Impact of the COVID-19 pandemic on the hours lost by self-employed racial minorities: evidence from Brazil

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Abstract Drawing on minority enclave theory and resilience theory in entrepreneurship, we test whether, with the onset of the COVID-19 pandemic, the self-employed lost more hours than the employed and whether traditionally disadvantaged self-employed racial minorities faced harsher penalties in the form of reduced hours of work. Though spatially concentrated ethnic minority colocations could improve business outcomes in the non-crisis period, with the pandemic affecting all the members in the enclave, the very dependencies in minority enclaves could be a liability. Using a large-scale survey during the COVID-19 pandemic conducted by the Brazilian government, we draw on a one-to-one nearest neighbor matched pair sample of 19,626 employed (public or private sector) and self-employed individuals, and control for industry-sector-interview-location fixed effects. The results show that self-employed people, compared to employed, reported a greater loss of hours. At the sample level, black self-employed people on aggregate lost 9,051 hours per month, and mixed race self-employed people on aggregate lost 27,880 hours per month. The disproportionate loss of work hours by the self-employed from racial minority groups during the COVID-19 pandemic in a developing country context calls for a closer examination and assessment of the long-term impact of COVID-19 on racial minorities.

Plain English Summary Large-scale evidence from Brazil: racial minorities lost more hours per month than other groups during the COVID-19 pandemic. Racial minorities face systemic discrimination in setting up and developing their businesses, especially in developing countries. We test whether during the COVID-19 pandemic self-employed racial minorities in Brazil lost more hours of work relative to employed racial minorities. We create a matched sample of employed and self-employed individuals based on age, sex, education categories, COVID-19 self-reported symptom index, income deciles, house ownership categories, week of the interview, state of the interview, and industry. We find that across racial minority groups, the hours lost by the self-employed were substantive during the pandemic, signaling that Brazilian policymakers should pay greater attention to the relief funds allocated to and policies geared towards self-employed racial minorities.

Keywords Self-employed · Race · Minority · COVID-19 · Brazil

JEL Classifications E26 · J15 · L26 · N16
1 Introduction

As of July 5, 2021, there were more than 183 million COVID-19 cases worldwide with close to 3.97 million deaths. Governments across the world have devised a variety of non-pharmaceutical interventions to stem the human and economic costs of the pandemic. The economic impact of COVID-19 has been especially far-reaching in developing countries. Significant contraction in the gross domestic product, rising unemployment, and volatile credit markets (Nicola et al., 2020) are more likely to worsen conditions in developing countries. Business closures, supply chain disruptions, emerging post-COVID-19 business models based on the “new normal,” and strong liquidity constraints in the banking system are some of the factors that may systematically impact current and future self-employment activities in developing countries. With the COVID-19 pandemic presenting greater challenges to the institutional, economic, and social fabric, among the most precarious groups of self-employed people are own-account workers belonging to racial minority groups in developing countries (Davis, 2015; Rodela et al., 2020). Self-employed racial minorities in Brazil face a double whammy—being in a developing country and facing systemic discrimination (Telles, 1994, 2004; Telles & Lim, 1998) with self-employment among the working poor spatially concentrated in poor neighborhoods and, in extreme cases, in favelas (or slums). The self-employed from racial minority groups in developing countries are not only facing increased challenges (Kesar et al., 2020; Saltiel, 2020; Webb et al., 2020), but their presence in spatially concentrated milieus of similar others could be a double-edged sword.

Drawing on minority enclave theory (Light et al., 1994; Wilson & Portes, 1980) and resilience theory (Bhamra et al., 2011; Branicki et al., 2018; Gunasekaran et al., 2011), on the one hand, the cross-cutting of different races in spatially concentrated enclaves results in shared resources, markets, information, and cultural ethos, which strengthens the ability of businesses owned by the working poor to endure. On the other hand, with the pandemic influencing all participants in such enclaves, the very communal fabric that strengthens the interconnectedness of businesses could weaken, resulting in lower resilience with the onset of the pandemic. Self-employed people in developing countries who face lower and more volatile income than employed people are especially vulnerable during the pandemic in minority enclave settings (cf. Åstebro & Chen, 2014). Therefore, the very strength of minority enclaves could be a liability during the pandemic.

The proposed theoretical framework allows us to hypothesize and test how stronger dependence among enclave members could prove to be a liability when facing a significant crisis affecting the entire enclave. Based on this backdrop, our research questions are as follows: Do the self-employed experience a greater decline in work hours relative to those employed in a developing country context during the COVID-19 pandemic? and Relative to white self-employed, do self-employed racial minorities experience worse business-related outcomes in the form of reduced hours?

To address this question, relying on large-scale survey evidence from the early months of COVID-19’s dissemination, we investigate the impact of the COVID-19 pandemic on self-employment in Brazil. Latin America was at the epicenter with Brazil surpassing the one million patient mark in late June 2020. Brazil offers a meaningful context to assess the impact of COVID-19 given that its ranks of the self-employed are characterized by a particular ethnic-racial makeup. We lack a pre-post design, and therefore, interrupted time-series estimates are not feasible with the data. Similarly, because of the ongoing impact of COVID-19, a more rigorous difference-in-differences analysis is also not feasible due to the lack of a control group. Despite the limitations of the cross-sectional data, we attempt to improve estimates by using matched-pair sampling based on a variety of matching variables and also controlling for industry sector×week of the interview×state fixed effects. Furthermore, to the best of our knowledge, the data are the only large-scale survey data available in a developing-country context. The Brazilian government has made this data accessible to improve understanding of the economic impact of the COVID-19 pandemic on individuals from various socioeconomic strata. We hope that, within the limitations of the cross-sectional data, our estimates provide early evidence that will stimulate future research.
Two caveats are in order. First, we focus on the self-employed and not on entrepreneurs. The studied context focuses on the working poor in Brazil during the pandemic, among whom high-growth entrepreneurship is less of a focus. Based on Levine and Rubinstein (2018), entrepreneurs have distinct human capital (e.g., creativity, risk-taking, education, and general ability), whereas the self-employed may score lower on these skills. From a regional policy perspective, racial minorities may be driven by necessity-based entrepreneurship whereas entrepreneurs are driven by opportunity-based entrepreneurship (Reuschke, 2015). Other research indicates that racial minorities are more likely to be self-employed than to engage in entrepreneurship (Bates et al., 2007; Clark & Drinkwater, 1998; Fairlie, 2005). Self-employed individuals may be non-employers or employers in small businesses; however, entrepreneurs are focused on growth opportunities. In the current context of the working poor in Brazil, our focus is on the self-employed and not on entrepreneurs. Second, our study is a theoretical framework that straddles minority enclave theory and resilience theory against the phenomenological aspects of race during the COVID-19 pandemic in Brazil. Based on institutional and cultural history, the manifestation, practices, symbols, and social narratives of race vary significantly by country. Applying theoretical frameworks based on higher-income countries may be less applicable to Brazil where distinct racial history and experiences may require distinct theoretical lenses developed through additional studies over time. Indeed, we know little about race and entrepreneurship in low-income countries.

