 of every 10 workers who lost their jobs between February and April dropped out of the labor force. This outcome is in part both fundamental and mechanic. On the one hand, workers might have been discouraged from a deteriorating labor market or forced to discontinue their job search due to increases in household duties or childcare. On the other hand, workers laid off from sectors halted by the lockdown might have found it impossible to search because their sectors of specialization were not operational, or they were simply unable to search due to the lockdown regulations.

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[4] Data from Observatorio de Gestión Educativa.

The lack of active job search would classify the latter group of workers as out of the labor force during this time, not necessarily due to lack of will to work, but because of the restrictions that lockdowns placed on job search. In any case, both channels produced sharp movements in labor force participation that explain most of the fluctuations in total employment during this period.

From a regional perspective, Colombian job losses were substantial, with unemployment spiking much more than regional peers. Net employment losses in the second quarter of 2020, as a share of total employment, were higher than in Brazil, Mexico and Chile but lower than Peru (Figure 2).[5] Alongside falling employment, large declines in the labor force were seen across the region. The Colombian case, however, is distinguished by larger movements in the unemployment rate. Unlike in the other LA5 economies, the pandemic and lockdown induced a larger rise in unemployment from what was already a higher pre-COVID level. As Table 1 and Figure 2 show, in the other LA5 countries the rise in unemployment between January and May 2020 was smaller than in Colombia both in percent terms (i.e., relative to unemployment in January) and as a fraction of employment losses.

Figure 2. Regional employment dynamics

Employment losses in Latin America
(relative to January 2020 employment level)

Contribution to Fall in Employment
(percent; February to April 2020)

Sources: Haver Analytics, national authorities, and authors' calculations.
Note: Contribution to fall of employment based on unemployment rates, labor force rates, and working age population projections from National Statistical Offices.

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[5] Henceforth, this set of countries is referred to as the LA5.

Table 1. Changes in labor force, employment, and unemployment during 2020 in Latin America

		Δ from January 2020 to May 2020			Δ from May 2020 to December 2020		
		Labor Force	Employment	Unemployment	Labor Force	Employment	Unemployment
Colombia	Millions	-2.8	-4.3	1.5	2.8	4.1	-1.4
	% of Jan. 2020	-11%	-20%	46%	11%	19%	-43%
Brazil	Millions	-7.4	-8.2	0.8	1.5	0.2	1.2
	% of Jan. 2020	-7%	-9%	7%	1%	0%	10%
Chile	Millions	-1.5	-1.7	0.2	0.6	0.6	0.2
	% of Jan. 2020	-6%	-18%	28%	2%	6%	28%
Mexico	Millions	-11.5	-11.3	-0.3	9.4	9.3	0.2
	% of Jan. 2020	-20%	-21%	-12%	17%	17%	8%
Peru	Millions	-6.1	-6.4	0.2	5.7	5.5	0.2
	% of Jan. 2020	-34%	-37%	33%	32%	32%	33%

Sources: Haver Analytics, National Statistical Offices, and authors' calculations.

B.   *The Uneven Recovery*

A swift rebound occurred in the second half of 2020, mainly driven by a record number of workers coming back from out of the labor force directly into employment status. The labor force participation rate recovered 10 percentage points from May to December, reaching 62 percent. As over two thirds of those who joined the labor force became employed, this contributed to a near 7 percentage point decrease in the unemployment rate to 13 percent by the end of the year. Overall, workers coming back to the labor force into employment accounted for over 75 percent of the total employment recovery observed on a year-on-year basis—many of them likely returning to their pre-pandemic jobs.

The corollary of this rebound is that the total number of unemployed remained relatively stickier, with the share of the workforce in unemployment remaining 2-3 percentage points above their pre-COVID level. Moreover, as the reopening transition slowed, the rebound in employment slowed towards the end of the year. As new lockdowns were imposed in January 2021, employment gains stopped, labor force participation declined, and unemployment rose again to 17 percent. The sharp snapback in employment in the second half of 2020, interrrupted at the beginning of 2021, is in line with the pattern observed in regional peers. Chile, Brazil, and Mexico also experienced a slowdown in the recovery of employment during the last months of 2020 and early 2021.

Both the initial impact and the recovery showed marked heterogeneity across sectors. The industries that were most affected by the lockdown recovered fast during 2020 but remained below pre-COVID employment levels. Figure 3 shows the changes in total employment levels by economic sector, as a share of pre-COVID employment, at the height of the shock and at the end of 2020, respectively. The figure illustrates the uneven impact and speed of recovery. For instance, construction and manufacturing— two of the sectors most affected by the economic shutdowns and least able to transition to telework modalities — experienced

significant employment losses in the first half of the year and a significant recovery in the second. In contrast, gains in sectors that suffered more prolonged disruptions, such as education services or hospitality, were much less pronounced. Overall, despite strong recovery in sectors most directly impacted, most of the economy remained below pre-COVID employment, with the exception of agriculture, trade services, and the public sector. At the end of 2020, there was an outstanding 1.4 million aggregate job gap relative to pre-COVID employment.

Figure 3. Employment shock and recovery by sector
(share of pre-COVID employment)
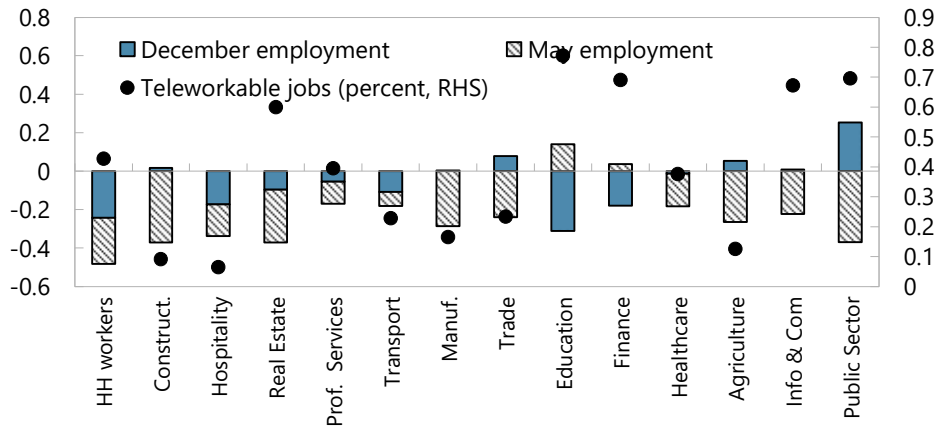
Sources: GEIH; and authors' calculations.
Note: Sum of bar heights reflect share of employment in May relative to February 2020. Height of blue bar reflects employment levels at the end of 2020 relative to February.

IV.   DISTRIBUTIONAL IMPACT AND POLICIES

A.   *Employment and Income Losses*

The pandemic also had a heterogenous effect across different groups of workers. Using available data from Peru and Chile to place Colombia into context, Figure 4 compares the quarter-on-quarter changes in employment across worker groups from the last quarter of 2019 to each of the first three quarters of 2020, respectively. Mirroring the regional pattern, job and labor income losses were more highly concentrated among those with lower levels of education, women, and the young—with employment dropping by close to a third among these groups. Although a recovery ensued for most of these workers, once restrictions eased in the second half of 2020, this process was uneven. Most saliently, bearing the brunt of childcare and home chore duties, women were not only the hardest hit during the height of lockdowns but also experienced a significantly slower recovery.

