WP/21/66

IMF Working Paper

The Short-Term Impact of COVID-19 on Labor Markets, Poverty and Inequality in Brazil

by Diala Al Masri, Valentina Flamini and Frederik Toscani

INTERNATIONAL MONETARY FUND

 WP/21/66

IMF Working Paper

Western Hemisphere Department

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Prepared by Diala Al Masri, Valentina Flamini and Frederik Toscani [1]

Authorized for distribution by Cheng Hoon Lim

March 2021

Abstract

We document the short-term impact of the COVID-19 pandemic on the Brazilian labor market focusing on employment, wages and hours worked using the nationally representative household surveys PNAD-Continua and PNAD COVID. Sectors most susceptible to the shock because they are more contact-intensive and less teleworkable, such as construction, domestic services and hospitality, suffered large job losses and reductions in hours. Given low income workers experienced the largest decline in earnings, extreme poverty and the Gini coefficient based on labor income increased by around 9.2 and 5 percentage points, respectively, due to the immediate shock. The government's broad based, temporary Emergency Aid transfer program more than offset the labor income losses for the bottom four deciles, however, such that poverty relative to the pre-COVID baseline fell. At a cost of around 4 percent of GDP in 2020 such support is not fiscally sustainable beyond the short-term and ended in late 2020. The challenge will be to avoid a sharp increase in poverty and inequality if the labor market does not pick up sufficiently fast in 2021.

JEL Classification Numbers: D31, E24, H50, H53, J40.

Keywords: labor market, inequality, poverty, public expenditure, social spending.

Author's E-Mail Address: diala.almasri@sjc.ox.ac.uk; vflamini@imf.org; ftoscani@imf.org.

[1] The authors are thankful to Nicolas Landeta and Nischel Pedapudi for excellent administrative support, and to IMF colleagues for insightful comments and suggestions.

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I. INTRODUCTION

The COVID-19 pandemic has triggered major economic disruptions and has severely affected labor markets around the world. Necessary policies to slow the spread of the disease and allow health systems to cope translated into an unprecedented economic shock.[2] Containment measures abruptly reduced activity in many sectors and brought others to a complete halt. As a result, millions of workers lost their jobs and suffered income losses.

Latin America has been one of the worst affected regions, with employment contracting sharply, more than in other emerging markets (EMs) and advanced economies (AEs) (IMF, 2020). In this paper we focus on the short-term impact of the COVID-19 pandemic on labor markets in Brazil. In particular, we use microdata from the quarterly household survey PNAD Continua as well as the newly created monthly PNAD-COVID to document the impact of the pandemic on employment, wages and hours worked, and across margins of worker heterogeneity such as age, formality status, gender, and education level. Using data on household income we also draw conclusions on the immediate impact of the pandemic on poverty and inequality, and the mitigating effect of the cash transfer program launched by the government.

To structure the analysis, we employ the framework of Alfaro et al (2020) to assess the ex-ante vulnerability of the Brazilian labor market to the COVID-19 shock. The methodology calculates the probability that an individual loses her job based on (i) a sector-specific demand shock (due to fear of contagion), (ii) an aggregate demand shock (a Keynesian multiplier), (iii) a sector specific supply shock associated with the state of lockdowns, (iv) the characteristics of a worker's occupation (contact-intensity, mitigated by teleworkability), (v) the impact of lockdowns and demand shocks on upstream sectors (suppliers) and downstream sectors (buyers), and (vi) the uneven impact of the lockdown on firms of different sizes. Employment at risk is then calculated as the sum of all individuals employed prior to the pandemic, weighted by their respective job loss probabilities.

Applying this approach, we find that ex-ante employment at risk during the shut-down stage of the pandemic was close to 38 million jobs (40.7 percent of total employment in Q2 2019).[3] More contact-intensive and less teleworkable jobs were naturally more at risk. Comparing the estimate for ex ante jobs at risk with ex post outturns shows a strong correlation in terms of the sectoral distribution of job losses but realized losses overall where only about one-third of employment at risk.

Employment fell by over 18-34 percent year-on-year in vulnerable sectors such as construction, household services and hospitality. The reduction in employment

[2] Mitigation measures in Brazil were implemented early on but steadily lost effectiveness. Social mobility indices dropped by about 50 percent when most regional governments closed schools and imposed restrictions on non-essential businesses around late March/early April. However, soon after, mobility levels picked up, recovering substantially by June when most social isolation measures were relaxed and non-essential businesses reopened (Annex A). Schools, on the other hand, only started reopening in September.

[3] Total employment in Q2 2019 was approximately 93.3 million jobs.

disproportionally affected informal workers, women and young cohorts of workers. Older cohorts of workers retained their employment but were more likely to be temporarily removed from their jobs, with high reductions in hours worked and monthly wages. Households in the bottom deciles of the income distribution where most affected, with extreme poverty and the Gini coefficient based on labor income increasing sharply when measured at the height of the pandemic in May 2020.

Having looked at the differential impact of the pandemic across different dimensions, we summarize the patterns of heterogeneity of the COVID-19 impact on people's wages, hours worked per week and status of informality in a regression analysis. We find that most of the margins of heterogeneity discussed above mattered and there is no one single factor that explains all the variation in the data.

To alleviate the impact of the pandemic (Annex A), the government launched a comprehensive policy response. Two key measures with regard to the labor market were (i) large-scale temporary cash transfers (*Auxílio Emergencial* – Emergency Aid – EA) to informal workers and poor households and (ii) an employment retention scheme for formal jobs which subsidized temporary reductions in hours. The former program had a cost of about 4 percent of GDP in 2020 and initially covered as much as 38.6% of all households (26.3 million out of 68 million)[4] in Brazil, while the cost of the latter is estimated at around 0.6 percent of GDP and around 25 percent of all formal private employment was covered by the program.

Based on survey data for May and June 2020, we estimate that the EA was highly successful in cushioning the impact of COVID-19 on low-income households at the peak of the pandemic. In fact, the EA more than compensated the negative impact on poverty and income inequality, at least temporarily. Inequality as measured by the Gini index would have increased from 0.53 pre-COVID to 0.58 post-COVID, not least because Brazil's large informal sector was deeply affected by the pandemic. Likewise, the poverty headcount ratio would have increased sharply from about 4.7 percent to 13.9 percent—corresponding to 15.7 million individuals. Instead, with the EA the poverty headcount ratio fell to 4.4 percent and the Gini coefficient to 0.51—both lower than their pre-COVID levels. Depending on the poverty line used, EA prevented between 7.8 and 16.4 million people from falling into poverty at the peak of the crisis.

In a counterfactual analysis based on survey data for October, we simulate the redistribution power of the EA under different targeting and benefit options. We find that with better targeting, just two thirds of the observed transfer would have led to the same extreme poverty rate as the one observed in October, even after accounting for the administrative cost of better targeting. This shows the room for a more cost-effective design should a renewed emergency cash transfer be implemented.

Our focus on household survey data prevents a direct assessment of the exact impact of the employment retention program, which was targeted at employers. However, the indirect

[4] These numbers are based on the month of May.

evidence mentioned above on ex post job losses being significantly below ex ante jobs at risk, along with the program's coverage of around 10 million workers, seems to suggest that the employment retention scheme is likely to have played an important role in protecting formal employment.

The remainder of the paper proceeds as follows. Section II summarizes related strands of literature; section III describes the data and methodology used, and section IV presents our results. It does so by starting with a high-level overview of Brazil's labor market pre-COVID; it then presents an ex-ante assessment of jobs at risk to the COVID-19 shock using the framework outlined in Alfaro et al.(2020) and compares it with ex-post outturns; subsection C reports empirical findings on the impact of COVID-19 across different margins of heterogeneity (formality, age, sector, gender); subsection D discusses the distributional impacts of the pandemic and the role of the EA in cushioning the shock for the most vulnerable. Last, subsection IV.E presents counterfactual scenarios under various EA targeting options. Section V concludes.

II. LITERATURE REVIEW

Our paper is related to the current emerging literature that documents the impact of the pandemic on labor markets. First, our analysis builds on the accounting framework developed by Alfaro et al. (2020) to calculate the ex-ante jobs at risk across multiple sectors and decompose the shock into its supply and demand components. The same methodology is also applied in IMF (2020) for a broader set of Latin American countries.

We also contribute to the discussion that documents the heterogeneity of the impact based on existing inequality, employee and sector level characteristics such as the extent of contact-intensity and teleworkability (Blundell et al. 2020; Mongey and Weinberg 2020; Alon et al. 2020; Leibovici et al. 2020; Dingel and Neiman 2020).

This paper complements the literature that studies the impact of COVID-19 on labor markets using survey microdata. In the case of Brazil, we use two large nationally representative household surveys, one of which is a special database released monthly to track the impact of COVID-19. In this respect, our work is closely related to Piyapromdee and Spittal (2020) who use data from the UK Household Longitudinal Study to document the differential labor market impacts of COVID-19 across workers incomes, characteristics and family structures. Similarly, for the US, Coibion et al. (2020) use a large-scale survey of households in the *Nielsen Homescan* panel to document impact on labor market characteristics in terms of employment losses. Benezeval et al. (2020) use new data from the *Understanding Society: COVID 19* survey which is a special survey from the *Understanding Society* panel collected over the past 10 years. The authors document the differential impact of the pandemic, showing that it affected mainly less educated workers without secure jobs. Adams-Prassl et al. (2020a, 2020b) use real time survey evidence form the UK, US and Germany to show that same highly unequal impact. In particular, women, less educated workers and those working in less teleworkable jobs are more likely to be affected by the crisis. In another study, the authors use three waves of data collected in March, April and May 2020 as part of the COVID *Inequality Project* in the US and the UK to document the heterogeneity of being able

to work from home across as well as within occupations and industries. Further, the ability to work from home differs across workers with male employees and university degree employees reporting a significantly higher share of jobs to be done at home.

Our results show a similar impact of the pandemic to that observed in advanced economies. For example, Cajner et al. (2020) find that cumulative losses in paid employment in the US reached 18 million by April 4, twice the losses suffered during the Great Recession, with the hospitality and leisure sectors most affected. Alon et al. (2020) show that, unlike previous recessions, this pandemic affected negatively women's employment more than that of men's because women are more concentrated in sectors that are more likely to be subject to lockdowns and social distancing measures.

Last but not least, this paper relates to the literature highlighting the importance of fiscal policy to tackle inequality (IMF, 2017) and on the design of safety nets (Coady and Le, 2020) both in general and more specifically during COVID-19 (IMF, COVID-19 notes)[5].

III. DATA AND METHODOLOGY

The main sources of data are the PNAD-Continua household survey and the PNAD COVID special edition of the household survey. Both surveys are representative at the 27 federation unit levels and at the national level, and are compiled by the *Instituto Brasileiro de Geografia e Estatistica* (IBGE). The PNAD-Continua is collected on a quarterly and annual basis and is available from the first quarter of 2012 to the second quarter of 2020. The survey reports indicators on income, hours worked, employment characteristics and individual level characteristics. It also indicates whether workers have a formal contract for their job. We use this indicator to distinguish between informal and formal workers. For the analysis of PNAD Continua, we use effective monthly income earned from all jobs. We change the nominal wages to real wages by dividing by the price index, taking Q1 2015 as the base quarter.[6] We exclude from our analysis households that indicate that they reported their income but their income is coded as missing in the survey (these constitute 0.08% of households for post-COVID income and 0.16% of households for pre-COVID income).

PNAD COVID is a special edition of the PNAD-Continua survey and it is available since May 2020. This survey was conducted by telephone for approximately 48 thousand households per week and has two parts: the first one collects health indicators on COVID symptoms and hospitalizations; and the second one compiles data on labor market statistics including the employment status of individuals, their occupation and sector. The survey also provides detail on remote work, leave from work and reasons for the leave, and asks about income received outside work such as the EA related to COVID-19, Bolsa Familia, BPC-

[5] https://www.imf.org/en/Publications/SPROLLs/covid19-special-notes#fiscal

[6] Our data on the price indices is from FRED: https://fred.stlouisfed.org/series/BRACPIALLQINMEI

LOAS,[7] retirement, unemployment insurance, rent and others. We consider income and hours "*usually*" received and worked to be the pre-COVID levels, and income and hours "*actually*" received and worked to be the post-COVID levels. In our analysis of poverty and the distributional impact of the EA, we only consider households that reported labor income.