We aim to make three contributions. First, the proposed framework facilitates a critical test of minority enclave theory and resilience theory in entrepreneurship. The public health crisis offers a unique opportunity to indirectly test whether enclave capital is a liability during the pandemic. Prior studies on resilience in self-employment contexts rarely focus on the effect of the crisis on a strongly interconnected collective such as minority enclaves. Drawing on the logic of antifragility (Taleb, 2012), the strong socioeconomic connectivity that helped an enclave sustain itself in pre-crisis periods could become the source of fragility with the onset of a pandemic (cf. Portes, 2014). Although resilience theory predicts that stronger bonds and embedded capital would lessen decline in the outcomes for the self-employed, we find that the decline in the hours worked is much worse for non-whites in the minority enclave-type locales. Although we cannot observe the counterfactual—what would happen if enclave capital were not present—we find that, with the onset of the pandemic, the decline was more severe for self-employed racial minorities.

Second, we make an important contribution to the intersectionality of race and developing country, a context seldom explored in the self-employment literature. Our study not only builds on prior studies on race and self-employment focused on a developed country context but more importantly, race—in the context of Brazil and other developing countries—remains an understudied topic. Extensive work by Telles (2017) on race and ethnicity in Brazil has documented conditions of lower income, poorer health, and lesser education among those who identify as non-white (Monk Jr., 2016; Dixon & Telles, 2017). Among the demographic dimensions of ethnicity, migrant status within the country, religion, gender, rural–urban origin, and mother tongue, race is one of the most studied bases of discrimination (Buchmann & Hannum, 2001; Kompass et al., 2017). Although not directly related to race, Jayachandran (2015) argues that discrimination against women may be stronger in developing countries. Self-employed people from marginalized racial groups in developing countries have faced even more severe challenges (Fouad, 2020; Nseobot et al., 2020). There is well-documented evidence showing that racial minorities have faced greater adversity from the COVID-19 pandemic than whites in the USA (Kantamneni, 2020; Tai et al., 2020) or in developed countries (Buheji et al., 2020; Yaya et al., 2020). Adding to this less explored area of self-employment research, we aim to provide a meaningful extension to this stream of research in the context of the COVID-19 pandemic.

Third, from a replication perspective (Freese & Peterson, 2017), we complement research on self-employment and race in the context of developed countries, by focusing on developing countries. This further adds to our understanding of whether challenges faced by racial minorities during the COVID-19 pandemic in the USA adds to the replicability of bias against racial minorities. A significant majority of data from the COVID-19 Supertracker from Oxford University
(https://supertracker.spi.ox.ac.uk/) are from developed countries where resources and infrastructure are readily available. Due to a much stronger research data collection infrastructure (Stubbs et al., 2021), much of the critical mass of COVID-19 research focuses on developed countries. Both behavioral and demographic data and studies on COVID-19 in developing countries are limited (Chookajorn, 2020; Loayza, 2020). Our goal is to complement prior research on the self-employed from racial minority groups and ongoing research on the impact of the Coronavirus outbreak on the self-employed in the context of a developing country facing the COVID-19 pandemic.

In the next section, we provide a theoretical background and develop hypotheses. In Section 3, we discuss the racial and self-employment context in Brazil, provide a description of the data, discuss operationalization of the variables, and present our results, along with additional robustness checks. Finally, in Section 4, we discuss the conclusions of our study.

2 Theoretical background

Prior studies in self-employment on racial minorities have focused on ethnic entrepreneurship, disadvantages faced by racial minorities, and immigrant entrepreneurship in developed country contexts (Aldrich & Waldinger, 1990; Dabić et al., 2020; Zhou, 2004). The view underpinning these studies is that those who are considered minorities based on race are at a distinct advantage in choosing and continuing in self-employment (Bates et al., 2018). The challenges for racial minorities stem from less developed human capital, limited availability of and access to financial capital, and restricted access to business opportunities. Focused on establishing businesses on a smaller scale and principally for sustenance (e.g., to earn a living) such self-employed in developing countries rely on their local networks and personal or ethnic background to launch a business. The smaller economic footprint of their businesses makes them especially vulnerable during a pandemic.

We expect the debilitating effects of a pandemic in developing countries to be exacerbated for the self-employed. Although governments around the world are providing subsidized loans, access to such funds may not be widely available in developing countries with less effective disbursement infrastructure. Prior research shows that self-employed racial minorities, with comparable characteristics, are less likely to receive loans than their white counterparts, with black applicants 25% more likely to be rejected than whites for business loan applications (Blanchflower et al., 2003; Cavalluzzo & Cavalluzzo, 1998). The lower participation in and vulnerability of self-employment could worsen during a pandemic as the social, economic, and political fabric of exchanges weaken, attenuating the scale, participation, and engagement of self-employed racial minorities. As aptly mentioned by Bates and colleagues, “self-employment and business ownership patterns only make sense when viewed in the context of prevailing constraints and opportunities (Waldinger et al., 2006)” (Bates et al., 2018, p. 416) where self-employed racial minorities in developing countries may be especially vulnerable during the pandemic. Business closures, declining disposable income, lower access to finances, and limited economic scalability of their businesses are some reasons why self-employed racial minorities may face even more severe financial constraints during a pandemic.

We use minority enclave theory (Light et al., 1994; Wilson & Portes, 1980) and resilience theory from the entrepreneurship literature (Bhamra et al., 2011; Branicki et al., 2018; Gunasekaran et al., 2011) to provide a theoretical basis to understand the impact of the COVID-19 pandemic on the self-employed who are racial minorities in a developing country context. Although the impact of the pandemic on small businesses is far-reaching in general, its intensity may be significantly higher for racial minority groups in developing countries. Engaging in entrepreneurial activities is a highly uncertain endeavor and requires the ability to administer risks (Knight, 1921). This is a weightier challenge in developing countries where trusted institutions are present only weakly, where the challenges in setting up economic activities are intense, and where reliance on spatially concentrated enclaves connecting individuals based on socioeconomic and racial basis is salient (Sydow, Cannatelli, Giudici & Molteni, 2020). Our core premise is that being members of a minority enclave could be an asset during pre-crisis; however, with the pandemic affecting all members of the locally concentrated enclave members, it could be a liability and thereby limit resilience in form of a decline in work hours. We first discuss each of the theories and then develop formal hypotheses.
2.1 Minority enclave theory

One of our theoretical frameworks is the minority enclave theory proposed by Wilson and Portes (1980), which highlights the value of networks and solidarity within enclaves organized in communities. Under minority enclave theory, the self-employed continue to rely on local information channels and relationships within more internally focused and marginalized communities. Given the available ties and the reinforcing identities, prime dispositions, and mindsets, greater reliance on the enclave’s economic, human, and social capital is the likely consequence (Portes, 1998). Economic capital refers to ongoing and embedded financial transactions; human capital refers to knowledge, preferences, enclave culture, and value systems; and social capital refers to the collective reciprocity, trust, and cooperation that influences both economic and human capital exchanges to improve performance.

The complex interdependence among the three modes of capital may produce or reproduce inequality (Bourdieu, 1986), which may significantly influence ongoing socioeconomic relationships. Based on Drori et al. (2009), similar to transnational entrepreneurship, ethnic minorities may rely on the network of racial origin and networks of practice. Those with a shared racial background may rely more so on one another, and they may also share a network of practice by pursuing common business interests. The shared networks of racial origins and practice may improve the robustness of economic opportunities and the establishment of friendly business ties that facilitate the exchange of information, connections with suppliers, and the sharing of business practices (Drori et al., 2009). The solidarity and shared cultural and ethnic values strengthen cooperation by improving bounded trust (Portes & Sensenbrenner, 1993).