Figure 4. Employment losses by worker characteristic

(employment loss, percent)

By education

By age

By gender

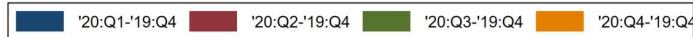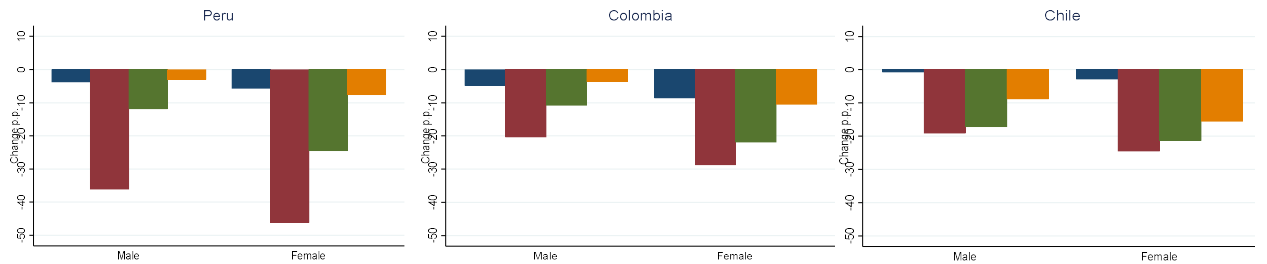| ■ '20:Q1-'19:Q4 | ■ '20:Q2-'19:Q4 | ■ '20:Q3-'19:Q4 | ■ '20:Q4-'19:Q4 |
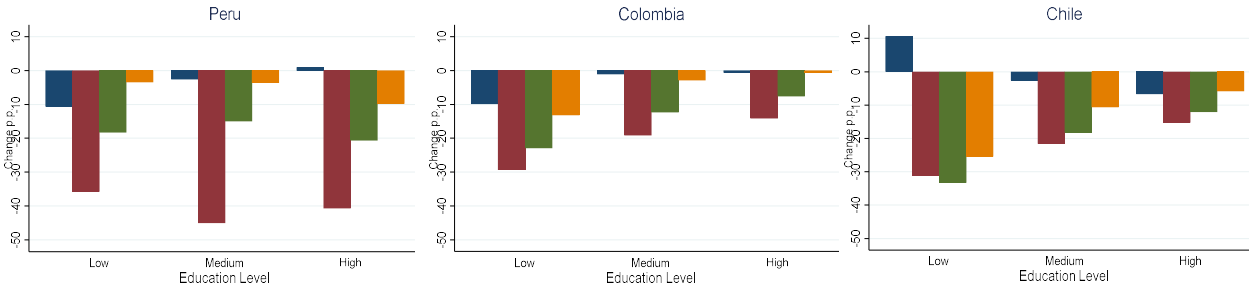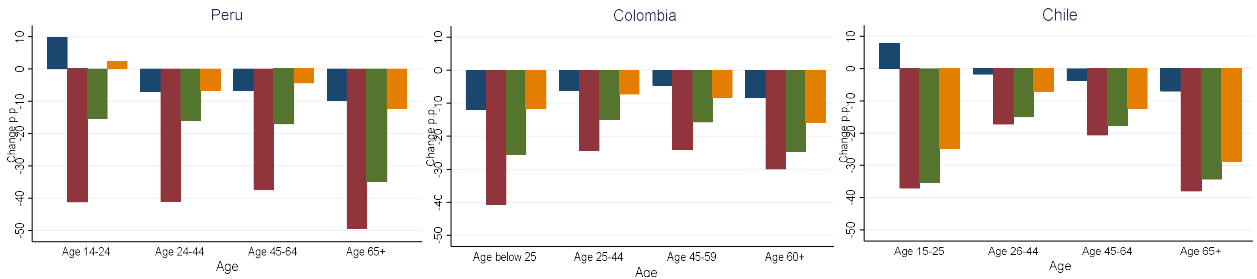
Source: GEIH, ENE, ENAHO, and authors' calculations.

Note: Each panel reports the change in employment level relative to 2019Q4 for a given demographic group. For education, the "Low" group includes those with primary schooling or less, "Medium" those with secondary schooling, and "High" those with post-secondary and tertiary schooling.

Figure 5. Income losses by worker characteristic
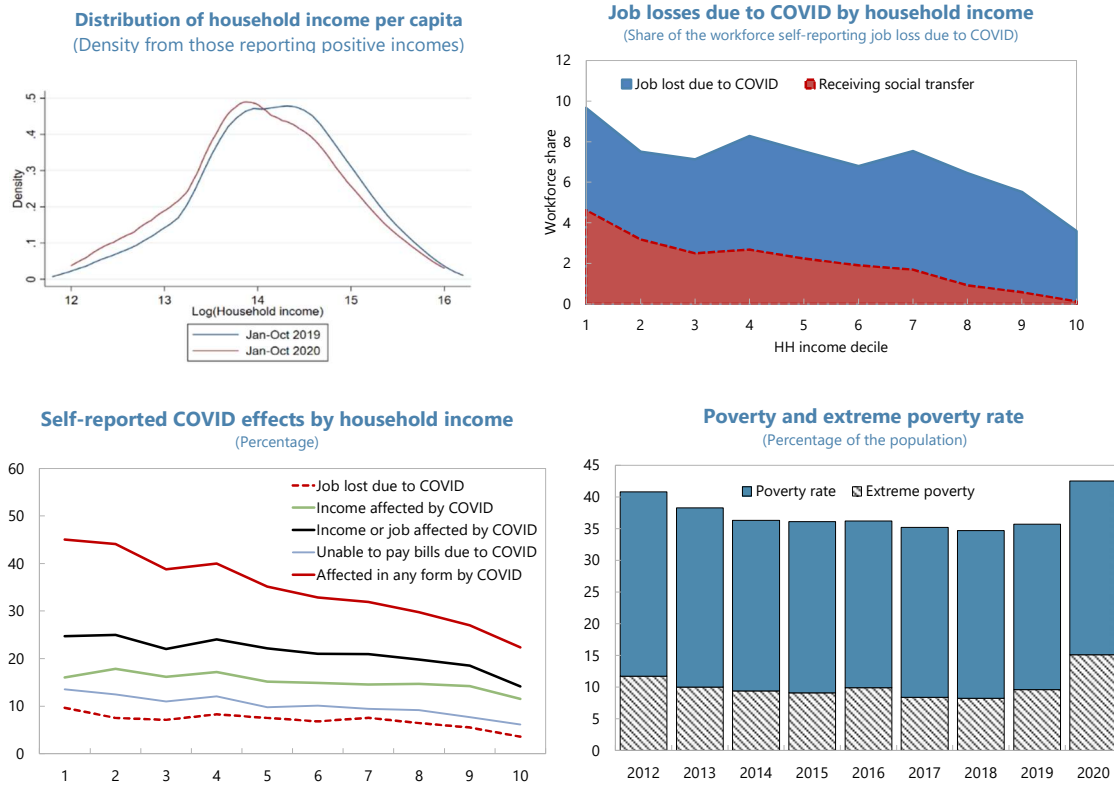(percent change since 2019Q4)
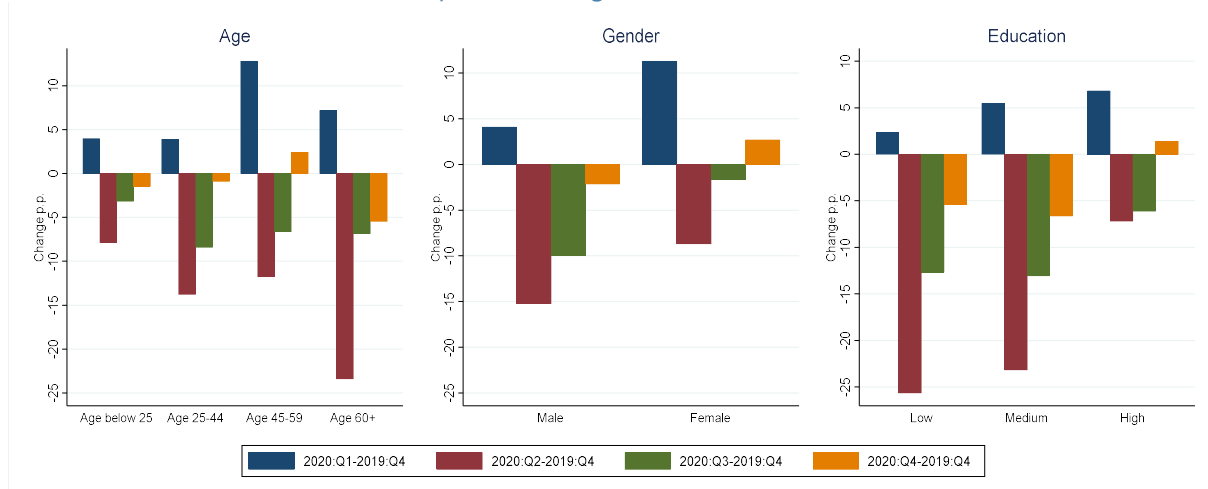
Source: GEIH, and authors' calculations.
Note: Each panel reports the average percent change in monthly earnings among employed workers relative to 2019Q4 for a given demographic group. For education, the "Low" group includes those with primary schooling or less, "Medium" those with secondary schooling, and "High" those with post-secondary and tertiary schooling.