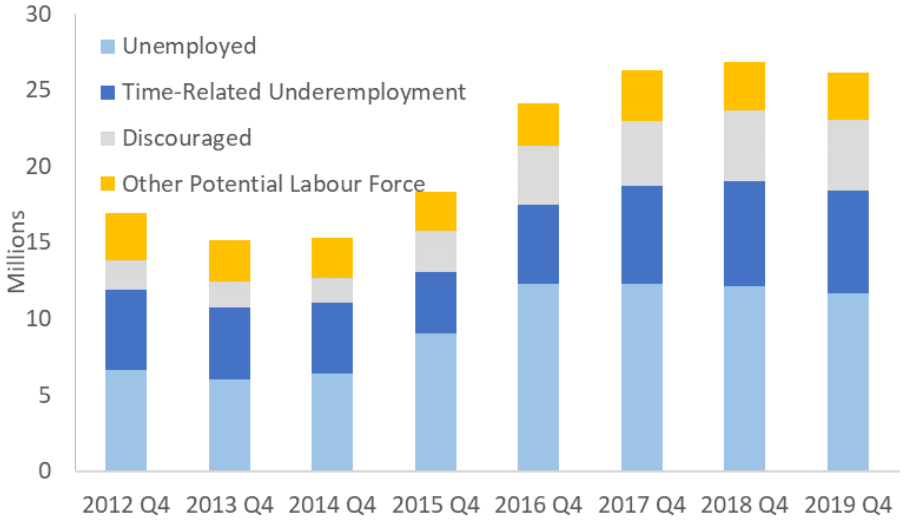
One important caveat is that the two surveys, PNAD-Continua and PNAD COVID, are not perfectly comparable. We thus never combine the two surveys in the same analysis and specify which survey each piece of analysis is based on.

IV. RESULTS

A. High-Level Overview of the Brazilian Labor Market in 2020

In early 2020, Brazil's labor market was still recovering from the 2015-16 recession. After reaching the highest level since the current unemployment series started in 2012 in early 2017, the unemployment rate only slowly fell from 13.7 percent to around 11 percent in late 2019. Looking at a broader measure of labor underutilization encompassing unemployed, underemployed and discouraged workers highlights the still high level of slack in the labor market in 2019 (Figure 1).

Figure 1. Brazil: Unemployment, Underemployment, and Labor Force



Source: PNAD Continua

Note: Underemployed people are those who worked less than 40 hours a week but are willing and able to increase their working hours. It is a measure of labor underutilization.

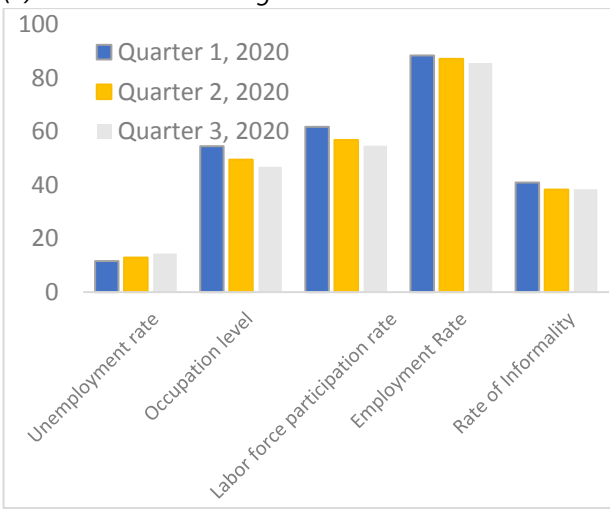
The COVID-19 shock thus hit with Brazil's labor market still in a fragile position. As in many countries around the World, job losses during the first months of the shock were unprecedented. Overall, as of August 2020, Brazil has lost roughly 12 million jobs relative to

[7] *Bolsa Familia* is the Brazil flagship cash transfer program targeted to poor households with children introduced in the early 2000s and widely regarded as one of the driving factors for the substantial improvement of social indicators in Brazil during the 2000s. BPC-LOAS is the cash benefit to disabled persons.

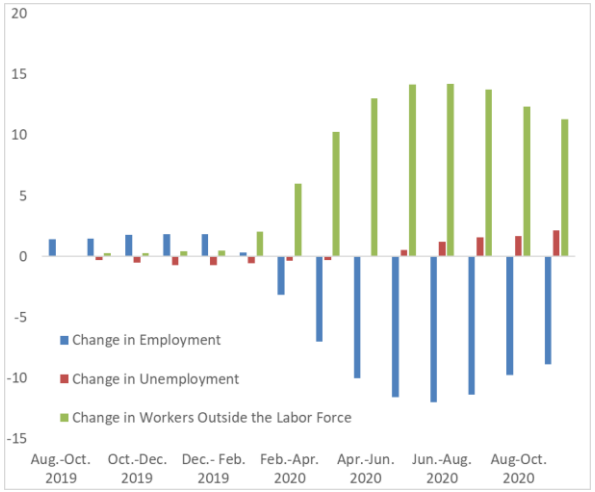
the same period in 2019, with most of the job losses concentrated in March, April and May. This far exceeds the employment destruction of around 4 million jobs during Brazil's deep 2015-16 recession. The vast majority of those who lost their job during the COVID-19 shock left the labor force, bringing the participation rate to a historic low of 55 percent. As a consequence, unemployment increased only modestly (Figure 2).[8]

Figure 2. Brazil: Key Labor Market Indicators

(a) Year on Year Changes



(b) Quarterly Variations Relative to Previous Year



Source: IBGE Official Statistics

In regional perspective, job losses in Brazil were somewhat less severe than in most peer countries. At the peak of the crisis in May 2020, job losses in Chile, Colombia and Mexico exceeded 20 percent of total pre-pandemic employment, close to double the losses for Brazil. The government's employment protection program likely played an important role here. It is worth pointing out though, that while employment had started to recover in peer countries by July 2020, Brazil was still experiencing additional job losses, bringing the impact closer in line with the regional average. The rolling quarter July-September saw the first job gains in Brazil after the initial shock, which continues in August-October and September-November. Job gains only erased a small fraction of the previous losses, and the number of unemployed workers continued to increase through the latest available data, however. Going forward, it will be important to understand when a turning point is reached for the Brazilian labor market, given the implications for social outcomes and the speed of the 2021 economic recovery.

B. Ex-Ante and Ex-Post comparisons of Jobs at Risk

To be able to look at labor market developments in Brazil in a more structured way, we turn to an ex-ante assessment of jobs at risk to the COVID-19 shock and compare this with the

[8] The sharply reduced participation rate following the COVID-19 shock is a common feature of Latin American labor markets but stands in contrast to advanced economies were unemployment increased more, likely because of stronger unemployment insurance (IMF, 2020).

ex-post outturns. To do so, we employ the framework outlined in Alfaro et al (2020). In particular, we calculate the probability that individuals lose their job based on the type of sector they are employed in, the size of the firm, and their formality status.

The probability is defined as follows:

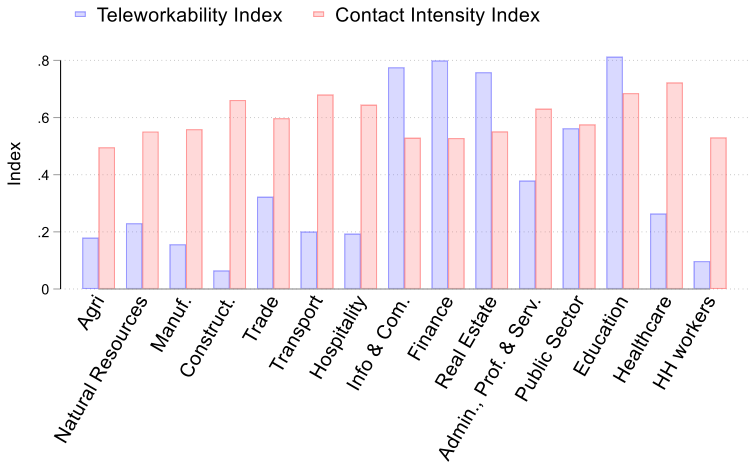
$$\pi_{it} = min\{1, ((Supply\ Shock_{it} + Demand\ Shock_s) * AD)\}$$

where the probability of losing a job depends on sector specific supply and demand shocks. The sector specific supply shock takes different values depending on the stage of the lockdown and the size of the firm (S_{it}), the characteristic of the worker's occupation in terms of its teleworkability and contact-intensity, and the probability that this sector and its downstream and upstream sectors also face lockdowns. In particular, the supply shock takes the following functional form:

$$Supply\ Shock_{it} = S_{it} * min\{1, (1 - T_i) * Highcontact_i\} * min\{1, Lock_s + Lup_s + Ldown_s\}$$

Given the importance of contact-intensity and teleworkability, Figure 3 presents the sectoral measures. In line with intuition, construction, domestic services, transportation and hospitality are especially vulnerable sectors given their low teleworkability and high contact-intensity as well as their higher share of informal workers (see Annex B for additional analysis).

Figure 3. Brazil: Teleworkability and Contact-Intensity Index by Sector



Source: PNAD-Continua and authors' calculations

The sector specific demand shock is defined as a combination of a direct demand shock ($Direct\ loss_s$), weighted by the final sales to the sector's output ($\frac{finalsales_s}{grossout_s}$) and an indirect demand shock reflecting weaker demand from buyers of s ($Indirect\ loss_j$), weighted by purchases to total output ($\frac{purchases_{j:from:s}}{grossout_s}$). The exact values of the direct and indirect demand shocks are adopted from the consumption shocks to Sweden and applied to the

sectoral specification used here. Table A1 in the Annex presents the exact values. The demand shock takes the following form:

$$Demand\ shock_s = Direct\ loss_s * \frac{finalsales_s}{grossout_s} + \sum_{j \neq s} Indirect\ loss_j * \frac{purchases_{j:from:s}}{grossout_s}$$

While the aggregate demand shock follows the standard Keynesian multiplier $AD = \frac{1}{1-MPC}$ [9]

To calculate individual job-loss probabilities employment-at-risk is defined as the sum of all individuals employed prior to the pandemic weighted by their respective job-loss probabilities. The analysis does not incorporate furlough schemes and support programs (such as Brazil's emergency employment retention program).

This framework allows calculating the employment-at-risk across three different stages. The first "shutdown stage" corresponds to the immediate impact we observe in the second quarter of 2020. In this stage, non-essential sectors such as accommodation, arts and entertainment, hospitality, etc. are subject to lockdowns. The severity of the shock on workers depends on the degree of teleworkability and contact-intensity of the sector, as well as on inter-industry linkages. The shock from the demand side is also felt across multiple sectors, mainly transportation, storage, accommodation, hospitality, and services.

To get a sense of how the labor market could develop after the immediate shock, two additional stages are analyzed. During the second "partial opening stage" lockdowns are eased for some sectors such as construction and mining. The key aspect here is the differentiation in resuming work across firm sizes. Specifically, in sectors where lockdowns are relaxed by 50 percent it is assumed that workers in small firms, informal jobs, and self-employed can resume work with no restrictions. On the other hand, medium sized firms in the same sectors face more restrictions due to a higher composition of formal workers, higher costs of hiring and firing employees, and the difficulty of operating under social distancing protocols. Other sectors will continue to face lockdowns, which will translate into higher employment at risk as the prolonged lockdown will exhaust resources and some firms might need to exit. The shock from the demand side ($Direct\ loss_s$) decreases by 25 percent relative to the 'shutdown stage'.

During the final "advanced reopening stage", those sectors that had partially reopened in the previous stage face no supply side restrictions. On the other hand, informal workers, self-employed and workers in small firms for sectors that starts reopening, as well as medium sized firms face a slow recovery due to financial stress from the prolonged impacts of the lockdown. The demand shock in this stage ($Direct\ loss_s$) is reduced by 50 percent relative to the shutdown stage as social distancing protocols are internalized by firms.

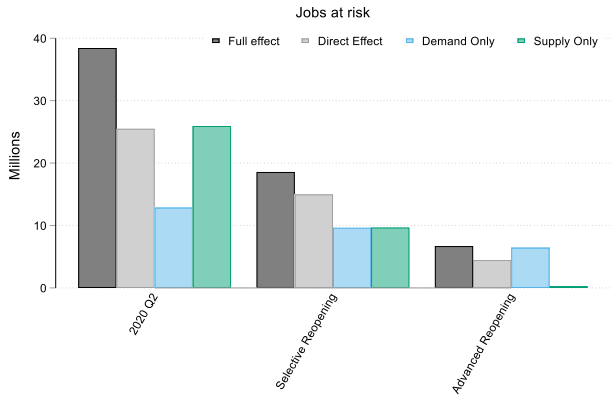
This exercise uses the second quarter of 2019 PNADC data as a baseline. Baseline results are presented in Figure 4. We find that ex-ante employment-at-risk in the shut-down stage was close to 38 million jobs considering intersectoral linkages and the effect of both the supply and demand channels. Employment-at-risk is reduced to 22 and 7 million jobs respectively in

[9] In this exercise, AD = 1.682, following Alfaro et. al (2020).