Beyond an economic system, the minority enclave is a socioeconomic system with cross-cutting resources and support systems (Valenzuela-Garcia et al., 2017). The shared co-ethnicity through which social structures are co-developed in a concentrated location (Light & Stavros, 1994), results in a variety of cross-cutting and interdependent relationships that sustain small, niche-based businesses in spatially concentrated locations shared by individuals of economic and/or ethnic minorities. Based on minority enclave theory, the intersectionality of different races forming enclaves and connectivity in spatial concentrations may result in an economic base that leads to economic adaptations built on the available labor force (Wilson & Portes, 1980), informational and financial capital (Bonacich & Modell, 1980; Light, 1979), and human capital (Portes & Zhou, 1992), which may not be ideal from an economic perspective but is certainly beneficial in leveraging trust and ethnic solidarity. In consequence, the ability to mobilize relationships and resources through both strong and weak ties in the enclaves is made possible.

The dual-edged nature of benefits or costs of spatially concentrated minority enclaves is motivated by Werbner (2001) who disputed that ethnic economy is not a “territorially circumscribed place and affirms that ethnic businesses are embedded in inter-firm relations that produce social space by trading particular goods and commodities in nodal points, which are vertically and horizontally organized” (p. 1) and “unlike the idea of ‘enclave’ as encapsulated and with a fixed structure, they focus on devices characterized by flexibility and a constant internal reorientation” (Valenzuela-Garcia et al., 2017, p. 4). The need for self-enclosed and densely connected socioeconomic relationships organized in low-income neighborhoods may limit human capital and reduce economic opportunities in mainstream employment, lower access to capital markets, and restrict the loci of customer preferences that can be met with limited human capital. Ethnic resources may be limited in providing the opportunities necessary to prosper in large-scale businesses and may requires focusing on niche opportunities in lower-income and less stable market niches (Waldinger et al., 1990). This then leads on to the pursuit of necessity-based self-employment for many (Portes, 1995; Portes & Manning, 1986).

The above discussion demonstrates that enclaves may be useful in the non-crisis period because participants at varying intersectionalities can rely on resources and capital stocks to improve their business outcomes. However, a parallel stream of work by Werbner (2001) argues that such ties could be a liability. The pandemic provides an opportunity to test whether the self-employed in concentrated locales are more likely to experience a higher or a lower decline in outcomes. To theoretically situate the level of decline, we turn to resilience theory in the entrepreneurship literature.
2.2 Minority enclave theory and resilience

Resilience is studied in a variety of fields with its earlier origins in the field of ecology (Standish et al., 2014). Resilience refers to the ability of a system to return to a stable state after disruption, and in other fields, it is the extent to which a system can absorb shock and survive (Gunderson & Folke, 2005). Our focus is on the latter definition since we are attempting to test the degree to which there was a lower decline in hours among the self-employed (relative to the employed) and among the self-employed of different racial backgrounds. In the broader management literature, resilience refers to the ability of businesses to respond to shocks and to undergo transformation by absorbing uncertainty and threats (Lengnick-Hall et al., 2011). Among the early efforts devoted to the study of resilience, Staw et al. (1981) focused on the organizational response to threats to lower further decline, manage future vulnerabilities, and improve competitive adaptation so as to emerge more strongly from the crisis. Much of the resilience literature on entrepreneurship has focused on individual traits among entrepreneurs or the improved capacity of governance modes (e.g., family firms) to improve organizational responses to the crisis (Korber & McNaughton, 2018).

In the context of COVID-19 and minority enclave theory, resilience calls for the adaptation of structure, strategies, and operations in the face of crisis. Although our framework draws on minority enclave theory during the early stages of the COVID-19 pandemic, we do not focus on the “re-bound” component of resilience, but rather on the immediate impact of the crisis and the extent of “decline”. Therefore, the extent of the decline in hours with the onset of the pandemic is related to the response to changing conditions. A lower decline in hours of work would indicate greater resilience. Minority enclave theory may help assess whether the social, economic, and cultural fabric shared in spatially concentrated spaces serves to mitigate or exacerbate the decline in hours worked.

Although the normative notions of minority enclave theory would indicate that hours might decline to a lesser extent with the onset of COVID-19, researchers on ethnic entrepreneurship caution against the “replication of inequality” that may make these communities more fragile (Portes, 2014; Portes & Zhou, 1996; Sanders & Nee, 1987). In other words, the added co-dependence and dense networks may not provide the necessary optionality required to mitigate decline (Taleb 2012). The resilience literature focuses on the response of individual firms; however, COVID-19 has engendered a crisis that influences all firms, resulting in a greater potential decline of co-dependent firms in a neighborhood. Thus, “resilience should be understood as a unitary entity rather than individual companies and businesses constituting the enclave” (Valenzuela-Garcia et al., 2017, p. 6). The connectivity among businesses in the enclave can make it difficult to adapt available resources largely embedded in the economic vulnerability of the neighborhoods. The mutual support and solidarity may be limited as all firms in the enclave struggle to cope with the pandemic. Popularly referred to as “bazaar economies” (Werbner, 2001), the larger concern is that the very co-dependence that makes these communities thrive, could prove to be a liability because the enclave specific resources that facilitate exchanges in the pre-pandemic milieu, may prove disadvantageous for the self-employed with the onset of a pandemic.

Based on the theoretical backdrop of minority enclave theory and resilience, we discuss self-employment, the pandemic, and integrate the content of sections 2.1 and 2.2 to arrive at our hypotheses.

2.3 Hypotheses development

Developing countries are among the worst hit countries and, in response to the pandemic, federal, state, and local governments have enforced a variety of non-pharmaceutical interventions and enacted various policies to lower the impact of the pandemic on social, economic, and educational spheres. However, the efficacy of government responses to the pandemic has been mixed with various media outlets criticizing the reaction of governments in developing countries. The economic impact of COVID-19 on developing countries has been devastating. For example, in Brazil, the economy declined by 9.7% of its GDP in the second quarter of 2020. At the start of 2020, the unemployment rate was approximately 13%, and about 40% of the economy was in the informal sector (Prates & Barbosa, 2020). Based on Prates
and Barbosa (2020), the data from the Ministry of Economy showed an increase of 4.9 million unemployed individuals, with 8.1 million hours of work lost by May 26, 2020.

Continuing on from the discussion in Sections 2.1 and 2.2, we expect the impact of COVID-19 to be more severe on the self-employed than the employed. According to estimates by International Labor Organization (ILO), working hours declined by 14% for the labor force, with an expected loss of income of 56% in low-to lower-middle-income countries. We anticipate that the brunt of the pandemic would be more severe for the self-employed in developing countries. With much of the population engaged in self-employment for reasons of sustenance and because they have limited options in the traditional labor markets, we expect that the self-employed, who tend to be exposed to high-income volatility and greater uncertainty, will sustain much worse outcomes than those who are employed.

Related to resilience, organizations that are more likely to have employees can absorb shocks better than the self-employed who own microbusinesses or work on their own account (Burchell & Coutts, 2019; Fields, 2019; Gindling & Newhouse, 2012). A significant body of research has highlighted the divide between developing and developed countries, where most self-employed in developing countries do not have the luxury of working from home (Bapuji et al., 2020a, b; Kniffin et al., 2021). With business closures, social distancing, and other factors that limit mobility, the self-employed in developing countries may not be as resilient due to their already limited resources, income volatility, and the general decline in economic activity. Though employees have also lost hours, we expect that, in relative terms, the self-employed would experience a greater loss of hours (i.e., lower resilience) due to the general economic uncertainty, lower stability of their enterprises, and the decline in economic activity faced to a greater extent by sustenance-based businesses. Therefore, based on the premise that the self-employed in lower-income countries have less shock-absorbing resources, we would expect them to experience a greater decline in hours worked. We hypothesize that:

Hypothesis 1: In a developing country, the self-employed experience a greater decline in work hours relative to those employed, with the onset of the COVID-19 pandemic.