Even among those workers that retained employment during the height of the shock, there were significant drops in income. Men, the least educated, and older workers experienced greater drops in monthly labor earnings (Figure 5). Although incomes recovered among these groups, they remained below pre-COVID levels as of the end of 2020. Together with the concentration of employment losses among vulnerable groups, the pandemic worsened the distribution of household income (Figure 6). In particular, since reported job and income losses due to COVID-19 were concentrated around those households who were poorer to begin with, this produced an uneven leftward shift in the distribution of household income per capita, with a thickening mass at the bottom of the distribution, thus worsening inequality. Overall, lossess were highly concentrated, with the mass of households reporting no income more than doubling from 2019 to 2020 and poverty rates increasing to levels not seen in the last decade (Figure 6).

Figure 6. Distribution of income losses and pandemic-induced losses

Distribution of household income per capita
(Density from those reporting positive incomes)

Job losses due to COVID by household income
(Share of the workforce self-reporting job loss due to COVID)

Self-reported COVID effects by household income
(Percentage)

Poverty and extreme poverty rate
(Percentage of the population)

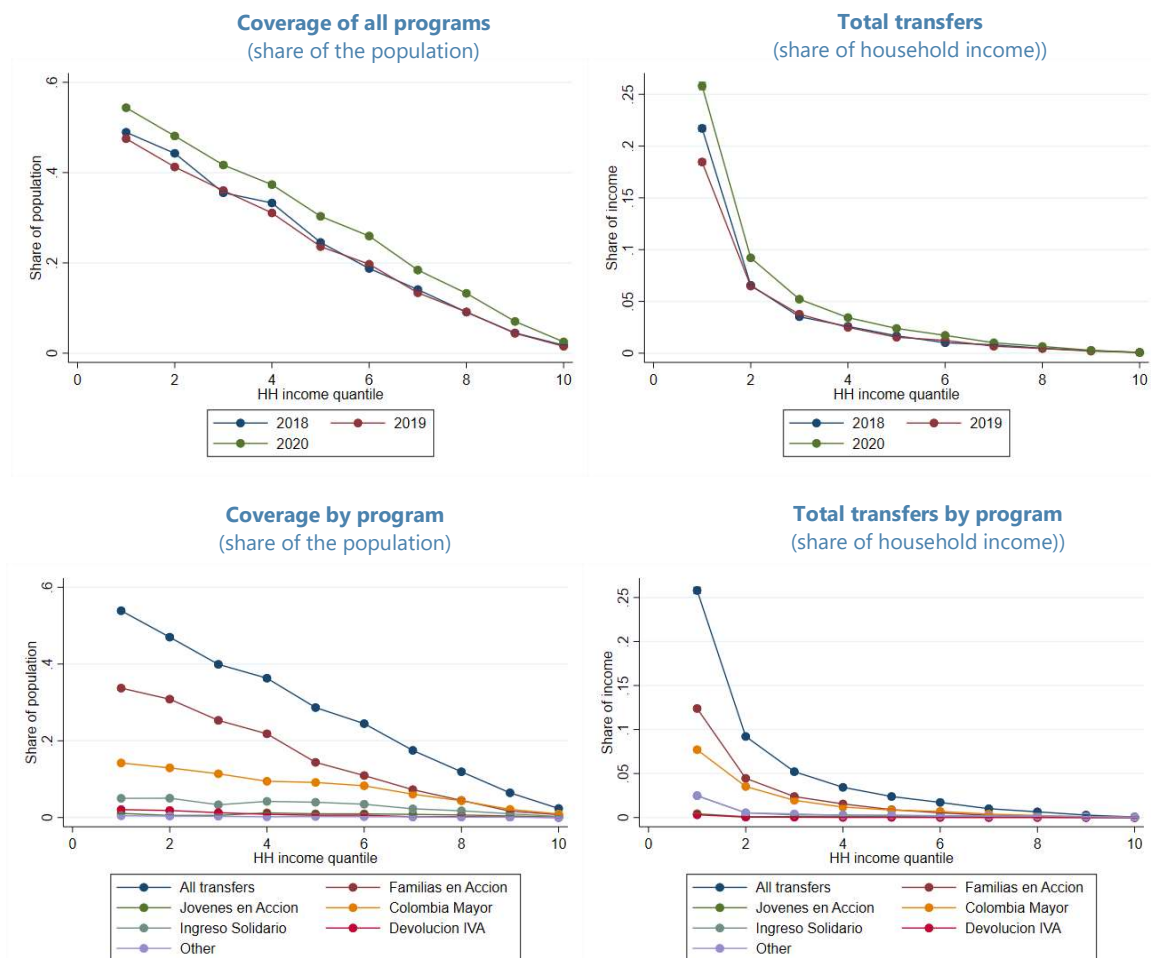Sources: GEIH; DANE; and author's calculations.
Note: Distribution of income per capita form GEIH using kernel density estimation. COVID effects and job losses due to COVID data based on self-reporting on employment status and reason for job loss. Poverty and extreme poverty rates estimated by DANE.

B. *Offsetting Policies*

In response to the pandemic, Colombia was able to leverage social protection transfer systems already in place. According to self-reported data from the GEIH, over half of the poorer households were covered by some form of transfer in Colombia before COVID-19. This takes into account pre-pandemic pension transfers, unemployment insurance schemes, and other conditional and unconditional cash-transfer programs. The *Familias en Acción* program remained the most important transfer mechanism in terms of coverage and magnitude among the existing programs, which helped cushion the pandemic's economic blow among its participants. Using the same system to identify beneficiaries for social programs, an expanded VAT-return transfer program was even more successful at targeting the poorest among *Familias en Acción* participants. This notwithstanding, self-reported data from the GEIH suggests that a significant portion of transfers were allocated to households that were not among the poorest income deciles (Figure 7)—even before the pandemic— pointing to room for improvement in terms of targeting.[6]

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[6] Authorities are currently implementing an update of their targeting methodology (SISBEN IV).

Figure 7. Expansion and coverage of transfer programs
(coverage and magnitude by household income decile)

Source: GEIH, and authors' calculations.
Notes: Coverage and transfer magnitudes based on self-reported transfer and household income data by household averaged over the year. Household income includes the sum of all cash labor earnings, rental income, pensions, remittances, and all other self-reported reported transfers. Ingreso Solidario and VAT transfers only identified for survey respondents that explicitly mentioned them verbally and as a result may be underreported and present less coverage than documented in administrative data.

The coverage and magnitude of social protection programs were also expanded in response to the pandemic and have remained in place at similar intensity during 2021. In particular, as part of emergency transfers and employment protection measures worth around 1.3 percent of GDP in 2020, wage subsidies equivalent to 40 percent of the minimum wage for formal workers were implemented at firms experiencing over 20 percent in revenue losses. To help informal workers, a new unconditional transfer program (*Ingreso Solidario*) was established, aimed at 3 million at-risk households not covered under other programs, and existing social protection programs were expanded. The household survey data suggests that the expansion was concentrated among poorer households, although expansions were observed across a significant portion of the income distribution, including households with earnings above the median. This was partly due to the design of pandemic-relief programs, such as *Ingreso*

Solidario, which intended widespread coverage outside the poorest groups to cover vulnerable populations at risk of moving into poverty. However, because of budgetary limitations and technical challenges in directly reaching all those affected by the pandemic—particularly in the informal sector—the transfer expansion helped but did not fully offset income losses, as a majority of those who reported losing jobs due to COVID-19 were not enrolled in any government transfer program.