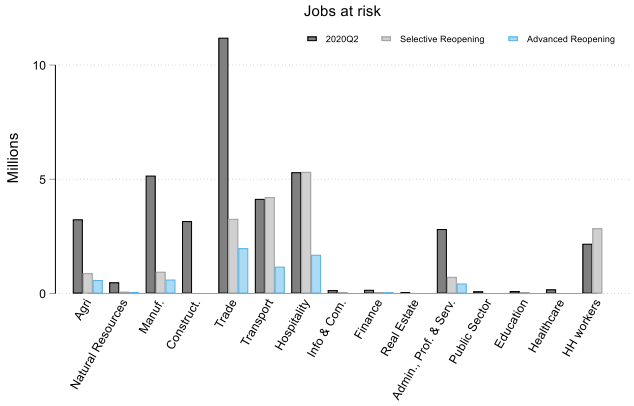
the partial and advanced reopening stage, dropping by roughly 50 percent in the initial reopening phase and by another 70 percent in the advanced reopening phase.

Figure 4. Brazil: Ex-Ante Jobs-at-Risk

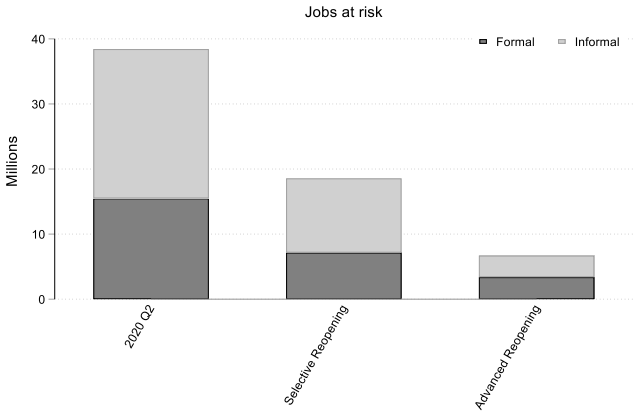
(a) Across Three Different Phases



(b) By Phase Across Sectors



(c) Formal and Informal Sector



Source: PNAD-Continua and authors' calculations

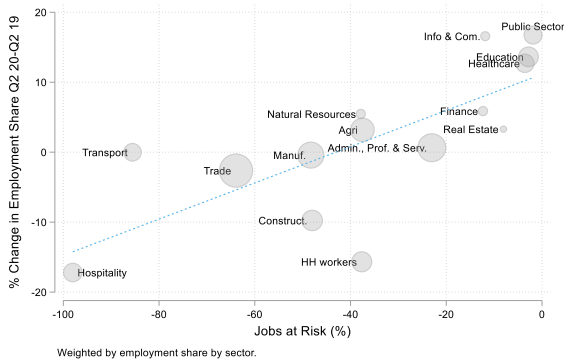
The remaining 7 million jobs at risk in the advanced reopening state come from a somewhat protracted impact of the shock in sectors such as hospitality, transport and commerce, due to lingering effect of the demand shock and the longer recovery for firms which exhausted their financial resources. The employment-at-risk is mainly concentrated in sectors that are less teleworkable and more contact-intensive such as trade, transport and hospitality. Informal workers face almost double the employment risk than formal workers because they work in more contact-intensive sectors that are more subject to lockdowns.

Comparing the estimates of the ex-ante jobs-at-risk with the ex-post loss in employment between 2020Q2 and 2019Q2 shows that the sectoral distribution of jobs-at-risk is fairly well estimated with respect to actual changes in employment (Figure 5 and Annex C). However, total job losses were significantly lower than the universe of jobs at risk. In particular, while for large firms, employment losses match predicted jobs at risks, job losses in small and medium-sized firms (below 50 employees) were much lower than what the jobs-at-risk analysis suggests. Several factors are at play here but the government's employment retention program, which covered around 10 million formal workers and allowed for a subsidized reduction in hours or temporary suspension of the employment relationship, likely played an important role. More generally, as many as 13 million workers were temporarily removed from work due to social distancing measures but officially remained employed (5 million of which unpaid). Including these categories of workers (especially the unpaid one) would bring "de facto" employment losses closer to the ex-ante jobs-at-risk estimate.

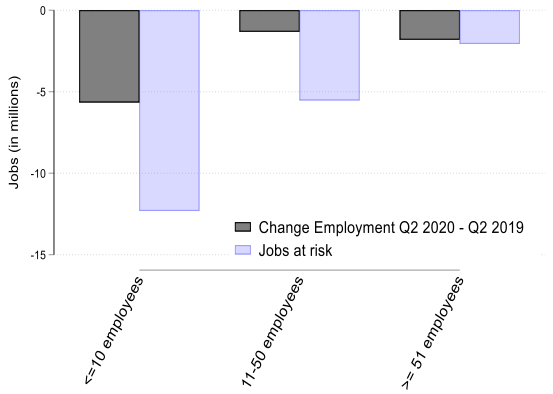
Looking at the reopening stages, even if quantitative estimates might be imprecise, the general pattern of a relatively fast rebound of a large share of jobs coupled with the lingering demand impact in key sectors is already playing out in countries such as the US.

Figure 5. Brazil: Ex-Ante and Ex-Post Job Losses

(a) By Sector



(b) By Firm Size



Source: PNAD-Continua and authors' calculations

A key question for Brazil will be whether the employment retention program will be able to maintain employee-employer relationships permanently or once it expires job losses will have been merely delayed rather than averted.

In the following section, we turn to a more granular look at how the labor market shock affected different groups of workers, before turning to the distributional implications in the final section.

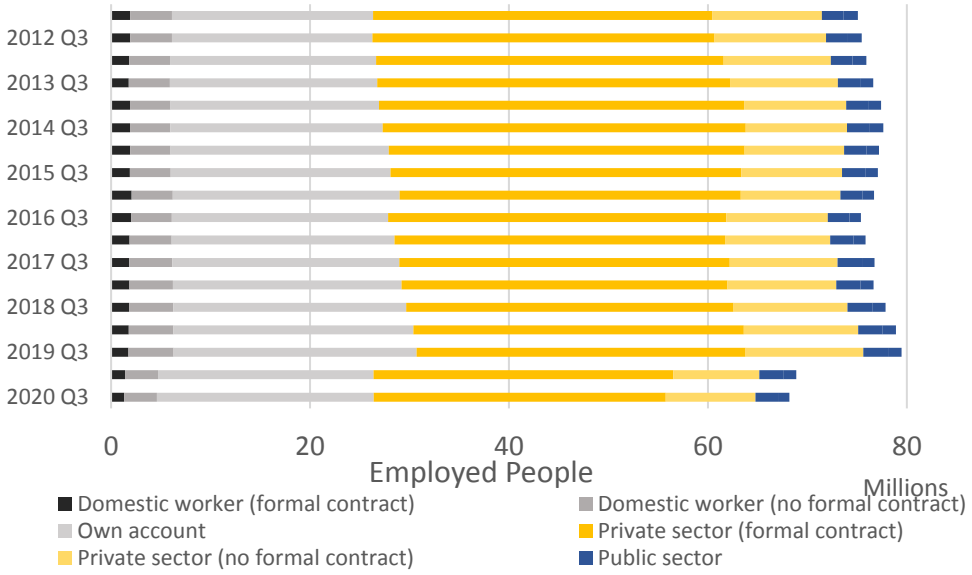
C. An Empirical Look at the Heterogeneous Labor Market Impact of COVID-19

We present stylized facts on the differential impact of the shock on employment, hours worked and income depending on labor formality, worker gender, age and economic sector before drawing together all characteristics in a simple descriptive regression.

Labor Formality

The reduction in employment was mainly driven by informal employees and self-employed workers. Using data from PNAD-Continua for Q3 2020 shows a reduction of approximately 11 million informal jobs relative to 3 million jobs lost for formal workers (Figure 6). The pattern of informal employment suffering the brunt of the immediate COVID-19 impact is mirrored across Latin America (IMF, 2020). As a consequence, the informality rate hit a record low during the peak of the crisis in 2020 Q2, falling by 6.1 percentage points relative to 2019 Q2.

Figure 6. Brazil: Total Employment Breakdown by Category



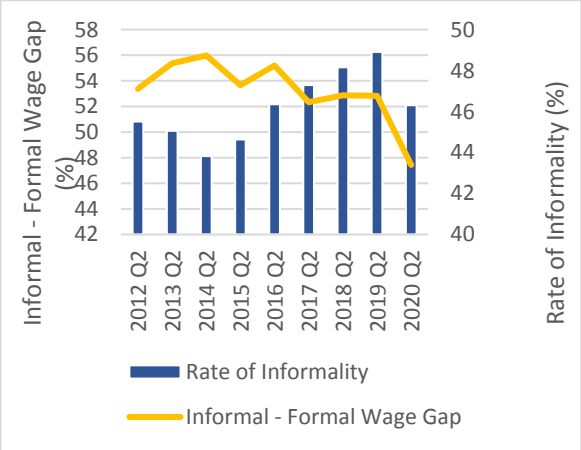
Source: PNAD-Continua and authors' calculations

Figure 7 shows the reduction in the rate of informality and in the wage gap between formal and informal workers in the second quarter of 2020. The wage gap reached a ratio of approximately 47 percent from 53 percent in the same quarter of 2019. These patterns can be explained by the fact that many informal workers exited the labor force and that the formal sector workers, while being more likely to retain their jobs, faced sharp reduction in wages (as will be documented in later sections). Using a logit regression analysis, we corroborate this observation by showing that formal workers were more likely to be doing remote unpaid

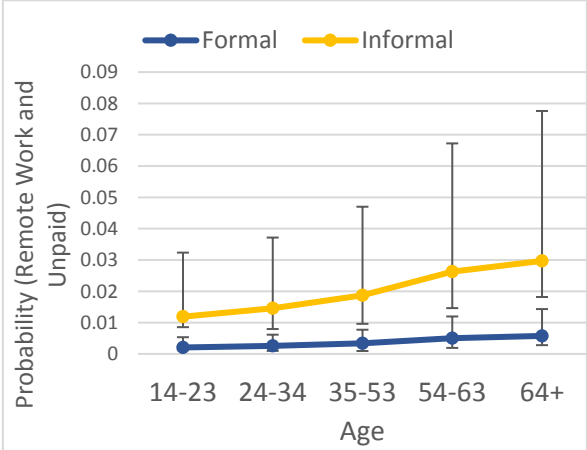
work. This probability is almost three times as large for older cohort workers than it is for younger cohort workers.

Figure 7. Brazil: Formal and Informal Work

(a) Informality Rate and Wage Gap



(b) Unpaid Remote Work Across Age Groups for formal and informal workers

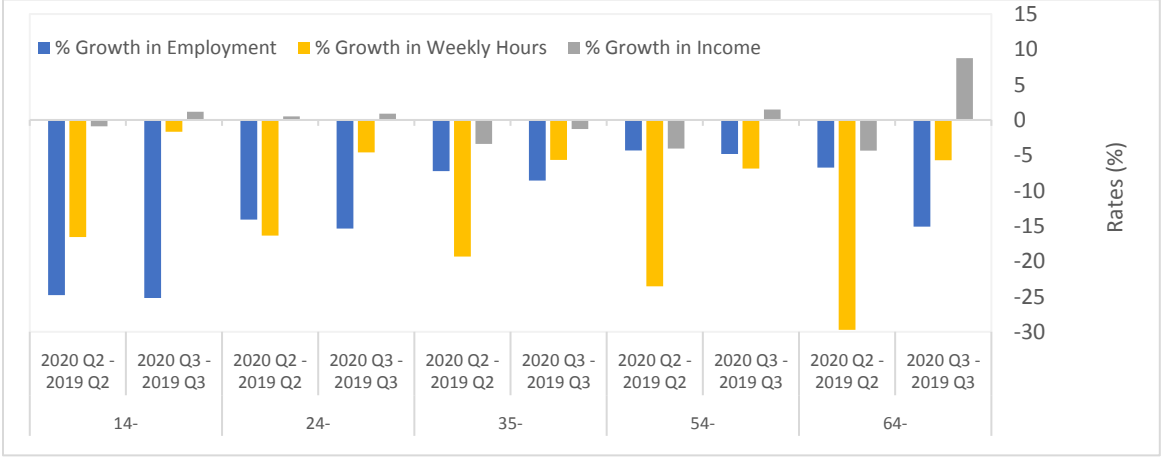


Source: PNAD-Continua and authors' analysis of PNAD COVID. Results are from a logit model. Sampling design and weights are taken into account. Estimation includes federation unit fixed effects and industry fixed effects. 95 percent confidence interval shown.