2.4 Self-employed racial minorities, minority enclave theory, and resilience

Taking the above discussion as a backdrop, it may therefore be entirely plausible to argue that, during the COVID-19 pandemic, self-employed racial minorities will have experienced more negative outcomes than white self-employed people. Related research evidence in the US context might lend theoretical support to the possibility that the COVID-19 pandemic may have a disproportionate effect on self-employed racial minorities in Brazil. Our focus is on racial minority identification rooted in the effects of racial stratification, leading to less prestigious work positions, greater unemployment, and lower wages (Devaraj & Patel, 2017; Goldsmith et al., 2007; Hersch, 2011; Klonoff et al., 2000; Norwood, 2014). Hunter (2007) states that “African Americans of all skin tones are subject to certain kinds of discrimination, denigration, and second-class citizenship, simply because they are African American, the intensity of that discrimination, the frequency, and the outcomes of that discrimination will differ dramatically by skin tone” (p. 238).

Tighter macroeconomic policies and economic contraction may exacerbate the conditions in minority enclaves. Self-employed racial minorities who already have lower education experience social disadvantages that lead to limited human capital, face less economically inclusive job experiences, and obtain only constrained access to social capital (Foley, 2010; Honig, 1998; Li, 2004; Siqueira, 2007). We expect that the generally lower entrepreneurial capital for self-employed racial minorities may be a particular liability during a COVID-19 pandemic because it may pose substantially increased challenges for the self-employed to receive financing, leverage social capital to improve business outcomes, and overcome the general disadvantage faced by their businesses in less economically inclusive industry sectors (Coleman, 2005; Fairlie & Robb, 2010; Harper-Anderson, 2019). The pandemic weakens
the socioeconomic fabric of enclaves, further lowering shock absorption ability (in the form of reduced work hours\(^1\)) of self-employed racial minorities.

We focus on business hours reduction for the following reasons. First, though the measure of hours lost has its limitations, it is less subject to reporting bias. Alternatively, another measure could be that the self-employed might focus more on their lucrative clients. Due to our sample’s focus on the working poor, we do not expect significant heterogeneity in a variety of client types by profit margin; nor are all self-employed likely to have access to segments of lucrative clients. The importance of hours lost is also highlighted by Prates and Barbosa (2020)—the Brazilian Ministry of Economy found that 8.1 million hours of work had been lost by May 26, 2020. Due to variations in government policies and a local propensity to abide by non-pharmaceutical interventions to lower the spread of COVID-19, the reduction in hours is an important indicator of the opportunities available to keep businesses open. The hours of business operation, after matching the self-employed by region, industry and period, may be based on their ability to maintain capital flows that may be restricted because of lower capital infusion during the pandemic.

Second, alternative outcome measures such as sales may be biased due to lower disposable spending during the pandemic, and profitability may also be biased due to significant cost spikes during COVID-19. Third, firm survival may also be a noisy outcome as macroeconomic interventions ranging from loan forgiveness to delayed loan payments to subsidies for not laying off employees may keep most businesses afloat. The decline in the number of business hours may reflect the general period over each week when business is operating during the COVID-19 pandemic. Due to the costs associated with keeping the business open, reducing the hours of business is the immediate short-term reaction that the self-employed can take to enhance the prospect of survival. Alternatively, the self-employed without employees or those working on their accounts may face reduced hours from the demand side. Facing distinct human capital and financial disadvantages, self-employed racial minorities may experience flagging demand for their services and, thus, face a reduction in hours.

Based on the minority enclave literature and resilience framework in entrepreneurship and the above discussion, we propose our second hypothesis:

Hypothesis 2: In a developing country, relative to white self-employed, self-employed racial minorities experience worse business-related outcomes in the form of reduced hours with the onset of the COVID-19 pandemic.

3 Data and method

3.1 The context—Brazil

Self-employment activity in Brazil is significant. Based on the Global Entrepreneurship Monitor (GEM) survey, about 40% or 52 million Brazilians were engaged in some type of entrepreneurial activity. According to World Bank data, between 2006 and 2018, Brazil experienced a year-on-year average growth rate of 8.4% in new business density or the number of firms registered per 1000 individuals. According to the OECD 2020 report, small and medium-sized enterprises accounted for 62% of the employment and 50% of the value-added. However, labor productivity diverged. Smaller firms had lower labor productivity than larger firms, with limited growth-oriented entrepreneurship. There are two modes of organization that affect the taxes of the self-employed in Brazil. The Simple Nacional mode of organization refers to a majority of small and medium enterprises, and Micro Empreendedor Individual (MEI) refers to an organization of a firm by own-account workers. The government also provides a wide range of incentives. Between 2016 and 2018, a significant portion of business loans from BNDES (Brazil’s largest public development bank) was

\(^1\) Our focus is on the effect of the COVID-19 pandemic during its early stages. Its impact on income and other outcomes can only be studied in the longterm. However, a variety of non-pharmaceutical interventions introduced by governments across the world had an immediate impact on business closures or reduction in hours worked, though estimates of decline in income would be ideal. However, especially in developing countries, income is likely to be underreported or not reported at all. A variety of studies have highlighted inaccuracies of income reporting in surveys (Hurst et al., 2014). Though business sales and earnings would also be more ideal measures, these measures would not be more accurately captured in the shortterm during a global pandemic.
granted to SMEs. Compared to developed countries where loan guarantees are more common, in Brazil, such loans are not available. There are two major innovation programs—Brasil Mais Produtivo and FINEP Conecta. Overall, Brazil has significant self-employment activity.

3.2 Brazilian context and race/ethnicity

Our study context of Brazil provides unique advantages in testing for the effects of race on self-employment. Miscegenation in Brazil over the last several centuries has resulted in distinct racial groups—blacks, mixed race, indigenous, yellow (a term from the Brazilian census bureau referring to those of Asian descent), and white (Harris et al., 1993). With a majority of Brazilians identifying as mixed, discrimination among blacks, mixed, indigenous, and those of Asian ancestry may be salient (Dixon & Telles, 2017).

Stratification economics studies demonstrate poorer economic outcomes for darker skin tone blacks (Diette et al., 2015; Piza & Rosenberg, 1999). Therefore, specific to the Brazilian context, our theoretical lens is focused on racial minorities where the “allocation of privilege and disadvantage according to the lightness or darkness of one’s skin, with favoritism typically granted to those with lighter skin” (Diette et al., 2015, p. 156) may play a role. Next, we discuss the self-employment context in Brazil.