V. INFORMALITY AS A MARGIN OF ADJUSTMENT

A. *Informality Adjustment Margins*

Partly due to the lack of regulation and greater flexibility in extensive (hiring/firing) and intensive (hours worked) employment margins, along with greater flexibility in adjusting labor prices, the informal sector acted as an important margin of adjustment. During the downturn, informal employment experienced moderately greater losses relative to the formal sector, comprising 51 percent of the aggregate contraction as of July 2020 relative to pre-pandemic levels (with a 48 percent baseline pre-COVID informality rate). The magnitude of and composition of this drop had a significant gender imbalance (Figure 8). Even though women comprised about 45 percent of the employed, they accounted for 52 percent of total job losses and 58 percent of the ones in the informal sector. Employment losses among women were mostly from informal workers, while men's losses were more evenly distributed between formal and informal sectors (Figure 8)

Once lockdown restrictions were eased and the labor market started to recover, total employment in the informal sector started to bounce back significantly faster for both men and women. Informal sector gains by December 2020 comprised 59 percent of total employment gains, 58 percent of total gains for men and 59 percent of total gains for women. This dynamism in the informal sector increased the informality rate from 47 to 49 percent for both genders, higher than the 48 percent total pre-COVID informality rate level (46 percent for men, and 50 percent for women). Furthermore, when looking at worker types within informal workers, those under self-employment appeared to have been the most elastic both during the downturn and upturn, presumably due to the greater flexibility relative to employer-employee contractual relationships.

Beyond movements in the extensive employment margin, the flexibility of the informal sector was even more prominent when looking at hours worked and earnings among those who remained employed during this period. Among the informal, average weekly hours worked decreased by 28 percent by the height of the lockdown in the second quarter of 2020, rebounding back close to pre-COVID levels by the end of the year. In contrast, the intensive hours margin was more muted among formal workers, with a maximum drop in hours worked of only 18 percent. This greater elasticity of hours is also observed in labor earnings, with workers without formal contracts experiencing a severe drop in average monthly income that was not experienced by those under formal contracts. More flexible employer-employee relationships appear to have aided faster adjustment in the informal sector both on the downside and the upside along both extensive and intensive employment margins. Moreover, many in the informal sectors are independent workers whose income directly depends on the

level of demand for their services and products, which was likely depressed during the lockdown.

B. Interaction with Sectoral Composition

The movements in informality rates portrayed above partly reflect heterogenous losses and recoveries of sectors with different pre-COVID informality rates. As shown in Figure 10, there was a negative correlation between employment losses at the height of the shock and the pre-COVID-19 level of informality, as sectors most affected also happened to have large levels of informal employment. The higher informal intensity in sectors more exposed to the pandemic partly explains why, when the pandemic first struck, the informal sector failed to play the short-term buffer role it had played in previous recessions.[7] The correlation between cumulative job destruction and informality, however, disappears when accounting for jobs recovered, meaning that highly informal sectors experienced the largest employment losses but also bounced back more quickly.

Figure 8. Employment changes by formality status
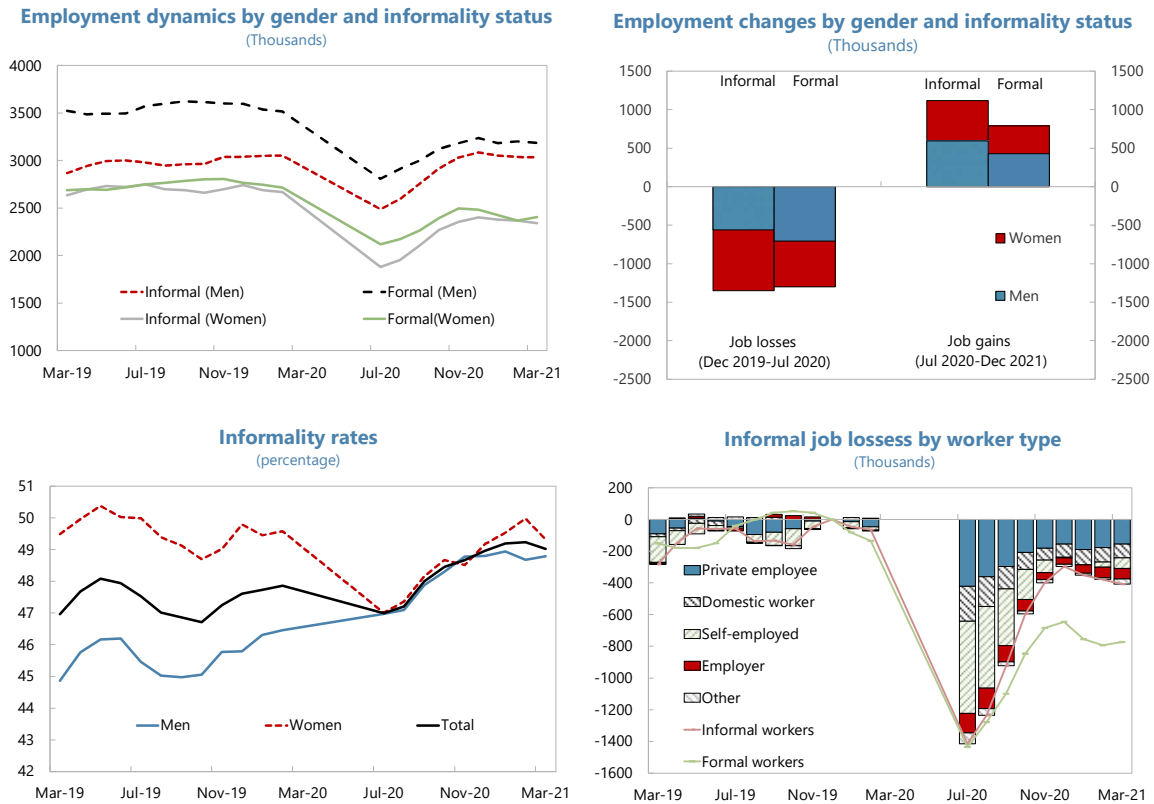
Sources: GEIH, DANE; and staff calculations.
Note: Informality rates based on DANE definitions. There is a gap in informality estimation between March and June due to temporary methodological changes in GEIH data collection ude to COVID-19.

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[7] A comparison discussed by Levya and Urrutia (2020).

Figure 9. Changes in hours and earnings
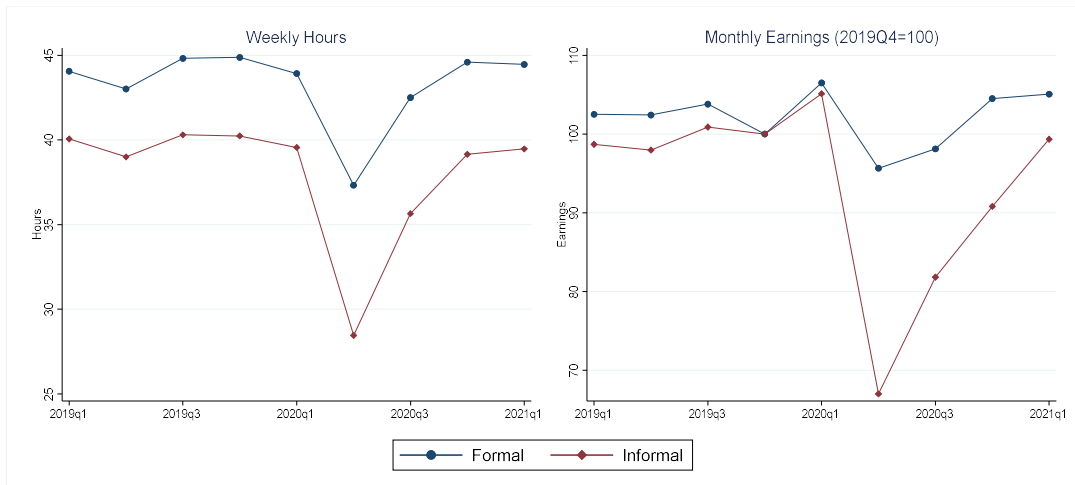
Source: GEIH and authors' calculations.
Note: The left panel reports the average effective hours worked per week among employed workers by formality status. The right panel reports average monthly earnings among employed workers by formality status and normalized to 2019Q4.