Age

Looking at patterns across age segments in Figure 8, we find that the younger cohorts faced the highest reductions in employment while older cohorts suffered more pronounced reductions in hours on the back of milder decreases in employment. Older cohorts were more likely to be removed from work specifically due to social distancing measures while retaining their employment status, resulting in an increase in income per hour worked during Q3 compared to a year earlier most likely as a result of the job retention program.

Figure 8: Employment, Income and Hours Worked by Age

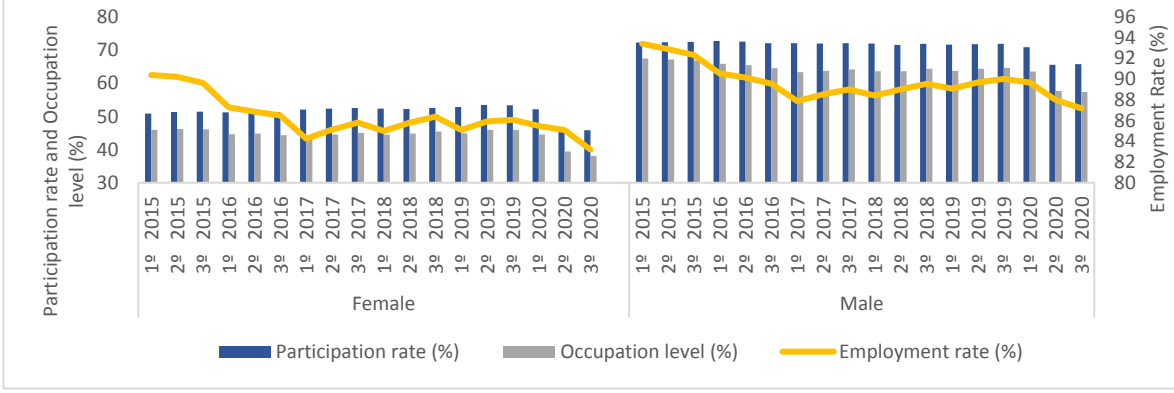


Source: PNAD-Continua and authors' calculations

Gender

Historically, in Brazil female labor force participation, occupation level and employment rate lagged those for males by a considerable margin (Figure 9 and 10). Between 2015 Q1 and 2020 Q1, the labor participation and unemployment rates for women averaged about 52 and 13 percent, compared to 72 and 10 percent for men, resulting in a striking 20 percentage points wedge in occupational levels, which averaged 45 percent for women and 65 percent for men. We document a sharp decrease across these rates in 2020 Q2 and Q3 due to the pandemic, to even lower levels than the rates prevailing during the 2015-2016 recession. In particular, the participation rate for women fell by about 6 percentage points to 46 percent in 2020 Q2, from 52 percent in 2020Q1 and continued decreasing in Q3, thus mitigating the increase in the unemployment rate during the same period from 14.5 in 2020Q1 to about 17 percent in Q3. By comparison, the participation rate for men decreased by 5 percentage points to 66 percent in 2020 Q2 but rebounded slightly in Q3, while the unemployment rate increased from 10.4 percent in 2020 Q1 to about 13 percent in Q3.

Figure 9. Brazil: Occupation level, Participation and Employment Rate by Gender

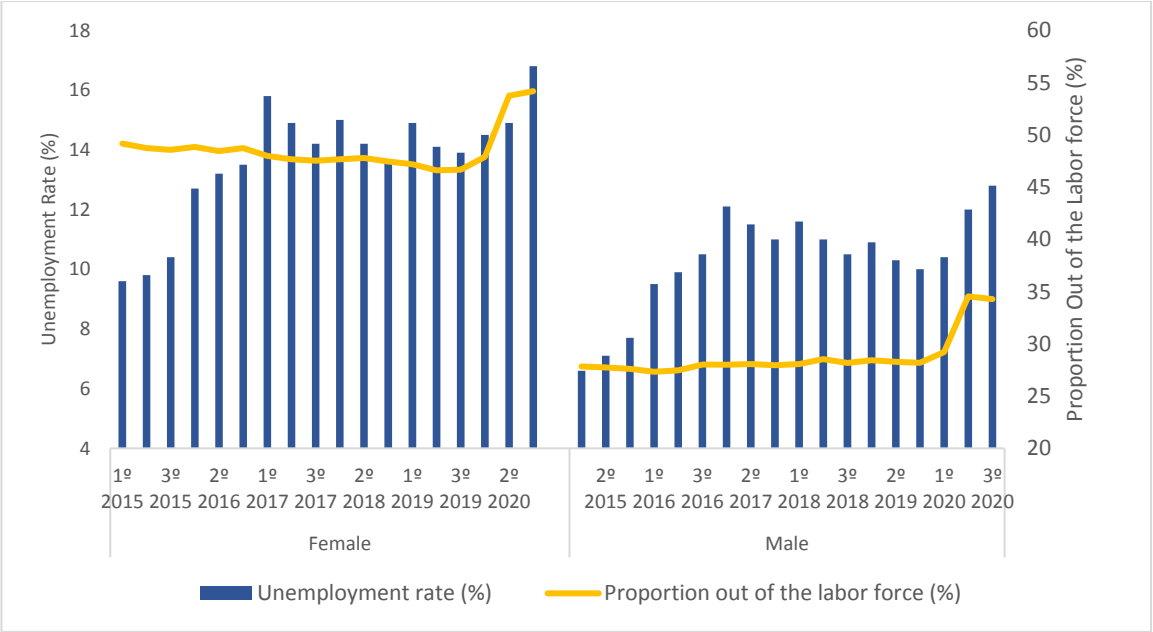


Source: IBGE Official Statistics

As shown in Figure 10, the proportion of both females and males exiting the labor force rose significantly in 2020 Q2, well above the levels observed in 2015 and 2016. However, while the flow out of the labor force continued increasing in Q3 for females, it slightly declined for males.

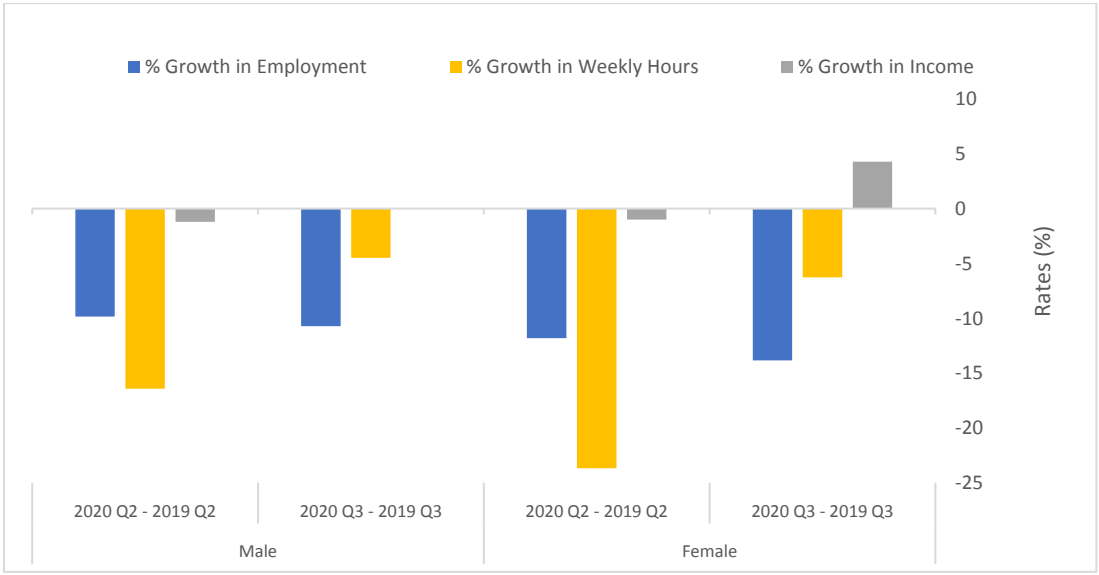
Looking at percentage changes in employment, weekly hours and income per hour in Figure 11, female workers suffered a more pronounced fall in employment than males in both Q2 and Q3, and those who retained their jobs, experienced a more significant reduction in hours worked. In particular, hours worked by women decreased by 24 percent in 2020 Q2 compared to 2019 Q2 and rebounded marginally to -6 percent in Q3, compared to a contraction of 16 percent in Q2 and 4 percent in Q3 for males. Possibly because of the job retention program launched by the government and the sharper reduction in hours worked for women that retained their jobs, female workers experienced a slight increase in hourly income in 2020 Q3 compared to a year before.

Figure 10. Brazil: Unemployment Rate and Labor Force by Gender



Source: IBGE Official Statistics

Figure 11. Brazil: Employment, Income and Hours Worked by Gender



Source: PNAD Continua and authors' calculations

Sector

The discussion of ex-ante jobs-at-risk versus ex-post employment losses has already highlighted the sectoral heterogeneity in job losses. There is also considerable variation by industry in terms of changes in hours worked and labor income. On average, hours worked decreased from 39 hours per week pre-COVID to 27 post-COVID. In addition to having suffered the largest job losses, industries that are more contact-intensive such as recreational

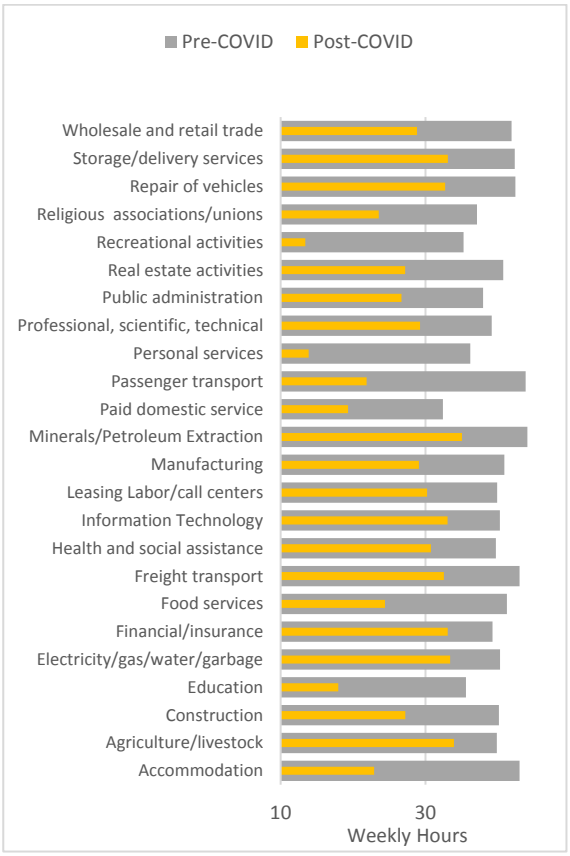
activities, personal and domestic services, experienced the largest drop in hours worked and income. For the month of May, females saw a reduction in monthly hours worked of 36 percent versus 27 percent for males. However, on average income per hour worked for formal workers rose by 26 percent (28 percent for females and 12 percent for males). As noted above, the government's employment protection program might have played an important role here, protecting incomes even as hours worked were reduced.

Urban/Rural

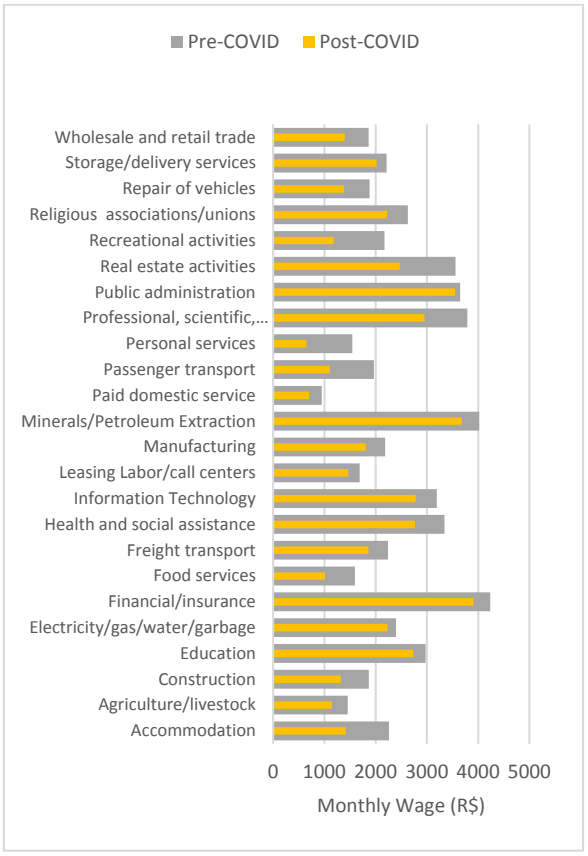
The reduction in employment was observed in rural and urban areas alike, reaching 12.4 % in the latter in 2020 Q3 relative to the same quarter of the previous year. In both urban and rural areas, those who remained employed saw little changes in income but sharp reductions in hours worked. The fall in hours worked was noticeably sharper in urban areas (Figure 13).