Telles (2004, 2015), and Telles and Paschel (2014) in their extensive body of work have documented race-based discrimination in Brazil. The context of race in Latin America is distinct from that in the USA. Latin America is the most ethnoracially heterogeneous continent with 600 million residents of whom 40 million identify themselves as indigenous, and about 120 million identify as black or other categories of African descent, including negro, mulato, and pardo (Perreira & Telles, 2014; Telles & Bailey, 2013). Ethnic self-identification is fluid and can vary depending on social context and social status (Schwartzman, 2007). Race and ethnicity are distinct in Latin America. Race refers to phenotypical differences in physical features. Ethnicity refers to cultural and linguistic distinctions among those of African descent, indigenous, and mixed-race people (Perreira & Telles, 2014). Since the 1930s, the mestiçagem, or race-mixing to promote national solidarity, drove identities such as mestiço (mixed-white) and mulato (mixed-black) (Bost, 2010; Perreira & Telles, 2014). Increasing miscegenation has also driven identification of indigenous and black identities, and identification with ethnicity remains fluid. A parallel stream is related to incongruence in reported ethnicity and the perceived ethnicity. A series of studies have found that the interviewer ascribed ethnicity in census reports differed from the reported ethnicity by the respondent (Telles & Lim, 1998), with Brazilians self-identifying as white in greater numbers than those reported by the interviewer.

Telles and Lim (1998) in a 1995 national survey in Brazil found that whites earned more than brown (based on interviewer classification), although the distinction between black and brown in terms of income is not significant. Telles (2007) discusses census and survey-based evidence showings that racial inequality is high and that discrimination based on race is common in labor markets, with black and mixed-race individuals earning half the income of whites. The middle class and the elite are almost entirely white. As stated in Telles (2007), “racial inequality is due partly to ongoing discrimination [and] brown, and especially black Brazilians, earn about 20 to 25% less than whites with the same background, when age, work experience, educational level, sex, region, class origin, and labor market characteristics are considered.”

Related to the impact of the COVID-19 pandemic, there is a preponderance of evidence that those of darker skin tone may experience poorer health and higher labor market risk due to lower access to healthcare. Perreira and Telles (2014) in a sample of Latin American countries, including Brazil, found that those from darker-skin racial minorities reported poorer health due to class discrimination and lower socioeconomic status. Indigenous people of darker
skin tone also have poorer health (Piza & Rosenberg, 1999).

3.3 Data description

To assess the impact of the COVID-19 pandemic on the employed and self-employed by race, we draw on the National Household Survey, conducted by the Brazilian Institute of Geography and Statistics (IBGE) over four weeks in May 2020. The primary aim of the survey was to assess the impact of the COVID-19 pandemic on the Brazilian labor force. The survey was conducted by telephone involving 48,000 households per week for over four weeks, resulting in the primary sampling frame of 193,000 households in Brazil from 3364 municipalities. The data represents a comprehensive assessment of Brazilian households in May 2020 during the COVID-19 pandemic.

The sampling was based on a two-stage stratified sample, with the first stage of sampling drawn from a random sample of primary sampling units (PSUs) selected with probability proportional to the number of households within each defined stratum. In the second stage, 14 private households were selected from each PSU selected in the first stage. The survey was divided into three parts. The first part focused on labor issues, the second part on health issues, specifically on symptoms associated with COVID-19—and finally, the third part concerned aspects of occupation and activity. The survey also asked respondents to report their experiences of COVID-19 symptoms.

The final sample includes 349,306 respondents. We dropped individuals who did not report race (132) and those below the age of 18 (87,926). The retirement age for males in Brazil is 65 and for females, 62. We dropped males above the age of 65 (16,655) and females above the age of 62 (26,448). We also dropped those who reported being in the labor force (114,416) or those in the labor force who reporting fewer than 20 h of work per week. Finally, we dropped those reporting their housing as “assigned otherwise” or “another condition” (1214). We also dropped those in the army, working in the family firm, out of the labor market, domestic care workers, and those who did not report their employment status but reported more than 20 hour’s work. We further matched the remaining individuals by self-employed vs. employed status (in the private or public sector) on a variety of demographics including income, state, industry, and the week of May 2020 based on one-to-one matching without replacement. Our final sample includes 39,582 matched pairs of self-employed and employed.

3.4 Variables

3.4.1 Decline in hours worked

The outcome variable is the reported decline in hours normally worked minus the hours worked recently. A larger resulting number indicates a higher loss in hours worked. To remove outliers from reporting, we winsorized the decline-in-hours-worked variable at 2.5% of each tail. It can be construed that there may be reporting issues. At face value, it does not seem that individuals would under- or over-report hours lost. However, it must be noted that we use the difference in normal weekly hours (“Quantas horas, por semana, normalmente trabalhava?” or loosely translated as “How many hours a week do you normally work?”) and hours worked last week (“Quantas horas, na semana passada, de fato trabalhou?” or loosely translated as “How many hours did you actually worked last week?”). Although the actual hours reported for the latter may shift (e.g., gig workers may have variable hours per week), this remains the limitation of the study. Controlling for industry-week-state fixed effects, we expect that the reported work hours in the previous week would systematically impact individuals to some degree and may not be highly idiosyncratic. We are also unable to uncover whether individuals switched from self-employment to employment or vice versa. Although a small portion of the sample may have switched, such moves represent a small portion of the sample in general.

3.4.2 Predictors

The variable is self-employed (= 1) if the respondent is an employer or own account, else = 0 if the respondent is a private sector employee or Public sector employee (including mixed-capital companies). The race variable includes white (reference category), black, yellow, 4 mixed race, and indigenous.

4 We note that the classifications are of the Brazilian census bureau.
We dropped cases where the participant did not report race.

3.4.3 Controls

We control for age (in years), sex (1 = male; 2 = female), and education categories. We also control for an index of self-reported COVID-19 type symptoms. Specifically, we take the total of reported symptoms for the question “in the last 7 days” (1 = yes; 0 = no): fever; cough; sore throat; trouble breathing; headache; chest pain; nausea; blocked or runny nose; fatigue; eye pain; loss of smell or taste; and muscle pain. Next, we take the deciles of the reported income and the value of remuneration in the form of goods or products, if applicable. To control for asset ownership, we include the available variable on residence ownership.

A critical set of controls in the COVID-19 context must control for the unique region-period-industry effects. Regional responses to COVID-19 vary substantially within a country, the experiences of COVID-19 vary over time, and workers in different industries face COVID-19 exposure to a varying extent. Therefore, we control for industry sector × week of the interview in May × state effect, resulting in 1,820 unique dummies.

3.5 Model specification

Due to a variety of individual, social, regional, and family-related factors, identification linked to choice in self-employment is challenging. Given the idiosyncratic drivers, using a unique instrument(s) or a treatment during the COVID-19 crisis is also challenging.

We estimate the effect of race on reduced work hours from COVID-19 by computing the average treatment effect on the treated (ATT), $E(Y_1 - Y_0|D = 1)$, where $D = 1$ refers to the self-employed, and $Y_0$ and $Y_1$ are the outcomes, loss in hours worked, for employed and self-employed, respectively. The ATT equation can be further rewritten as:

\[
ATT = E(Y_1|D = 1) - E(Y_0|D = 1)
\]

where $E(Y_0|D = 1)$ is the mean outcome of the self-employed, had they been employed, or the unobservable counterfactual average of the self-employed. However, for the employed, $E(Y_0|D = 0)$, the value can be written as:

\[
\Delta = E(Y_1|D = 1) - E(Y_0|D = 0) = ATT + E(Y_0|D = 1) - E(Y_0|D = 0)
\]

where $E(Y_0|D = 1) - E(Y_0|D = 0)$ represents the “selection bias.” ATT is only identifiable if the selection bias equals zero. In empirical contexts where individuals are randomly assigned to the self-employed and employed groups, the selection bias will be zero; however, the occupational choice is non-random. The non-randomness matching approach lowers selection bias (Caliendo & Kopeining, 2008) with the identifying assumption that unconfoundedness or conditional independence relies on a set of observable covariates, $X$, potential outcomes are independent of treatment.

\[
Y_0, Y_1 \perp D|X
\]

Rosenbaum and Rubin (1983) proposed using the probability of being treated given observed characteristics based on vector variables to compute the propensity score. Propensity score matching (PSM) in the current study refers to the calculated probability of being self-employed given the matching variables. PSM also relies on the conditional independence assumption, or the common support or overlap condition requires that individuals with the same

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5 A small number of employees received salary in the form of goods.