Figure 10. Employment losses by sector and informality intensity
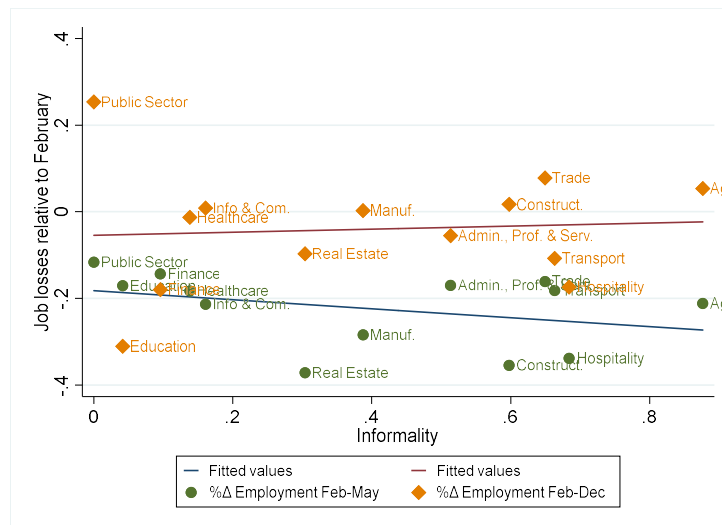
Source GEIH, and authors' calculations.
Note: Informality presented as a share of employment by sector. Job losses is the change of employment in each sector relative to February levels.

When decomposing the aggregate informality share during the employment loss and recovery phases into their between- and within-sector components (Figure 11), we observe the following key patterns[8]. First, most of the decline in the share of informal employment during the height of the lockdowns was driven by contraction in high-informality sectors, highlighting both the sector heterogeneity that characterized the COVID-19 shock and the differences in pre-COVID informality rates between these sectors documented above. Second, the rise in informality in the second half of the 2020 was driven by both the recovery of those same sectors and the increase of informality *within* sectors, reflecting to a degree a substitution away from formal job creation. Although the *between*-sector component has been offset during the recovery, as sectors most sensitive to lockdowns have bounced back, informality has increased in net terms, on average, within sectors. To the extent that these *within* sector movements become entrenched after COVID-19 restrictions are lifted, this can imply more persistent changes in the contractual structure of the economy toward greater informality. This pattern is at odds with the long-run formalization process observed before the pandemic and may imply a reversal of this trend.

Figure 11. Informality decomposition
(Change in share of informal workers)
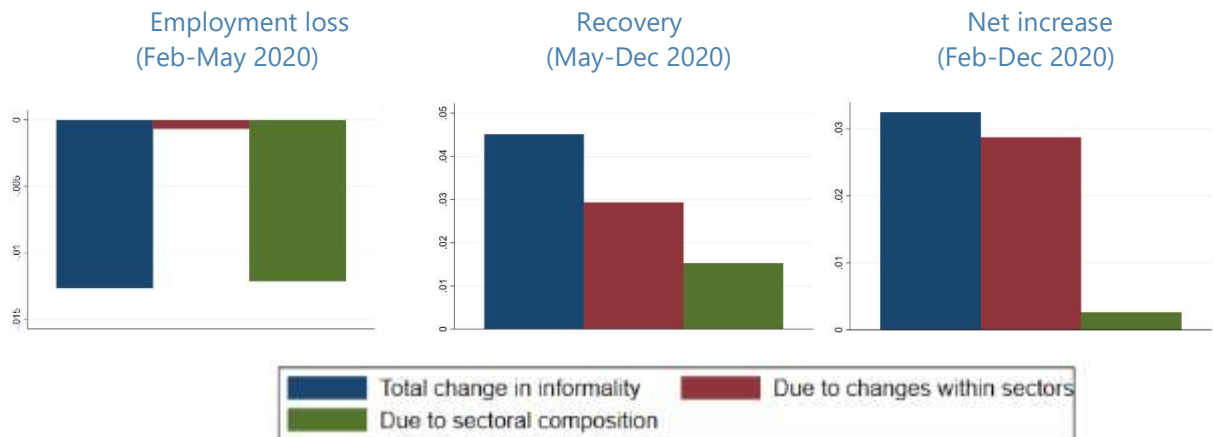
Source: GEIH, and authors' calculations.
Note: Results of between-within sector decompositoins of informality rates. See Annex for decomposition details.

VI.   THE (DIMINISHING) EFFECTS OF LOCKDOWNS

As the sectoral composition and informality share of the economy shifted, there was also a change in the sensitivity of the economy to lockdown measures. This section combines high-frequency data on mobility with employment changes observed at the sector-region level to document the decrease in this sensitivity.

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[8] See the Annex A for details on the decomposition.

A. *The Diminishing Effect of Lockdowns on Mobility*

Colombia experienced two national lockdowns between the pandemic's outset and March 2021. Figure 12 (left panel) shows the timing of the containment measures at the national level, as proxied by the Stringency Index compiled by the Oxford COVID-19 Government Response Tracker (OxCGRT), and the time series of new daily cases.[9] The first lockdown, reflected in the steep rise of the index in late March 2020, resulted from the announcement of restrictions to citizens' mobility and to the operations of selected industries on the 25th of March of 2020 (Decree 457 of 2020). As the virus had not yet spread widely in the country by that date, these measures were implemented pre-emptively. Consequently, cases only rose progressively and reached a peak in August 2020. In the following months, restrictions were gradually lifted while cases subsided, although school closures remained in place. As cases rose again after the December holidays, a second wave of lockdown measures was implemented in early January 2021, with social and employment support policies remaining in place at similar intensity. The Stringency Index rose again, and cases fell steeply. The second round of tightening thus appears to have been more effective in reducing the spread of the pandemic within a short time frame.

Figure 12. Daily cases, national-level stringency of restriction, and department-level workplace mobility
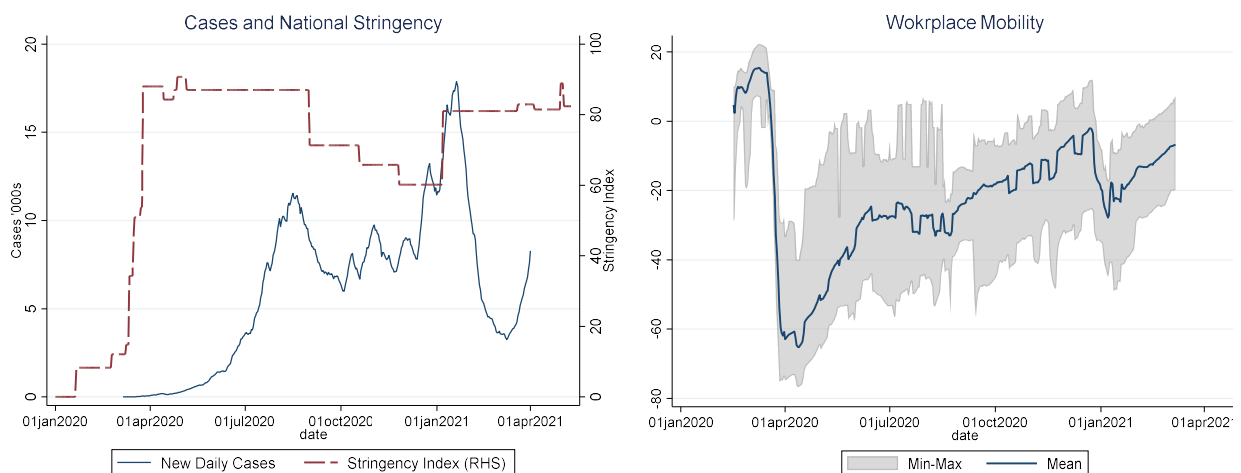
Source: OxGRT, Ministry of Health and Social Protection of Colombia, Google Community Mobility Reports, and authors' calculations. Note: In the left panel, the solid blue line reports the 7-day moving average of new reported cases of COVID-19 throughout Colombia. The dashed red line reports the Stringency Index from OxGRT. In the right panel, the solid blue line and the shaded area report the mean and the minimum-maximum range, resepctively, of the 7-day moving average of workplace mobility relative to February 2020 across Colombia's departments from the Google Community Mobility Report.