Figure 12. Brazil: Pre- and Post-COVID Hours Worked and Wages Across Sectors

(a) Weekly Hours Worked.

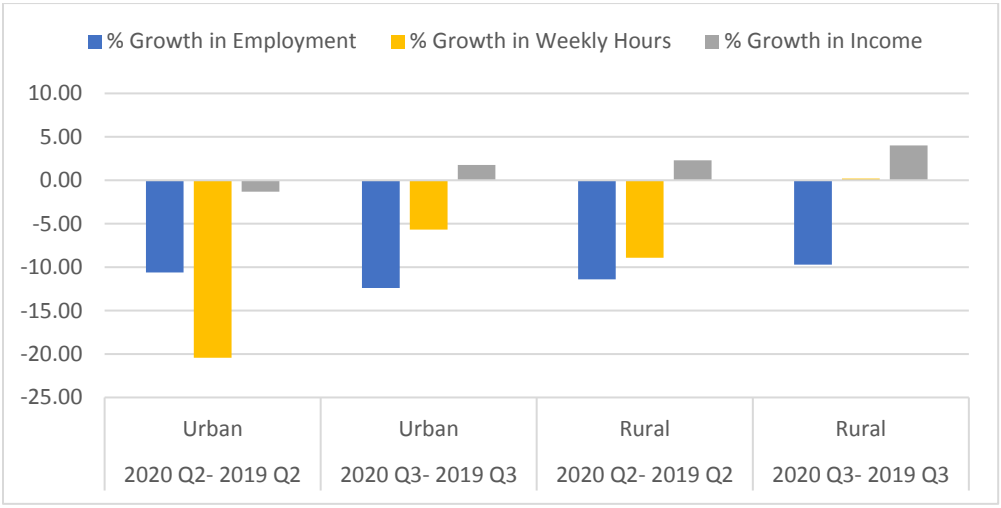


(b) Wages



Source: PNAD COVID (May, 2020) and authors' calculations

Figure 13. Employment, Weekly Hours, and Monthly Wage for Rural and Urban Regions



Source: PNAD-Continua and authors' calculations

Which margins mattered the most?

Having looked at the differential impact of the pandemic across different dimensions, we summarize the patterns of heterogeneity of the COVID-19 impact on employment, wages and hours worked per week. In particular, we estimate the following equation:

$$Y_{it} = \alpha + \beta_1 X_{it} + \beta_2 Post_t + \beta_3 X_{it} x Post_t + \gamma_{uf} + \gamma_{industry} + \epsilon_{it} \quad (1)$$

where Y_{it} are the dependent variables, namely: (i) whether the person is employed, which takes the value of 1 if the worker is considered employed and zero otherwise (ii) monthly wage, and (iii) hours per week. X_{it} are a set of worker level characteristics including demographics and the type of occupation and industry, namely: sex, education level, age, size of firm, extent of teleworkability and contact intensity of an industry, probability of lockdown, and race and high exposure. High exposure is defined as being in a state with confirmed COVID-19 cases that exceed the 60th percentile of the average cases of all states. $Post_t$ is a dichotomous variable that takes the value of 1 for the quarter 2 of 2020 and 0 otherwise. γ_{uf} and $\gamma_{industry}$ are state and industry fixed effects respectively. Table 1 shows results on the main coefficients of interest (β_3) on employment, wage and hours worked. We exclude workers that report working zero hours and receiving a zero wage.

We estimate the probability of being employed with a logit regression based on the specification in equation (1), while the impact on wages and hours is estimated with ordinary least squares using 2019 Q2 and Q3 as the pre-period and 2020 Q2 and Q3 as the post period. We find that most of the margins of heterogeneity discussed above mattered and there is no one single factor (say economic sector) that explains all the variation in the data.

As shown in Table 1, individuals present in high exposure areas were 1.3 percentage points less likely to be employed that those present in less exposed areas. As observed in the descriptive analysis, employment fell sharply for younger cohorts of workers, with those

aged 14-34 and 35-54 being 1.3 and 2.7 percentage points less likely to be employed than the older cohort (54+). However, those who remained employed in the youngest cohort (14-34) worked more hours and earned more than the older cohorts. This is consistent with what we observed in Figure 8. We also find that workers with secondary education were 1.5 percentage points less likely to be employed than the tertiary educated workers.

Table 2. Brazil: Heterogeneity of Impact by worker and industry characteristics

VARIABLES	(1) Employed	(2) Log(Wage)	(3) Log(Hours per week)
Post COVID X High Exposure	**-0.0129*** **	0.00866	-0.00353
	(0.00287)	(0.00734)	(0.00511)
Post COVID X Primary Educ	-0.00421	**0.0725*** **	**0.0337*** **
	(0.00380)	(0.0115)	(0.00722)
Post COVID X Secondary Educ	**-0.0154*** **	**0.0271*** **	-0.00379
	(0.00367)	(0.00971)	(0.00602)
Post X Female	-0.000776	-0.00380	**-0.0251*** **
	(0.00235)	(0.00549)	(0.00442)
Post COVID X age 14-34	**-0.0134*** **	**0.0209** **	**0.0543*** **
	(0.00335)	(0.0103)	(0.00848)
Post COVID X age 35-54	**-0.0265*** **	**-0.0244*** **	0.00752
	(0.00335)	(0.00947)	(0.00774)
Post COVID X Black	**-0.0129*** **	0.000456	0.00530
	(0.00463)	(0.00989)	(0.00758)
Post COVID X Asian	0.0209	**0.144** **	0.00803
	(0.0195)	(0.0611)	(0.0344)
Post COVID X Brown	-0.00232	**0.0233*** **	0.00690
	(0.00264)	(0.00645)	(0.00520)
Post COVID X Indigenous	**-0.0537*** **	-0.0247	0.00574
	(0.0194)	(0.0450)	(0.0326)
Post COVID X Pr. Lockdown		**-0.0554*** **	**-0.0338*** **
		(0.00816)	(0.00715)
Post COVID X Teleworkability		**0.0201*** **	**-0.0192*** **
		(0.00754)	(0.00602)
Post COVID X Contact-Intensity		0.00185	**-0.0113** **
		(0.00589)	(0.00529)
Post COVID X <=10 employees		**-0.0697*** **	**-0.0410*** **
		(0.00687)	(0.00501)
Post COVID X >10 and <=30 employees		**-0.0584*** **	**-0.0346*** **
		(0.00951)	(0.00987)
Post COVID X Informal		**-0.0127** *	**0.0126** **
		(0.00717)	(0.00564)
Constant		**8.332*** **	**3.843*** **
		(0.0208)	(0.0125)
Observations	1,494,975	691,065	710,014
R-squared		0.469	0.139
State F.E.	YES	YES	YES
Year F.E.	YES	YES	YES
Industry F.E.	YES	YES	YES
Controls	YES	YES	YES

Note: The table shows regression results based on the specification in equation (1) and PNAD-Continua microdata. Standard errors are in parenthesis. Survey data design and sampling weights are taken into consideration in the estimation. Controls include sex, formality status, education level, age, size of firm, extent of teleworkability and contact-intensity of an industry, probability of lockdown, and race. The omitted categories are as follows: on education it is tertiary education, on age it is 54+ cohort, on race it is white, and on firm size it >30 employees.

However, workers with primary or secondary education who retained their jobs saw a statistically significant increase in their wage per hour, and workers with primary education

worked more hours relative to tertiary educated workers. A potential explanation for the former effect is that high-productive workers were less likely to lose their jobs than their low-productive peers, in addition to the effect of the job retention scheme for formal workers. Results suggest that, although females are not significantly less likely to be employed after COVID, those employed worked 2.5 percent fewer weekly hours.

Black workers post-COVID were 1.3 percentage points less likely than white workers to be employed but there is no significant difference in wage and hours worked for those who remained employed. Brown workers were not less likely to be employed post COVID vis-à-vis white workers, but those that remained employed witnessed an increase in their wage of 2.3 percent compared to white workers.

Workers in sectors that were subject to a higher probability of lockdown worked 3.4 percent fewer hours and earned 5.5 percent lower monthly wage. Workers in sectors that are contact-intensive worked 1.1 percent less hours and those in teleworkable sectors worked 1.9 percent less hours and earned 2 percent more than those in less teleworkable ones. Workers in small (<10 employees) and medium sized (between 10 and 30 employees) firms earned 7 percent and 5.8 percent lower monthly wage respectively while working 4.1 percent and 3.4 percent less, respectively, than workers in large firms (above 30 employees). Informal workers worked 1.3 percent more hours than formal workers but earned 1.3 percent lower monthly wage (also see Annex D for additional results).[10]

D. Distributional Impacts and the Role of Emergency Aid

The above sections provide some indication that economically more vulnerable groups (informal workers, women, the young) were the hardest hit by the COVID-19 shock on Brazil's labor market. As shown in Figure 14, while labor income fell across the entire income distribution, poor households were the most affected. Households in the bottom income decile saw their monthly labor income decrease by 35 percent from R$502 to R$327, resulting in a loss of about 1 percentage point of their percentile share in total income. Labor income in the top decile of the distribution decreased by 17 percent, resulting in an increase in their percentile share by approximately 3.2 percentage points.

In order to mitigate the impact of the pandemic on vulnerable households, the government rolled out the EA cash transfer program in April. The EA initially covered 67.7 million eligible beneficiaries, around one-third of the population (Annex E). For the months of May through August, beneficiaries received monthly cash payments of R$600 (150$US) with women head-of-households receiving twice the amount.[11] The program was extended twice

[10] We have attempted to include an interaction term for informal workers that perform contact intensive sectors. However, the reduction in hours worked and wage was not significant, which can be rationalized by the fact that the rate of informality decreased significantly after the crisis.

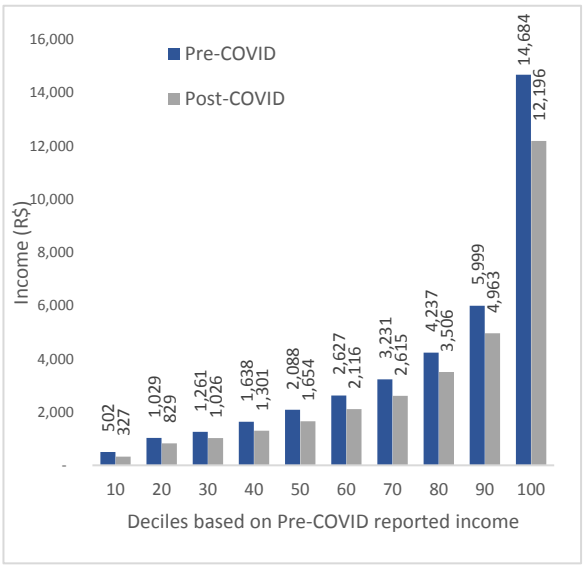
[11] To be eligible, individuals had to satisfy the following criteria: be at least 18 years of age, hold an informal job or be unemployed, is not the holder of another welfare benefit except for *Bolsa Familia*, and have monthly per capita family income of up to half the minimum wage (R$522.5 or 150U$S) or total monthly family income of (R$3,135 or 608US$). Only two members of the same household may receive the aid. Women providers of a

(continued…)

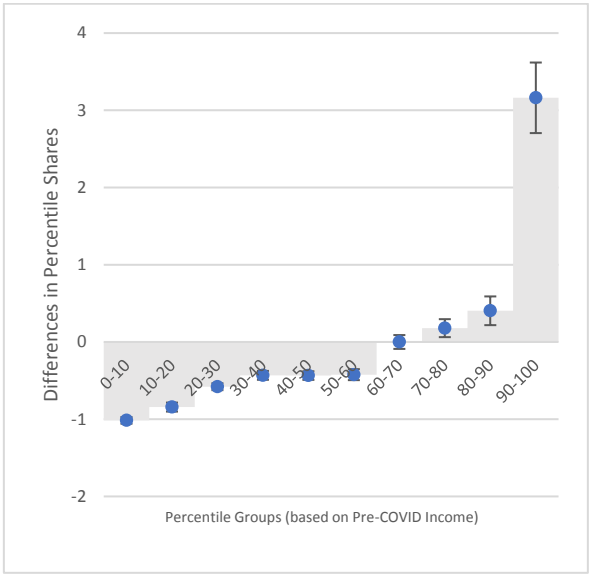
through end-2020, with the benefit reduced to R$300 for the last four months of the year[12]. Eligibility was also gradually tightened, with about 50 million beneficiaries receiving the aid by end-year.