6 We do not create matched pairs within self-employment category by race for two reasons. First, we are unaware of a method that allows matching on a categorical outcome, here white, black, yellow, mixed race, and indigenous. Second, a matching specification based on white vs. non-white will be too coarse as race-based experiences among non-whites, that is by black, yellow, mixed race, and indigenous, may vary significantly; lumping all non-white participants in a single category would be too coarse grained and less representative of the lived experiences of these groups in Brazil.
Table 1  Sample descriptives ($N=39,582$)

| Variable                          | Description                                                                 | Mean   | SD    | Min | Max |
|-----------------------------------|-----------------------------------------------------------------------------|--------|-------|-----|-----|
| Decline in hours worked           | Change in hours: hours normally worked minus hours worked recently (winsorized at 2.5%) | 5.7313 | 10.5491 | -2  | 48  |
| Self-employed                     | Self-employed = 1 (if an employer or own account); else = 0 if private sector employee or public sector employee (including mixed-capital companies) | 0.5000 | 0.5000 | 0   | 1   |
| Black (ref. white)                | $1 = yes; 0 = no$                                                           | 0.0822 | 0.2746 | 0   | 1   |
| Yellow                            | $1 = yes; 0 = no$                                                           | 0.0085 | 0.0916 | 0   | 1   |
| Mixed race                        | $1 = yes; 0 = no$                                                           | 0.4186 | 0.4933 | 0   | 1   |
| Indigenous                        | $1 = yes; 0 = no$                                                           | 0.0029 | 0.0541 | 0   | 1   |
| Age                               | Age (years)                                                                 | 40.2975 | 11.1441 | 19  | 65  |
| Female                            | $1 = male; 2 = female                                                        | 1.3025 | 0.4594 | 1   | 2   |
| Complete elementary but not high school [ref. elementary or less] | $1 = yes; 0 = no$ | 0.1668 | 0.3728 | 0   | 1   |
| High school                       | $1 = yes; 0 = no$                                                           | 0.3356 | 0.4722 | 0   | 1   |
| Some college                      | $1 = yes; 0 = no$                                                           | 0.0683 | 0.2522 | 0   | 1   |
| College                           | $1 = yes; 0 = no$                                                           | 0.1708 | 0.3763 | 0   | 1   |
| Graduate school                   | $1 = yes; 0 = no$                                                           | 0.0451 | 0.2075 | 0   | 1   |
| COVID-19 self-reported symptom index | Total of reported symptoms ($1 = yes; 0 = no$): “in the last seven days”: fever; cough; sore throat; trouble breathing; headache; chest pain; nausea; blocked or runny nose; fatigue; eye pain; loss of smell or taste; and muscle pain | 0.2880 | 1.0971 | 1   | 12  |
| Decile of income                  | Decile of total income (sum of cash receipts or payment in the mode of products/merchandise) | 5.4350 | 2.8787 | 1   | 10  |
| House own (still paying) [ref. House already paid] | $1 = yes; 0 = no$ | 0.0807 | 0.2723 | 0   | 1   |
| Rented                            | $1 = yes; 0 = no$                                                           | 0.1801 | 0.3842 | 0   | 1   |
| Assigned by employer              | $1 = yes; 0 = no$                                                           | 0.0157 | 0.1244 | 0   | 1   |
| Provided by family members        | $1 = yes; 0 = no$                                                           | 0.0831 | 0.2761 | 0   | 1   |
| Acre [ref. Rondônia]              | $1 = yes; 0 = no$                                                           | 0.0124 | 0.1105 | 0   | 1   |
| Amazonas                          | $1 = yes; 0 = no$                                                           | 0.0165 | 0.1276 | 0   | 1   |
| Roraima                           | $1 = yes; 0 = no$                                                           | 0.0088 | 0.0936 | 0   | 1   |
| Pará                              | $1 = yes; 0 = no$                                                           | 0.0229 | 0.1495 | 0   | 1   |
| Amapá                            | $1 = yes; 0 = no$                                                           | 0.0044 | 0.0663 | 0   | 1   |
| Tocantins                         | $1 = yes; 0 = no$                                                           | 0.0139 | 0.1171 | 0   | 1   |
| Maranhão                          | $1 = yes; 0 = no$                                                           | 0.0241 | 0.1534 | 0   | 1   |
| Piauí                             | $1 = yes; 0 = no$                                                           | 0.0129 | 0.1129 | 0   | 1   |
| Ceará                             | $1 = yes; 0 = no$                                                           | 0.0265 | 0.1606 | 0   | 1   |
| Rio Grande do Norte               | $1 = yes; 0 = no$                                                           | 0.0173 | 0.1305 | 0   | 1   |
| Paraíba                           | $1 = yes; 0 = no$                                                           | 0.0166 | 0.1278 | 0   | 1   |
| Pernambuco                        | $1 = yes; 0 = no$                                                           | 0.0274 | 0.1633 | 0   | 1   |
| Alagoas                           | $1 = yes; 0 = no$                                                           | 0.0179 | 0.1327 | 0   | 1   |
| Sergipe                           | $1 = yes; 0 = no$                                                           | 0.0175 | 0.1312 | 0   | 1   |
| Bahia                             | $1 = yes; 0 = no$                                                           | 0.0361 | 0.1865 | 0   | 1   |
| Minas Gerais                      | $1 = yes; 0 = no$                                                           | 0.1072 | 0.3094 | 0   | 1   |
| Espírito Santo                    | $1 = yes; 0 = no$                                                           | 0.0497 | 0.2174 | 0   | 1   |
| Rio de Janeiro                    | $1 = yes; 0 = no$                                                           | 0.0748 | 0.2631 | 0   | 1   |
| São Paulo                         | $1 = yes; 0 = no$                                                           | 0.1067 | 0.3088 | 0   | 1   |
| Paraná                            | $1 = yes; 0 = no$                                                           | 0.0764 | 0.2656 | 0   | 1   |
characteristics have a positive probability of being self-employed and employed.

### 3.5.1 Selection of matching covariates

We use nine matching covariates, specifically, age, sex, education categories, COVID-19 self-reported symptom index, income decile categories, house ownership categories, week of the interview, state of the interview, and industry category listed in Table 1. We note that many of the participants in the sample are the working poor of Brazil. Compared to prior works based on racial and ethnic minorities in developed countries, we note that our sampling context is unique—racial minorities who are working poor in a developing country. Not only are developing countries limited in systematic data collection infrastructure, but also the tracking and availability of richer information on drivers of self-employment are seldom available.