The regulatory changes in lockdowns produced markedly different mobility changes during each lockdown wave. The right panel of Figure 12 shows the workplace mobility index, produced by the Google Community Mobility Report, at the geographic department level

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[9] See Hale et al. (2021) for details on the construction of the index.

relative to the beginning of February 2020.[10] At the outset of the first lockdown, mobility fell sharply and progressively rebounded, returning very close to pre-pandemic levels by the end of 2020 in most departments. When the second lockdown began, although stringency and cases were as high or higher than in the first lockdown, mobility only reached a trough of -25 percent compared to February 2020. Hence, the impact of the lockdown on mobility was more muted, either because the nature of the restrictions was different or because the economy learned how to adapt to the restrictions, or a combination of the two. This finding is consistent with Bakker and Goncalves (2021), who observe a similar pattern of decreasing correlation between stringency and mobility across the entire Latin American region.

## B. *The Diminishing Effect of Lockdowns on The Labor Market*

The first lockdown in Colombia was imposed at the national level and was broad-based, with only a few sectors allowed to operate. As teleworking was unfeasible in many sectors, the fall in mobility was highly correlated with the drop if employment. Over time, however, Colombia, like many other countries, learned how to "live with the pandemic" and control the spread. Lockdowns became more differentiated based on local conditions and concentrated on critical sectors, with more industries allowed to partially reopen. Consequently, at the departmental level, mobility became less correlated with the labor market situation.

Figure 13 shows this shifting relationship graphically. The left panel plots average mobility relative to February 2020 and the fall in employment at the departmental level for various months in 2020. As the first lockdown took place in April 2020, departments with larger drops in mobility also experienced larger contractions in employment. Over the following months, as both mobility and employment recovered in all departments, the relationship between the two variables also became weaker. The right panel of Figure 13 shows the same relationship for the first quarter of 2021. As the second lockdown was implemented in January, mobility fell again slightly (red line in right panel compared to green line in the left panel) and while employment stopped rebounding, it did not fall in all departments. Consequently, the relationship between mobility and employment continued to flatten.

An alternative way to inspect the relationship between employment, mobility, and lockdowns is through the exposure of individual sectors to the restrictions. When the first national lockdown was implemented, it prohibited the operation of businesses in specific industries while allowing essential services and those activities that could be performed remotely to remain open. It is *a priori* a tenable hypothesis that the fall in workplace mobility is closely linked to the inability of specific industries to operate without in-person work.

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[10] Colombia has 32 geographic departments with some degree of political and administrative autonomy from the central government.

Figure 13. Changes in workplace mobility and employment at the department level over time
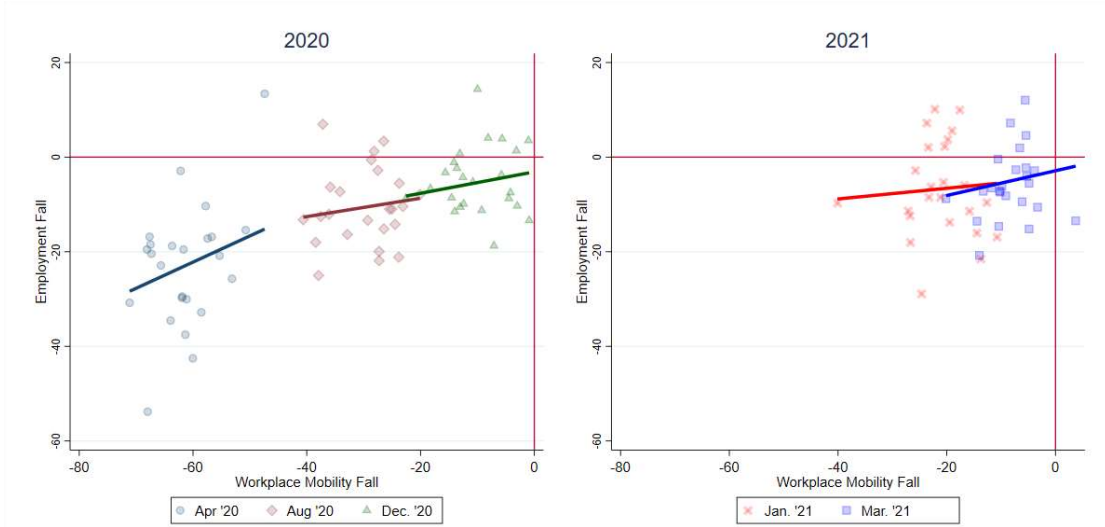
Source: Google Community Mobility Reports, GEIH, and authors' calculations. Note: Each set of points represents the year-on-year percent change in employment and the percent change in workplace mobility relative to February 2020 for departments in Colombia in a different month in 2020 and 2021. The solid lines report the best-fit prediction for the relationship between the two variables from a linear regression.

We follow Alfaro et al. (2020) and Morales et al. (2020) in computing a binary variable of sectoral exposure to the restrictions in the first lockdown (see Annex B for details). Figure 14 plots the average change compared to employment in February 2020 for "unexposed" and "exposed" sectors. By April 2020, the median unexposed sector had experienced a 20 percent contraction while the median contraction in exposed sectors was close to 40 percent. Over the following months, however, exposed sectors recovered faster and by November 2020 the median gap with respect to pre-pandemic levels was comparable across the two groups. Moreover, when the second lockdown occurred, the contraction in employment was very small in both sector groups.

The evolving impact of lockdowns on economic activity, and its differential effect across sectors, can also be captured quantitatively with a simple regression framework at the sector-department level, similar to Morales et al. (2020):

$$Log(Employment_{djt}) = \beta * Cases_{dt} + \Sigma_{i\epsilon I}\, \delta_i * \mathbb{I}(Phase_i) * Exposed_j + \gamma_t + \eta_{jd} + \epsilon_{djt}$$

where employment in department d and sector j in month t is a function of the average number of daily cases per 1,000 inhabitants, a set of national-level time fixed effects γ_t, department-sector fixed effects η_{jd}, and a binary variable capturing the differential impact δ_i of each regulatory phase $i \epsilon I$ on exposed sectors compared to unexposed ones. The three

phases[11] we consider are the first lockdown (April-July 2020), the reopening phase (August – December 2020) and the second lockdown (January 2021 onwards).

The first three columns of Table 2 report the coefficients of the regression run by progressively extending the window of months in the time sample. Throughout the first lockdown, on average, exposed sectors contracted by an extra 9 percent. In the reopening phase, this gap reduces to 5 percent and is not statistically significant. By the third lockdown the differential even turns mildly positive but still not significant.