Figure 14. Brazil: Post-COVID Labor Income

(a) By Income Decile



(b) Change in Percentile Shares vs Pre-COVID



Source: PNAD COVID (May 2020) and authors' calculations. Note: Pre-COVID income is the baseline.

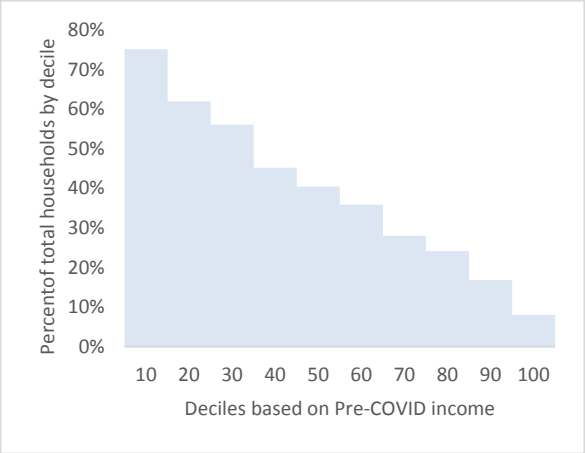
Brazil was able to respond to the shock quickly thanks to the existing social assistance programs and the associated infrastructure to identify and deliver payments. Eligibility for the EA was automatically evaluated for those individuals who were already in the Unified Civil Registry (*Cadastro Único*, CU). This substantially simplified the implementation of the EA since the CU already contained data on a large fraction of the poorest Brazilians, including all *Bolsa Família* beneficiaries and those who had applied to the program but were not beneficiaries yet, which lowered the risk of errors of exclusion. By May 2020, the government had analyzed all 52 million individuals in the CU, of which 29.7 million were approved, including 96 percent of Bolsa Familia beneficiaries who were switched to the EA. The rest of the beneficiaries were identified by self-selection through an app run by *Caixa Econômica Federal*, the largest state-owned bank in Brazil by number of customers also responsible for the payment of *Bolsa Família* benefits. Beneficiaries also had the option of receiving the cash transfer via digital savings account, which also had the benefit of promoting fintech and financial inclusion during the early stages of the pandemic.

single parent family received twice the amount of the aid. The aid represented 60 percent of the minimum monthly wage.

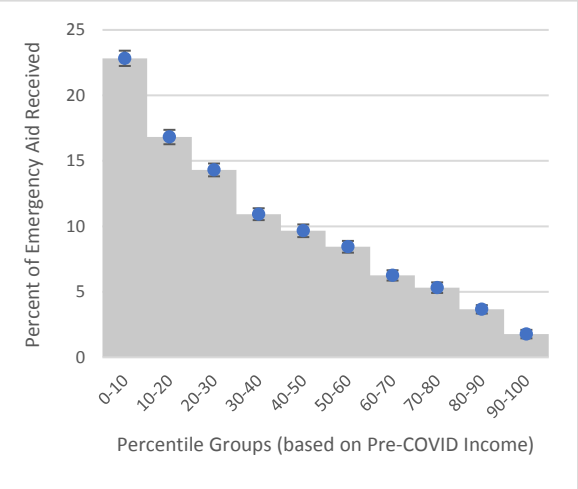
[12] The change in the amount of aid given is recorded starting from the October vintage of PNAD COVID as those individuals that started receiving the transfer in May instead of April because of delays in distribution were paid the full amount of the benefit in September. As of October 2020, 1.2 million female head-of-household received R$746, down from 1.3 million in May receiving an average benefit of R$960.5.

Figure 15. Brazil: Distribution of EA by Income Deciles

(a) Share of Total Households in Decile



(b) Share of Total EA Paid

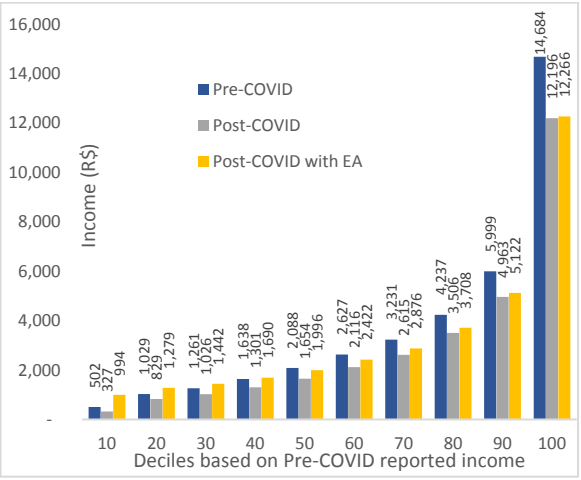


Source: PNAD COVID (May, 2020) and authors' calculations

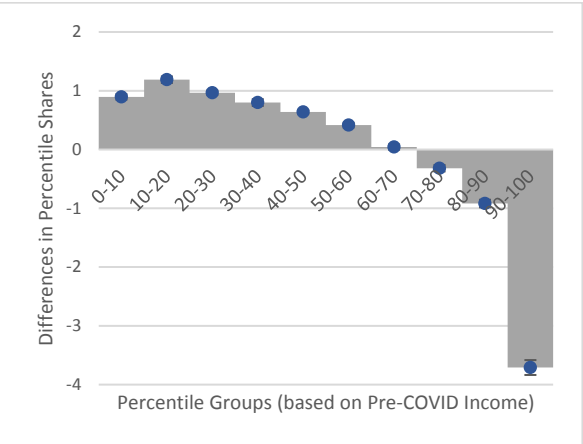
Analysis based on PNAD-COVID for May (Figure 15) shows that more than 70 percent of households in the bottom decile received the aid,[13] accounting for almost 23 percent of total EA disbursements. In total, the bottom three deciles received 53.9 percent of benefits. However, there was room for improvement in targeting as the top three deciles of the income distribution received about 10.7 percent of the aid. As of May, at the peak of the crisis, the transfers increased the average income of the bottom 40 percent of households by 20 percent relative to the level of pre-COVID income (Figure 16).

Figure 16. Brazil: Income Distribution with EA by Income Decile

(a) Relative to Pre-COVID and Post-COVID



(b) Change in Percentile Shares vs Pre-COVID



Source: PNAD COVID (May, 2020) and authors' calculations

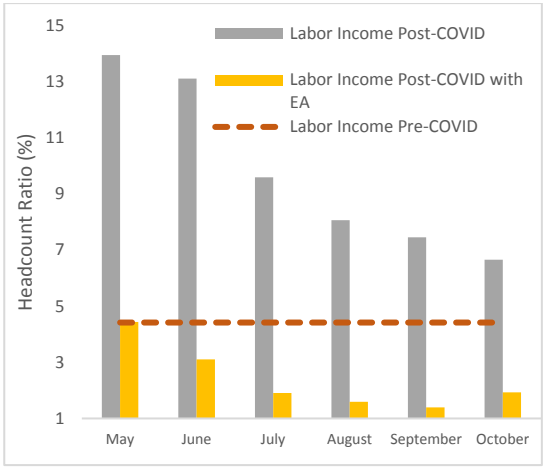
[13] Deciles are calculated on equal number of households.

The aid corresponded to 150 percent of the pre-COVID labor income in the bottom decile and 40 percent of the pre-COVID overall median labor income. The EA more than compensated the negative impact of the pandemic on poverty and income, at least temporarily (Figure 17). Inequality as measured by the Gini index in May would have increased from 0.53 pre-COVID to 0.58 post-COVID. Likewise, the poverty headcount ratio based on the extreme poverty line of R$128 per month (US$1.9 per day) would have increased sharply from 4.7[14] percent to 13.9 percent in May—corresponding to approximately 15.7 million individuals saved from falling into extreme poverty. Instead, with the EA the poverty headcount ratio fell to 4.4 percent and the Gini coefficient to 0.51—both lower than their pre-COVID levels (Figure 16). For households headed by single earner women with at least one child, who received double the transfer, the poverty rate[15] would have increased from 11 to 30.4 percent without EA, instead it temporarily fell to 8.4 percent[16] because of the EA. Depending on the poverty line used, EA prevented between 7.8 and 16.4 million people from falling below the poverty line between pre-COVID and post-COVID income from May until October.

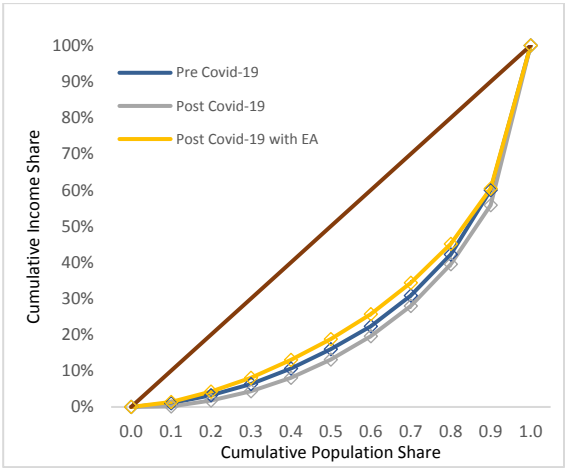
The counterfactuals without EA could admittedly overestimate poverty and income inequality outcomes as the initial amount of the benefit could have discouraged labor participation for workers in the bottom deciles (who, as discussed, received on average 150 percent of their pre-COVID income), particularly women head-of-households (who received double the benefit).

Figure 17. Brazil: Poverty and Income Inequality Pre- and Post-COVID

(a) Poverty (Extreme Poverty Line)



(b) Income Inequality (Gini Index).



Source: Authors' analysis based on PNAD COVID.

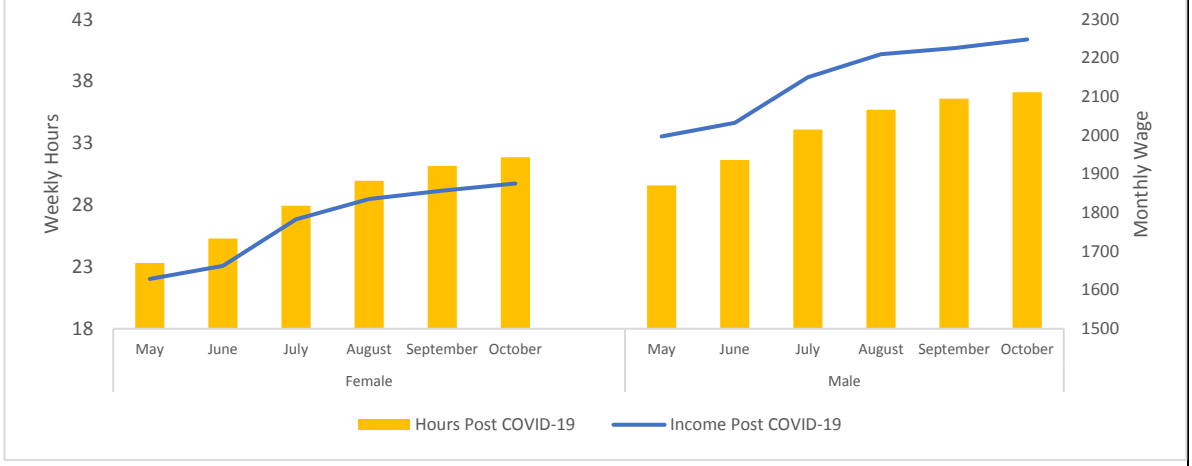
[14] Based on households that have at least one income earning member. Pre-COVID income differs from month to month due to small errors of reporting of this value. So, in figure 16, we take the arithmetic mean across all the months.

[15] This poverty rate is calculated as the total of members of households headed by a female who is a single earner and who are under the extreme poverty line, divided by the total of such households in Brazil.

[16] Based on the analysis of PNAD COVID which has methodological differences from previous household surveys such as (PNAD-Continua) and therefore figures from earlier months in the year may not be directly comparable.

Encouragingly, as documented in Figure 16, there is already evidence of a gradual rebound in the labor market shown by the progressive decrease of the post-COVID poverty headcount ratios between May and October, along with a slight increase in the ratio including EA in October that reflects the lower benefit granted in September. This is consistent with the recovery of monthly wages and hours worked for both males and females over the same period reported in Figure 18 below. Nevertheless, since the aid expired at the end of 2020, a continued substantial improvement in the labor market will be necessary to avoid a potentially sharp increase in poverty and inequality in 2021.