We also do not have the data on whether the working poor have access to the internet to pursue remote work opportunities, nor do we have location-specific data within the city. The working poor are less likely to occupy higher occupational classes where teleworkability is more likely to be available. In Brazil, due to variations in income within a city, locational effects may also have an impact. However, matching by income could absorb some of these effects. We do not have data on the employment benefits claimed (e.g., furloughs, or state compensation schemes) in response to the COVID-19 pandemic, nor do we have information on whether a worker was classified as an essential worker, or data on the local infection rate. These data are important to derive sharper inferences. However, we note that the self-employed are less likely to have furlough benefits or be classified as essential workers. The working poor who generally focus on sustenance-based occupations are seldom likely to qualify for traditional human-resource-related benefits. The general challenges in testing have also rendered testing and infection prevalence data in Brazil less useful (Silva & Figueiredo Filho, 2020). The challenges to collecting data in a developing country during a pandemic are immense. We acknowledge the limitations of our analyses, but we also highlight the variety of controls and time-trends on industry and state that we control for.

To lower bias in the estimates, we use only one-to-one nearest neighbor matched pairs of employed and self-employed without replacement using a caliper of 0.1. Table 1 provides the listing and operationalization of all variables, and Table 4 in the Appendix presents the distribution of information by state. To assess the matching quality, we present the matching estimates in Fig. 1. The distribution of variance ratios of residuals is much tighter
after matching. Rubin’s $B$ is the absolute standardized difference of the means of the linear index of the propensity score in the treated and (matched) non-treated group. Rubin’s $B$ is slightly above the cutoff of 25 ( = 26.1). Rubin’s $R$ is the ratio of treated to (matched) non-treated variances of the propensity score index. Rubin’s $R$ was between the recommended band of 0.5 and 2 (Leuven & Sianesi, 2012), and after matching the percentage of concerning and bad matching variables, declined from 25 to 2 and from 19 to 2, respectively.

### 4 Results

We only use the one-to-one matched employed and self-employed observations, a total of 39,582 observations. In Table 1, the decline in hours is

![Matched-pair sampling tests](image-url)

* if B>25%, R outside [0.5; 2]
Table 2  Correlation matrix (contd.) \((N = 39,582)\)

|   | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 1 | Decline in hours worked | 1  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 2 | Self-employed  | 0.1801* | 1  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 3 | Black (ref. white)  | 0.0071  | -0.0369* | 1  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 4 | Yellow  | -0.0662 | 0.0416* | -0.0276* | 1  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 5 | Mixed race  | 0.0112* | -0.0340* | -0.2399* | -0.0784* | 1  |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 6 | Indigenous  | -0.0014 | -0.0019 | -0.0162* | -0.0053 | -0.0469* | 1  |    |    |    |    |    |    |    |    |    |    |    |    |
| 7 | Age  | 0.0307* | -0.0206* | -0.0001 | -0.0311 | -0.0615* | -0.0038 | 1  |    |    |    |    |    |    |    |    |    |    |    |
| 8 | Female  | 0.0178* | 0.0013 | -0.0357* | 0.0284* | -0.0103* | -0.0218* | 1  |    |    |    |    |    |    |    |    |    |    |
| 9 | Complete elementary but not high school (ref. elementary or less)  | -0.0096 | -0.0032 | 0.0102* | -0.0147* | 0.0473* | 0.0021 | -0.009 | -0.0718* | 1  |    |    |    |    |    |    |    |    |
| 10 | High school  | 0.0002 | 0.0232* | 0.0084 | -0.0102* | 0.0112* | 0.0086 | -0.1023* | 0.0109* | -0.3179* | 1  |    |    |    |    |    |    |    |
| 11 | Some college  | 0.0083 | 0.0047 | -0.0128* | 0.0165* | -0.0307* | 0.0091 | -0.1307* | 0.0468* | -0.1211* | -0.1024* | 1  |    |    |    |    |    |    |
| 12 | College  | 0.0222* | -0.003 | -0.0519* | 0.0306* | -0.1352* | -0.0085 | -0.0212* | 0.0086* | -0.0182* | -0.1541* | -0.0582* | 0.0288* | 1  |    |    |    |
| 13 | Graduate school  | 0.0138* | -0.0029 | -0.0175* | 0.0185* | -0.0012 | -0.0208 | 0.0384* | 0.0062* | -0.0072* | -0.1544* | -0.0582* | -0.0586* | 0.0086* | 1  |    |    |
| 14 | COVID-19 self-reported symptom index  | 0.0437* | -0.0025 | 0.0118* | 0.0079 | 0.0421* | 0.0105* | -0.0182* | 0.0435* | -0.0155* | 0.0148* | 0.0250* | 0.0219* | 0.0052 | 0.0109* | 1  |    |
| 15 | Income_10  | 0.0183* | 0.0148* | -0.0692* | 0.0197* | -0.2098* | -0.0144* | 0.1829* | -0.0584* | -0.1091* | -0.0681* | 0.0241* | 0.3169* | 0.2295* | -0.0193* | 1  |    |
| 16 | House own (still paying) (ref. house already paid)  | 0.0011 | 0.0032 | -0.0150* | 0.0121* | -0.0385* | -0.0096 | -0.0989 | 0.0218* | -0.0382* | -0.0011 | 0.0243* | 0.0672* | 0.0541* | -0.0040 | 0.1818* | 1  |    |
| 17 | Rented  | 0.0250* | 0.0066 | 0.0307* | 0.0041 | 0.0072 | 0.0087 | -0.0827* | 0.0143* | 0.0149* | -0.0043 | 0.0265* | 0.0028 | 0.0167* | 0.0316* | 0.0454* | -0.1388* | 1  |
| 18 | Assigned by employer  | -0.0340* | -0.0016 | 0.0029 | -0.0055 | 0.0307* | -0.0031 | -0.0134* | 0.0044* | -0.0235* | -0.0476* | -0.0236* | -0.0178* | -0.0612* | -0.0374* | -0.0592* | 1  |    |
| 19 | Provided by family members  | 0.0302* | -0.0015 | 0.0042 | 0.0012 | 0.0185* | 0.0074 | -0.0696* | -0.0182* | 0.0101* | 0.0289* | 0.0056 | -0.0262* | -0.0310* | 0.0234* | -0.0660* | -0.0892* | -0.1411* | -0.0380* |

*p < 0.05 (two-tailed); the state, industry, and week of survey variables included in the estimation of correlations, but not reported for brevity.
Table 3  OLS estimates with high-dimensional fixed effects estimates for matched pair sample