Figure 14. Changes in employment for sectors that were directly exposed to lockdown restrictions and those that were not (Feb. 2020=100)
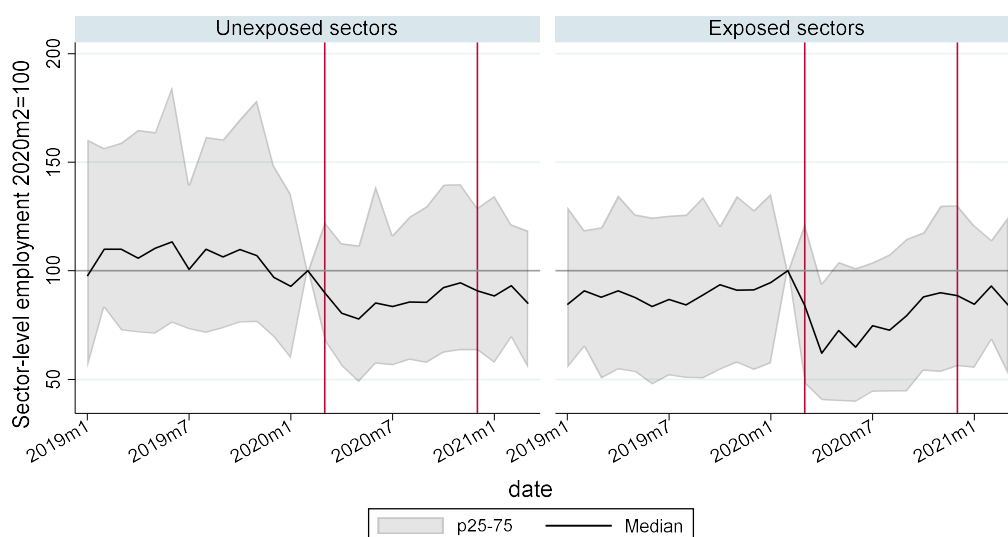
Source: GEIH, and authors' calculations. Note: The black lines report the average employment at the secotr level relative to February 2020, the grey areas report the 25th-75th percentile range. The vertical red lines represent the months in which the first and second locdowns began.

The last three columns of Table 2 report the same specifications focusing solely on informal employment.[12] While informal employment fell during the first lockdown, the positive coefficient of the interaction term with the exposed sector dummy suggests that this set of industries experienced a substantially milder fall in informal employment in the first months of pandemic containment. Moreover, the interaction term with respect to the reopening phase (fifth column) has an estimated coefficient of very similar value. This indicates that the differential in the dynamics of informal labor across sectors persisted throughout the second half of 2020 while the aggregate economy rebounded. Finally, the differential may have widened further during the second lockdown, as the interacted coefficient is larger than for the first lockdown.

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[11] Three phases are encompassed in the set *I*.

[12] The sample size is reduced because region-sector observations that have no informal workers at all times are excluded from the regression.

Considering together all the regressions, the picture that emerges is one of differential dynamics across exposed and unexposed sectors throughout the different phases, not only in terms of total employment but also with respect to the informality composition. When exposed sectors shed a greater number of jobs in the first lockdown, they did so predominantly through formal jobs. When they caught up with the unexposed sectors, they recovered the lost jobs mostly through informal positions. This led to comparatively higher informality rates within these industries and nationally both during the reopening and the second lockdown.

Table 2. Regressions of log employment at the department-sector level on cases, exposure to restrictions, and phase of the pandemic

	Log Total Employment			Log Informal Employment		
Time Sample	Dec. '19 - Jul. '20	Dec. '19 - Dec. '20	Dec. '19 - Mar. '21	Dec. '19 - Jul. '20	Dec. '19 - Dec. '20	Dec. '19 - Mar. '21
Exposed Sector * First Lockdown	-0.0944***	-0.0897**	-0.0871**	0.297***	0.273***	0.277***
	(0.0358)	(0.0358)	(0.0360)	(0.0808)	(0.0807)	(0.0808)
Exposed Sector * First Reopening		-0.0224	-0.0353		0.255***	0.260***
		(0.0346)	(0.0368)		(0.0588)	(0.0590)
Exposed Sector * Second Lockdown			0.0520			0.382***
		(0.0457)	(0.0326)			(0.0612)
New Cases per 1000 residents	-0.164	0.176	0.0433	0.224	0.343*	0.204
	(0.213)	(0.116)	(0.106)	(0.354)	(0.177)	(0.143)
Constant	9.552***	9.542***	9.537***	8.732***	8.681***	8.660***
	(0.0767)	(0.0766)	(0.0766)	(0.0942)	(0.0944)	(0.0947)
Time Dummies	Y	Y	Y	Y	Y	Y
Observations	3,828	6,226	7,659	2,613	4,804	6,120

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

We also inspect the relationship between mobility and sectoral exposure through a similar specification in which we interact the workplace mobility indicator at the department level with the binary variable for sectoral exposure and a categorical variable for the phase of the pandemic restrictions. Table 3 presents various combinations of interactions among these variables. Column 1 shows that, over the entire time sample from February 2020 to March 2021, total employment was correlated with mobility movements, as expected, but employment in exposed sectors was more highly correlated with mobility since these industries more heavily relied on in-person interactions.[13] Column 2 shows that mobility and employment for the average sector -not conditional on exposure- were positively correlated before the pandemic, during the first lockdown and the first reopening. However, the relationship is effectively inexistent during the second lockdown. Finally, Column 3, featuring a triple interaction, shows that the same pattern of variation in the correlation of employment with mobility over the phases of the pandemic holds for both exposed and unexposed sectors.

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[13] For this regression the sample starts in February 2020 because the Google Mobility Indicator starts only in the first week of that month.

Columns 4-6 of Table 3 propose the same analysis for informal employment only. Comparing the coefficients of Column 4 with those of Column 1, it is apparent that across all sectors informal employment is more strongly associated with changes in mobility. Moreover, Column 4 suggests that the higher correlation of employment in exposed sectors with mobility does not hold when only focusing on informal workers. This implies that the difference in behavior across the two sector groups is driven by the dynamics of formal employment. Finally, Columns 5 and 6 confirm that the pattern of a decreasing association between employment and mobility during the second lockdown hold when considering exclusively informal work.

Table 3. Regressions of log employment at the department-sector level on workplace mobility, exposure to restrictions, and phase of the pandemic

	Log Employment			Log Informal Employment		
	(1)	(2)	(3)	(4)	(5)	(6)
Mobility * Unexposed Sector	0.00280***			0.0178***		
	(0.000566)			(0.00164)		
Mobility * Exposed Sector	0.00539***			0.0152***		
	(0.000529)			(0.00101)		
Feb '20 * Mobility		0.0104***			0.00698**	
		(0.00200)			(0.00333)	
First Lockdown * Mobility		0.00373***			0.0179***	
		(0.000456)			(0.00115)	
First Reopening * Mobility		0.00529***			0.0117***	
		(0.000786)			(0.00139)	
Second Lockdown * Mobility		0.000471			0.00810***	
		(0.000993)			(0.00174)	
Feb '20 * Mobility * Unexposed Sector			0.00414			0.00139
			(0.00274)			(0.00657)
Feb '20 * Mobility * Exposed Sector			0.0140***			0.0101***
			(0.00267)			(0.00367)
First Lockdown * Mobility * Unexposed Sector			0.00265***			0.0207***
			(0.000671)			(0.00216)
First Lockdown * Mobility * Exposed Sector			0.00433***			0.0164***
			(0.000601)			(0.00134)
First Reopening * Mobility * Unexposed Sector			0.00422***			0.0167***
			(0.00119)			(0.00284)
First Reopening * Mobility * Exposed Sector			0.00588***			0.00891***
			(0.00104)			(0.00154)
Second Lockdown * Mobility * Unexposed Sector			0.00198			0.0187***
			(0.00161)			(0.00370)
Second Lockdown * Mobility * Exposed Sector			-0.000392			0.00230
			(0.00125)			(0.00182)
Constant	9.543***	9.523***	9.523***	8.769***	8.731***	8.733***
	(0.0738)	(0.0742)	(0.0742)	(0.0899)	(0.0905)	(0.0905)
Observations	6,699	6,699	6,699	5,224	5,224	5,224
Number of Sector-Departments	501	501	501	481	481	481

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Overall, Figures 12-14 and Tables 2 and 3 portray the evolving nature of the impact of the pandemic and associated restrictions on the economy. Over time, the economy and society learned to adapt to the pandemic. The second wave of lockdowns was less disruptive of

general human activity, as proxied by mobility, and of economic production, as proxied by employment. In particular, while the first lockdown had a disproportionate impact on sectors that were more directly exposed to restrictions, the second lockdown had a more homogeneous effect. The behavior of informal employment somewhat differed between exposed and unexposed sectors, showing a more pronounced rebound (and thus an increase in the informality rate) in the former. Furthermore, the relationship between mobility and employment became progressively more tenuous, suggesting that working remotely or with minimized personal interactions may have become more common.