Figure 18. Brazil: Evolution of Income and Hours by Gender



Source: PNAD COVID and authors' calculations

E. Counterfactual Analysis

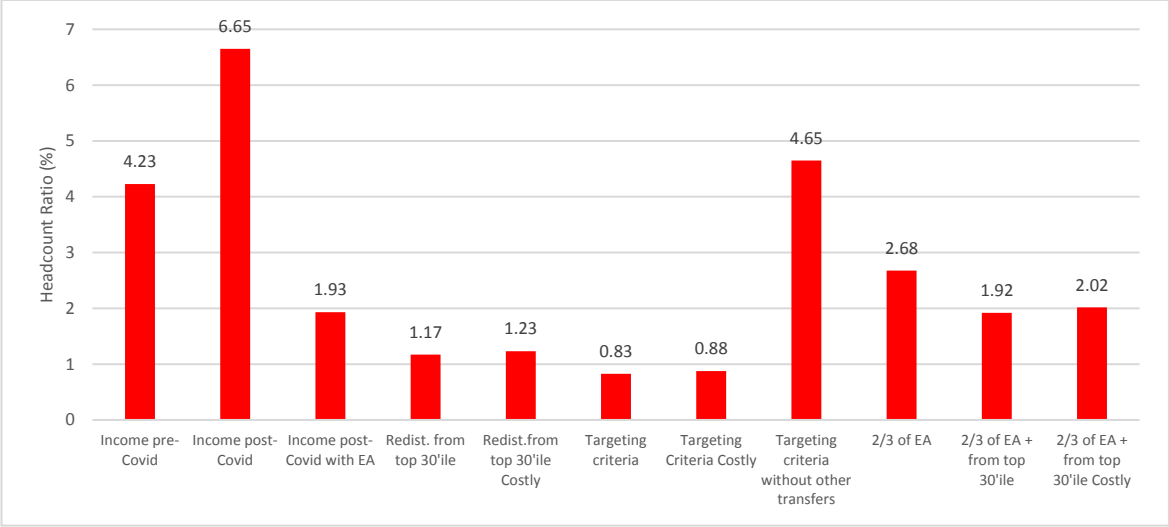
Given the difficulty of ensuring that a program of the magnitude of Brazil's EA is paid only to those who meet the criteria while at the same time all eligible people receive the benefit - thus minimizing errors of inclusions and exclusions respectively - we analyze below different targeting scenarios for the month of October and their impact on poverty.

The first three columns of Figure 19 show the headcount ratio (extreme poverty line) for households earning labor income pre-COVID, post-COVID and post COVID with the EA. As noted above, the EA was key in preventing a rapid and significant rise in short-term poverty levels, in fact lowering the poverty headcount compared to pre-COVID times. Bars 4 and 5 titled "*Redist from top 30'ile*" and "*Redist from top 30'ile Costly*" show the headcount ratio that would have prevailed if all payments that were received by the top 30th percentile were redistributed to the bottom decile without any costs, and with an administrative targeting cost of 3 percent of the aid given, respectively. In this latter simulation, the cost of the targeting is passed down to the beneficiary in the form of less aid received. As expected, in both cases, the extreme poverty headcount ratio is reduced to below its observed level, to about 1.2 percent.

In bars 6, 7, and 8, we replicate the eligibility criteria for the EA targeting and present results for a counterfactual scenario where only those that are eligible as per the stipulated conditions receive the aid with no extra cost of targeting , "*Targeting Criteria*", and with a 3 percent cost of targeting, "*Targeting Criteria Costly*". Under the former simulation, the total amount spent would have been R$3.1 billion lower than what was disbursed in October. We also present the case incorporating an additional requirement stating that those who receive other welfare benefits except for *Bolsa Família* are not eligible for the EA aid. We do not observe that this criterion is binding in practice, whereby 4.2 million households said they received EA alongside benefits such as unemployment benefits and retirement pension. In the first two scenarios of the targeting criteria simulations, the bottom 40th percentile of households receives the benefits and the headcount ratio falls to 0.8 and 0.9 percent respectively—still less than the current headcount ratio with EA of 1.9 percent. In the third scenario, the poverty headcount ratio would rise to 4.7 percent if individuals receiving benefits other than *Bolsa Família* were excluded.

Finally, we simulate counterfactuals where the unit transfer is reduced by a third (to R$200). Holding the original distribution of transfers, "*2/3 of EA*," would result in R$4.9 billion savings in October (approximately 33 percent of the EA cost in the same month)[17] and a marginal increase in the extreme poverty headcount ratio to 2.7 percent as transfers are reduced. With redistribution from the top 30th percentile to the bottom deciles "*2/3 of EA from top 30'ile*" and with a 3 percent targeting cost "*2/3 of EA from top 30'ile Costly*", the extreme poverty ratio would be reduced to 1.9 and 2 percent of the population respectively. Hence with better targeting, even two thirds of the original amount of aid would be very effective in reducing extreme poverty to a ratio very close to the one observed in October.

Figure 19. Brazil: Poverty Counterfactual Analysis for the Administration of EA



Source: Authors' analysis of PNAD COVID for the month of October

[17] Based on a total cost for October of R$14.7 billion for the sub-group of households with a wage earner.

V. CONCLUSION

COVID-19 had an unprecedented impact on Brazil's labor market, resulting in almost 13 million job losses between December 2019 and August 2020. The reduction in employment disproportionally affected informal workers, women and young cohorts of workers. Older cohorts of workers retained their employment but were more likely to be temporarily removed from their jobs, with high reductions in hours worked and monthly wages.

An ex-ante analysis of jobs-at-risk shows that employment-at-risk in the shut-down stage was close to 38 million jobs considering intersectoral linkages and the effect of both the supply and demand channels. The employment-at-risk is mainly concentrated in sectors that are less teleworkable and more contact-intensive such as trade, transport and hospitality. Informal workers face almost double the employment risk than formal workers because they work in more contact-intensive sectors that are more subject to lockdowns.

A comparison with actual changes in employment shows that, while the sectoral distribution of jobs-at-risk is fairly well estimated, total job losses were significantly lower than the universe of jobs at risk, in particular for small and medium-sized firms. While several factors are at play, the government's employment retention program, which covered around 10 million formal workers and allowed for a subsidized reduction in hours or temporary suspension of the employment relationship, likely played an important role. A key question going forward is whether the employment retention program will be able to maintain employee-employer relationships permanently or once it expires job losses will have been merely delayed rather than averted.

While labor income fell across the entire income distribution, poor households were the most affected. Households in the bottom income decile lost about 1 percentage point of their percentile share in total income as their monthly labor income decreased by 30 percent. Our analysis shows that poverty and the Gini index would have increased sharply as a consequence, to about 13.9 percent and 0.58 respectively, compared to about 4.7 and 0.53 pre-COVID for May. However, the government sponsored EA was successful in cushioning the blow of the crisis on the livelihoods of Brazilians, in fact reducing poverty and income inequality to 4.4% and 0.51 respectively, lower than their pre-COVID levels.

Nevertheless, at a cost of about 4 percent of GDP the program is not sustainable beyond the short-term and was terminated in December. Given the significant role played by the EA in mitigating the short-term increase in poverty and income inequality, a substantial improvement in the labor market will be necessary to avoid a potentially sharp deterioration in social outcomes during 2021. Encouragingly, we already see some sign of a gradual rebound since the peak of the crisis in May, both in terms of hour worked, monthly wages and disposable income. The reduction by half of the EA transfer resulted in only a marginal uptick of the poverty ratio in October.

To gauge options to provide continued stimulus, we present counterfactual scenarios for the distribution of the EA under different targeting and benefit options. We find that further reducing the transfer by one-third (to R$200 a month per individual) with improved targeting

would be successful in keeping the poverty headcount ratio close to its October levels even after accounting for the administrative cost of targeting.

Going forward, given the importance of the federal expenditure ceiling to preserve debt sustainability, macroeconomic stability and market confidence, it will be important that any additional social assistance spending be financed within the expenditure limits imposed by the ceiling. Considering the rigidity of Brazil's budget, this will require firm implementation of fiscal structural reforms aimed at flexibilizing the budget process and reducing mandatory spending to create the necessary fiscal space for increased social assistance spending.

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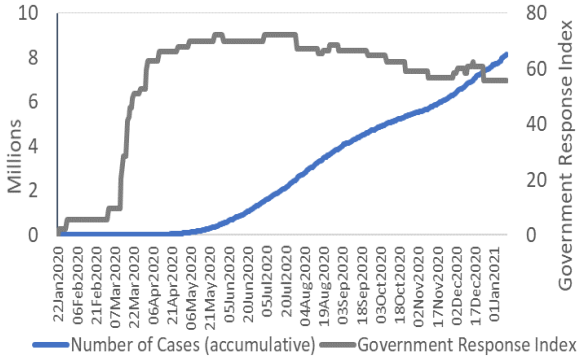
ANNEX I

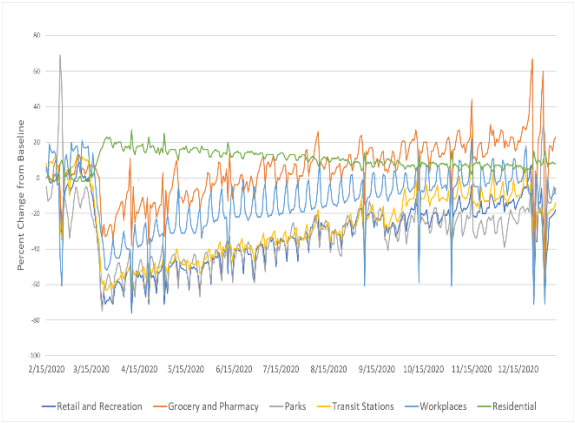
A. COVID-19 Cases, Government Regulations and Mobility

Figure A1. Brazil: COVID-19 Cases and Government Response



Source: Blavatnik School of Government – University of Oxford. The government response index measures how many of a set of indicators a government has acted upon and to what degree.

Figure A2. Brazil: Mobility in Brazil



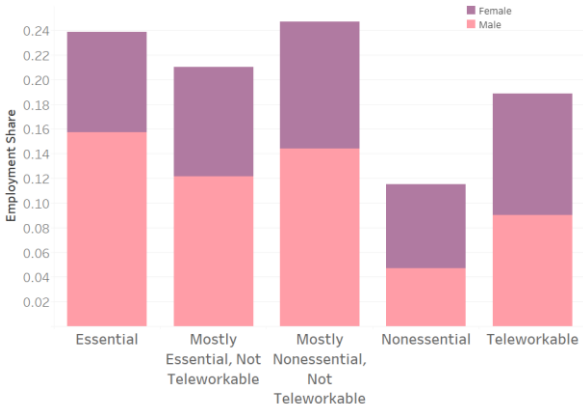
Source: Google Mobility data.

B. Ex-Ante Employment Distribution

Figure A3. Brazil: Employment Share by Gender Across Teleworkable and Contact-Intensive Jobs

Source: PNAD-Continua 2019Q2. Authors' analysis of employment share based on Dingel and Neiman (2020) teleworkability and contact-intensive indices.

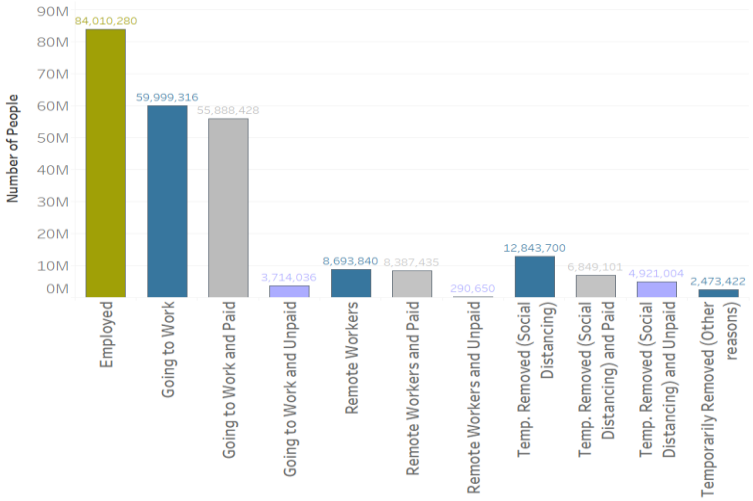
Figure A4. Brazil: Employment Share by Gender Across Sectors Defined by Confinement Measures



Source: PNAD-Continua 2019Q2. Authors' analysis of employment share based on Perez et al (2020) division of sectors based on COVID-19 confinement measures on EU labor markets.

C. Ex-Ante and Ex-Post Employment Analysis

Figure A5. Brazil: Ex-Post Employment Categories



Source: PNAD COVID (May, 2020) and authors' calculations

Figure A6: Probability of Being Removed from Work Temporarily due to Social Distancing by Age.

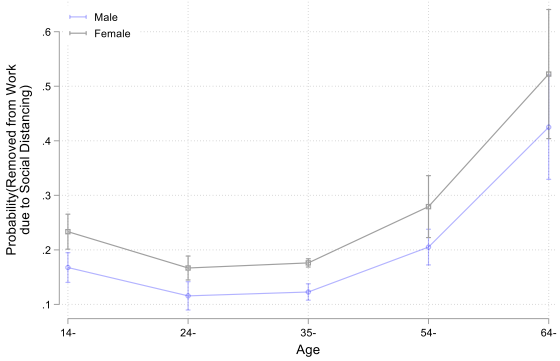
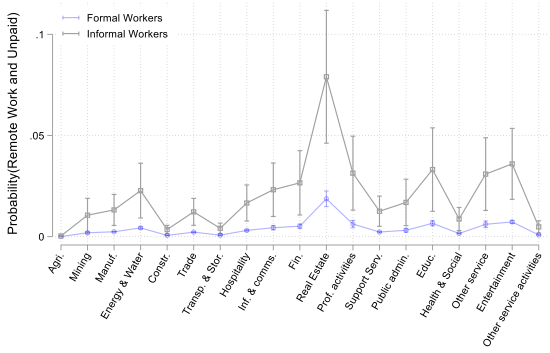


Figure A7: Probability of Doing Unpaid Remote Work by Sector



Source: Authors' analysis of PNAD COVID. Results from a logit model analysis.

Figure A8: Change in Actual Employment in the Formal Sector

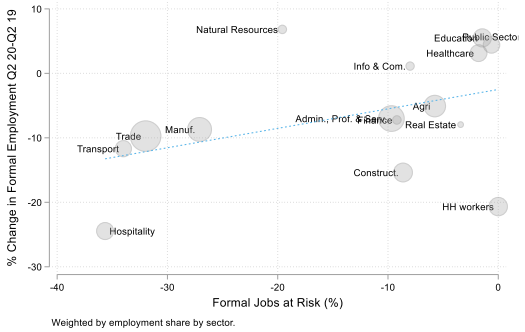
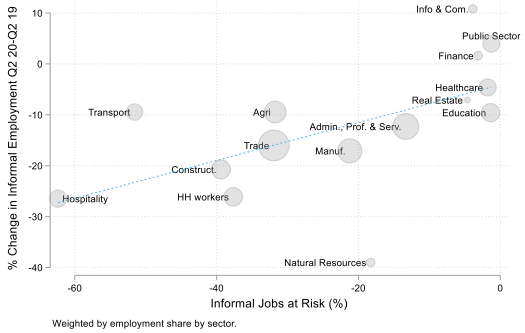


Figure A9: Change in Actual Employment in the Informal Sector



Source: Authors' analysis of PNAD Continua using the Alfaro et al. (2020) Accounting framework.

Table A1. Brazil: Calibration Parameters for the Accounting Exercise

Lock_j reflects the impact of different stages of lockdowns in each sector. The following values are assumed:

sector_code	sector_name	Lock_s	Lock_s_selective
A	Agriculture	0	0
B, D, E	Mining, electricity and water	1	1
C	Manufacturing	0.681	0
F	Construction	1	0
G	Wholesale and Retail	0.561	0.280
H	Transportation and Storage	0.647	0.647
I	Accommodation and Food Services	1	1
J	Information and Communication	0	0
K	Finance and Insurance	0	0
L	Real Estate	0	0
M, N, R, S	Professional services, administrative services, arts and entertainment, etc.	0.114	0.114
O	Public administration	0	0
P	Education	0	0
Q	Human Health and Social Services	0	0
T	Household as employer etc.	1	0.7

S_{it} takes the following values:

	Shutdown period	Partial opening period		Advanced opening period	
		Sectoral Opening<50 percent	Sectoral Opening>50 percent	Sectoral Opening<50 percent	Sectoral Opening>50 percent
Small, self-employed, informal	0.31	0.58	0	0	0
Medium	0.24	0.45	0.225	0.225	0
Large	0.13	0.29	0	0	0

Direct loss (direct demand shock): Adopting consumption shock to Sweden to our sectoral classification

A	Agriculture	0.055
B, D, E	Mining, electricity and water	0
C	Manufacturing	0.111
F	Construction	0
G	Wholesale and Retail	0.188
H	Transportation and Storage	0.526
I	Accommodation and Food Services	0.540
J	Information and Communication	0
K	Finance and Insurance	0
L	Real Estate	0
M, N, R, S	Professional services, administrative services, arts and entertainment, etc.	0.081

O	Public administration	0
P	Education	0
Q	Human Health and Social Services	0
T	Household as employer etc.	0

AD=1.692, following Alfaro et al. (2020).

Data Sources:
Input-Output table: sourced from WIOD for Brazil.
Shares of high teleworkability and high contact intensity in each occupation: sourced from Dingel and Nieman (2020) and Leibovici et al. (2020), computed on the US occupations with the SOC 2010 classification using the 2017 American Community Survey. The variables are then applied to the national labor surveys through a set of crosswalks from the SOC 2010 to various editions of the ISCO.

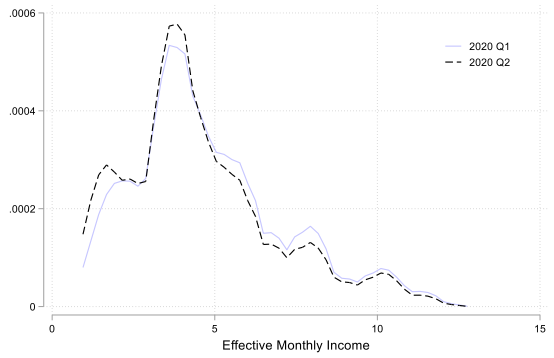
D. Change in Earnings and Actual Hours Worked

Table A2. Brazil: Change in Hours and Income Statistics for May

	(1) All Employed	(2) Employed (excluding zero wage earners and zero hours worked)
Monthly Income Change (%)	-17.9	-10.8
Change in Hours (%)	-30.3	-11.2
Hourly Income Change (%)	17.9	0.4
Change in Hours-Formal Employees (%)	-25.9	-7.9
Change in Income-Formal Employees (%)	-6.4	-4.3
Hourly Income Change-Formal Employees (%)	26.3	3.9
Change in Hours - Male (%)	-26.6	-10.4
Change in Hours - Female (%)	-35.9	-12.5
Change in Income - Male (%)	-17.9	-11.2
Hourly Income Change-Male (%)	11.8	-0.9
Change in Income - Female (%)	-17.7	-10.1
Hourly Income Change-Female (%)	28.3	2.7

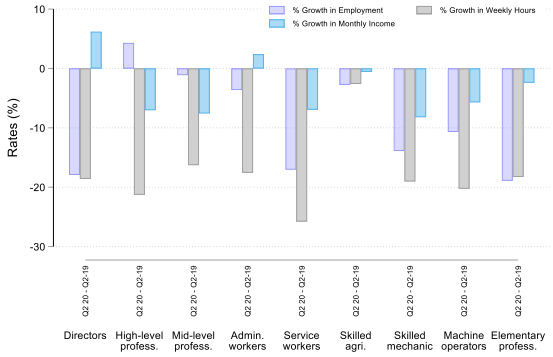
Note: The table presents the percent change in hours worked per month, wage per month and wage per hour for the month May (comparing pre-COVID and Post-COVID). The first column presents the percent changes among all employed people and the second column presents the results for employed people excluding those that report earning a zero wage and working zero hours.

Figure A10. Brazil: Kernel Density Function of Log (Effective Monthly Income)



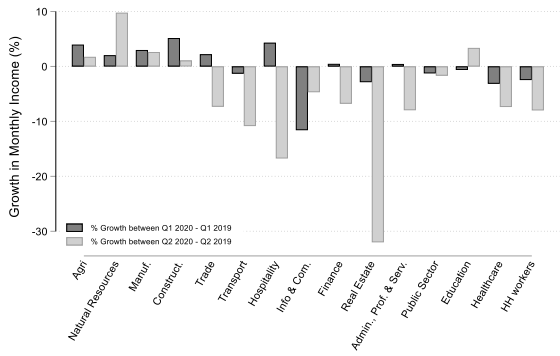
Source: PNAD Continua and authors' calculations

Figure A11. Brazil: Variation of Employment, Income and Hours by Occupation (2020Q2 vs 2019Q2)



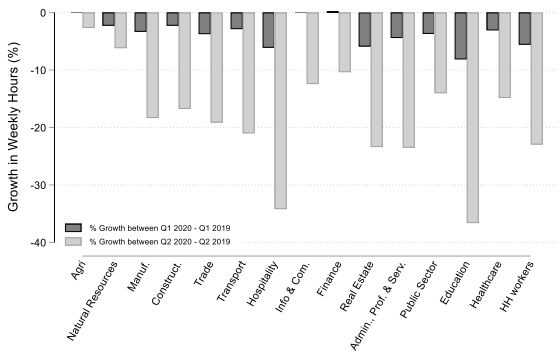
Source: PNAD Continua and authors' calculations

Figure A12: Variation in Monthly Income across Sectors



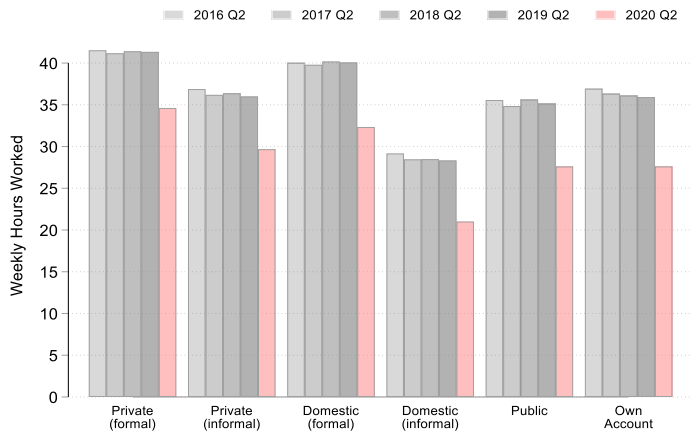
Source: PNAD Continua and authors' calculations

Figure A13: Variation in Weekly Hours across Sectors



Source: PNAD Continua and authors' calculations

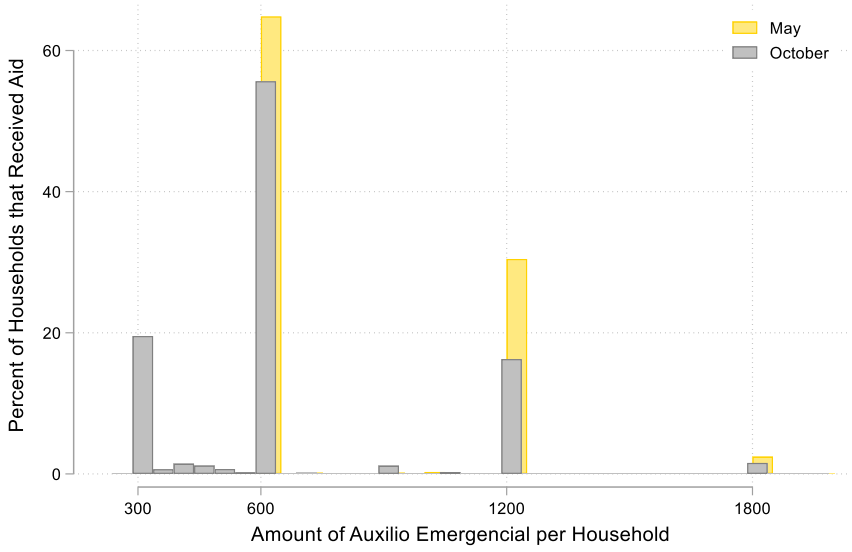
Figure A14. Brazil: Change in Weekly Hours across Formal and Informal Employees



Source: PNAD-Continua and authors' calculations

E. Auxilio Emergencial

Figure A16. Brazil: Percent of Beneficiary Households by Amount of Transfer



Source: PNAD COVID and authors' calculations

Table A1. Brazil: Aid Received by Top 2 Deciles Households
(based on pre-COVID and current post-COVID income)

	mean	median	min	max
Auxilio Emergencial	659	600	300	6000
Household Members	2.6	2	1	12
Pre-COVID Income	5475.6	4600	100	52200
Post-COVID Income	5162.6	4300	1250	42000
Post-COVID Income with EA	5821.6	5100	1580	42600

Source: PNAD COVID and authors' calculations

Table A2. Brazil: Households that received aid above R$900

	mean	median	min	max
Auxilio Emergencial	1913.2	1800	1209	5432
Household Members	4.8	4	1	17
Pre-COVID Income	2178.4	1500	30	30000
Post-COVID Income	1383.5	1000	0	30000
Post-COVID Income with EA	3296.7	2845	1212	32400

Source: PNAD COVID and authors' calculations