VII. CONCLUSION

Similar to regional peers, the arrival of COVID-19 disrupted about a quarter of employment in Colombia, with heterogeneous effects across sectors and demographic groups. Women, the young, and the less educated experienced the largest losses in employment and labor income, due in part to their concentration in lockdown-sensitive sectors and the greater prevalence of job informality among these groups.

For workers, informality was both a blessing and curse. On the one hand, lacking employment protection, vulnerable informal workers were more likely to experience job losses or reduced working hours when the pandemic struck. On the other hand, informality's role as a margin of adjustment appears to have helped the economy bounce back and build resilience—particularly in sectors that were directly exposed to the first lockdown and thus contracted most in the first half of 2020. Employment in these industries did not contract as severely in later lockdowns, pointing to a newly acquired adaptability to pandemic measures and shifting conditions. The extent to which the greater flexibility and adaptability of informal work contributed to this greater aggregate resilience deserves deeper attention in future research.

This informal adaptation, however, might come at a long-term cost. From a structural perspective, informality rates have increased within several sectors, gains have been slower in formal jobs under more rigid salaried contracts, unemployment numbers have remained substantially above pre-COVID levels, and a significant number of women still have not returned to the labor force due to school closures and the gender imbalance in child and household care. If pandemic-induced labor force shortfalls or informality rate increases were to become permanent, this could lead to persistent resource dislocations resulting in lower aggregate productivity levels and potential output. The appealing flexibility of informal markets therefore should not hinder policies aimed at building a more formal economy in the medium-term.

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ANNEX I

A. Between-within Sectoral Decompositoin of Informality

Changes in the aggregate informality rate—defined as informal employmnet over total employment—between two months, *a* and *b*, can be written in terms of sectoral components as follows:

$$\Delta Inf = Inf_b - Inf_a = \frac{1}{Emp_b}\sum_{s\epsilon S}(Inf_{b,s} * Emp_{b,s}) - \frac{1}{Emp_a}\sum_{s\epsilon S}(Inf_{a,s} * Emp_{a,s})$$

Where Inf_t and Emp_t refer to the total informality rate and total employment at time *t,* and $Inf_{t,s}$ and $Emp_{a,s}$ (with two subscripts) refer to the informality rate and total employment of sector *s* at time *t.* With this notation, the change in informality rate between periods can be decomposed as follows:

$$\Delta Inf = \sum_{s\epsilon S}\left((Inf_{b,s} - Inf_{a,s}) * \frac{Emp_{a,s}}{Emp_a}\right) \quad \longleftarrow \quad \text{Within-sector change component}$$

$$+ \sum_{s\epsilon S}\left(Inf_{a,s} * \left(\frac{Emp_{b,s}}{Emp_b} - \frac{Emp_{a,s}}{Emp_a}\right)\right) \quad \longleftarrow \quad \text{Between-sector change component}$$

$$+ \sum_{s\epsilon S}\left((Inf_{b,s} - Inf_{a,s}) * \left(\frac{Em_{b,s}}{Emp_b} - \frac{Em_{a,s}}{Em_a}\right)\right) \quad \longleftarrow \quad \text{Covariance term}$$

The first component is driven by within-sector changes in informality rates using baseline sectoral employment rates as weights, the second is driven by sectoral composition of employment taking baseline informality rates, and the third is the residual covariance term capturing the correlation between informality and employment changes. Aggregate changes, along with the first two components are presented in the main text, for the following three period intervals.

$$\Delta_{shock}Inf = Inf_{May} - Inf_{Feb}$$

$$\Delta_{recovery}Inf = Inf_{Dec} - Inf_{May}$$

$$\Delta_{net}Inf = Inf_{Dec} - Inf_{Feb}$$

B. Details on the Measure of Lockdown Exposure

We follow Alfaro et al. (2020) in the classification of subindustries that were affected by the operational restrictions through Decree 457 of the 25th of March 2020 (see Table A2 in the original paper). The authors classify subindustries as directly exposed to the lockdown in a binary way: 0 for "not exposed" and 1 for "exposed". We then combine the subsectors to a higher level of aggregation, using employment in 2019 from the GEIH as weights. Figure A1 reports the resulting classifications. For the analysis in the main text, we then turn these values into a binary variable by using 0.5 as a threshold for the "exposed" category.

Figure A1. Direct exposure of economic sectors to the national lockdown
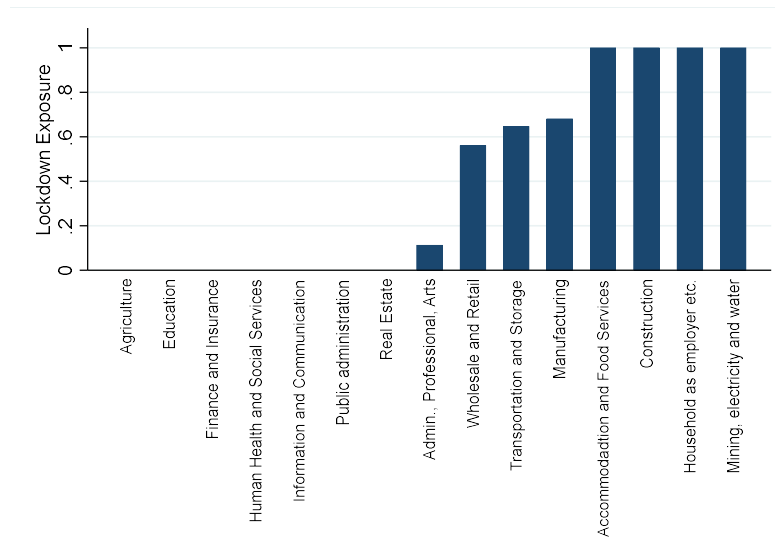
Source: Alfaro et al. (2020), GEIH, and authors' calculations. The bars report the direct exposure of each sector to the national lockdown restrictions. See the text for more details.

C. Definition of Informality

The definition of informal employment used by DANE in the GEIH is outlined in its 2009 methodological report (DANE, 2009) includes workers satisfying one or more of the following characteristics:

- Employees of firms with 5 workers or less including the owner

- Non-remunerated workers who work for their own family or family business

- Non-remunerated workers who work for the business of other households

- Household workers (e.g., domestic help)

- Day laborers

- Autonomous (own-account) workers who work for firms with 5 workers or less, except for those who work as independent professionals

- The owners or associates of a firm with 5 workers or less

Those workers who are employed by the government are not definied as informal even if they satisfy any of the above characteristics.

Based on the variables available in the GEIH, the ILO definition of informal employment can be implemented by classifying as informal: (i) the employees and owners of firms who do not contribute to the social security system and, (ii) those autonomous workers whose business is not registered with any national authoritiy (e.g., business registry, tax authority).[14]

The DANE and ILO definitions have a significant degree of overlap. In the 2019 GEIH, on average, 85 (83) percent of informal workers based on the DANE (ILO) definition are also classified as informal based on the ILO (DANE) definition.

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[14] This exhaustive definition by the ILO can be found on its web page https://ilostat.ilo.org/resources/concepts-and-definitions/description-informality/