DV = decline in hours worked

|                  | (1)       | (2)       | (3)       | (4)       | (5)       | (6)       | (7)       | (8)       | (9)       |
|------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Self-employed    | 3.800***  | 3.834***  | 3.803***  | 3.810***  |           |           |           |           |           |
|                  | (0.104)   | (0.105)   | (0.106)   | (0.106)   |           |           |           |           |           |
| Black (ref. white) | 0.400**  | 0.758***  |           |           | −0.297    | 0.111     |           |           |           |
|                  | (0.203)   | (0.199)   |           |           | (0.216)   | (0.212)   |           |           |           |
| Yellow           | −0.559    | −0.747    | −0.885    | −1.017*   |           |           |           |           |           |
|                  | (0.539)   | (0.535)   | (0.569)   | (0.566)   |           |           |           |           |           |
| Mixed race       | 0.287**   | 0.468***  |           |           | −0.133    | 0.0907    |           |           |           |
|                  | (0.112)   | (0.110)   |           |           | (0.130)   | (0.127)   |           |           |           |
| Indigenous       | −0.0402   | 0.130     | −0.946    | −0.771    |           |           |           |           |           |
|                  | (1.030)   | (0.995)   |           |           | (1.038)   | (1.003)   |           |           |           |
| Employed × black | 0.131     | −0.397*   |           |           |           |           |           |           |           |
|                  | (0.224)   |           |           |           |           |           |           |           |           |
| Employed × yellow| −0.369    | −0.548    |           |           |           |           |           |           |           |
|                  | (0.715)   |           |           |           |           |           |           |           |           |
| Employed × mixed race | 0.0786 |           |           |           | −0.252*   |           |           |           |           |
|                  | (0.130)   |           |           |           | (0.146)   |           |           |           |           |
| Employed × indigenous | −1.258* |           |           |           | −2.229*** |           |           |           |           |
|                  | (0.727)   |           |           |           | (0.818)   |           |           |           |           |
| Self-employed × white | 3.399*** |           |           |           | 3.440***  |           |           |           |           |
|                  | (0.146)   |           |           |           | (0.147)   |           |           |           |           |
| Self-employed × black | 4.883*** |           |           |           | 4.141***  |           |           |           |           |
|                  | (0.341)   |           |           |           | (0.351)   |           |           |           |           |
| Self-employed × yellow | 2.411*** |           |           |           | 2.097***  |           |           |           |           |
|                  | (0.760)   |           |           |           | (0.795)   |           |           |           |           |
| Self-employed × mixed race | 4.246*** |           |           |           | 3.864***  |           |           |           |           |
|                  | (0.163)   |           |           |           | (0.177)   |           |           |           |           |
| Self-employed × indigenous | 4.976*** |           |           |           | 4.167**   |           |           |           |           |
|                  | (1.892)   |           |           |           | (1.840)   |           |           |           |           |
| Age              | 0.0325*** | 0.0361*** | 0.0323*** | 0.0363*** | 0.0363*** |           |           |           |           |
|                  | (0.00524) | (0.00515) | (0.00525) | (0.00516) | (0.00516) |           |           |           |           |
| Female           | 0.190     | 0.204     | 0.185     | 0.208*    | 0.201     |           |           |           |           |
|                  | (0.128)   | (0.126)   | (0.128)   | (0.126)   | (0.126)   |           |           |           |           |
| Complete elementary but not high school [ref. elementary or less] | 0.0763 | 0.0637 | 0.0684 | 0.0689 | 0.0763 | | | | |
|                  | (0.176)   | (0.173)   | (0.176)   | (0.173)   | (0.173)   |           |           |           |           |
| High school      | 0.0974    | 0.0361    | 0.0867    | 0.0466    | 0.0555    |           |           |           |           |
|                  | (0.157)   | (0.155)   | (0.158)   | (0.155)   | (0.155)   |           |           |           |           |
| Some college     | 0.368     | 0.356     | 0.352     | 0.379     | 0.390     |           |           |           |           |
|                  | (0.254)   | (0.249)   | (0.255)   | (0.249)   | (0.249)   |           |           |           |           |
| College          | 0.305     | 0.323     | 0.278     | 0.352*    | 0.360*    |           |           |           |           |
|                  | (0.210)   | (0.208)   | (0.212)   | (0.209)   | (0.209)   |           |           |           |           |
| Graduate school  | −0.173    | −0.120    | −0.204    | −0.0826   | −0.0842   |           |           |           |           |
Impact of the COVID-19 pandemic on the hours lost by self-employed racial minorities: evidence…

approximately 5.73 h on average, therefore supporting Hypothesis 1. Because the sample in the analysis compromises matched pairs, half the participants are self-employed. Mixed race participants are the highest in representation, an average respondent is approximately 42 years old, and a majority of participants are males. A smaller percentage of participants completed college or graduate school. Related to the self-reporting of COVID-19 symptoms, the prevalence of reported symptoms was very small (mean = 0.27, with the maximum possible value of 12). In the correlation table (Table 2), the self-employed were more likely to lose hours ($r = 0.18$, $p < 0.05$), with mixed race individuals facing a small increase in hours lost ($r = 0.01$, $p < 0.05$). Self-employment seems negatively correlated with black, yellow, and mixed race. Both age ($r = 0.03$, $p < 0.05$) and female ($r = 0.02$, $p < 0.05$) are associated with increased hours lost.

Due to concerns about potential bias from self-reports, we conduct a Harman’s factor test. In Fig. 3, the scree plot shows five distinct factors based on the outcome, predictor, and control variables. The correlations among the predicted five factors were zero. Overall, we do not expect significant bias in reporting from a common source.

Table 3 presents our estimates with controls (using high-dimensional fixed effects regression [reghdfe, Stata 16] to accommodate industry sector×week of the interview in May×state effect dummies; models 5–9) and without controls (OLS; models 1–4). We note that the data are cross-sectional data. In models 1 and 6, the effect of self-employment on hours lost is positive and significant. In model 1, the inclusion of the self-employed variable explains R-square of 3.2% and the change in R-square from models 5 to 6 is approximately 3%. To examine the effects of race, we present the margin plots of the estimates in model 9. In Fig. 2, based on $t$ tests, self-employed blacks
experienced a decline in hours worked (0.7012 h lost [Fig. 2: 8.1129–7.4117] $p = 0.0496$). However, mixed race self-employed had a statistically significant fall in hours worked relative to white self-employed ($= 0.4242$ h per week, $p = 0.025$).

The two resulting inferences are that the self-employed lost more hours relative to the employed (Hypothesis 1) and, relative to the white self-employed, black individuals and mixed race self-employed experienced a higher decline in hours (Hypothesis 2). The total hours lost are meaningful. Of the 39,252 individuals, 3,227 individuals are black (8.22%) and 16,431 individuals are of mixed race. Based on the estimates, relative to white self-employed individuals, the black self-employed lost 9,051 hours per month (3227 individuals×0.7012 h lost per week×4 weeks), and the mixed race self-employed lost 27,880 h (16,431 individuals×0.4242 hours lost per week×4 weeks), despite participants being matched in a multitude of location, individual, and timing characteristics. Both hypotheses are supported.

### 4.1 Robustness checks

#### 4.1.1 Differences by self-employment type

In Table 5, we analyze differences in effects between self-employment types. In our sample, there are (i) employer self-employed and (ii) own account self-employed. Using the estimates in Table 5, there is no difference in hours lost by non-whites relative to whites by self-employment type.

#### 4.1.2 Additional bases of lost hours—age and sex

In Table 6, we assess if sex and age further contribute to the hours lost for the self-employed. In models 1 and 2, we find that the interaction terms are non-significant indicating that age and sex did not drive differences in the decline of hours worked by self-employed.

#### 4.1.3 Oaxaca-Blinder decomposition by sex discrimination

In addition to race, women in the labor force have been affected disproportionately by COVID-19

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Fig. 2 Margins plot by race categories

| Margin       | S.E.   | z    | t-tests                           |
|--------------|--------|------|-----------------------------------|
| 1 Employed × White | 3.9717 | 0.0981 | 40.50                           |
| 2 Employed × Black    | 3.5743 | 0.2131 | 16.77                           |
| 3 Employed × Yellow | 3.4240 | 0.7663 | 4.47                            |
| 4 Employed × Mixed-race  | 3.7193 | 0.0995 | 37.38                           |
| 5 Employed × Mixed    | 1.7428 | 0.8114 | 2.15                            |
| 6 Self-employed × White | 7.4117 | 0.1181 | 62.74                           |
| 7 Self-employed × Black    | 8.1129 | 0.3326 | 24.39                           |
| 8 Self-employed × Yellow | 6.0684 | 0.7893 | 7.69                            |
| 9 Self-employed × Mixed-race  | 7.8359 | 0.1383 | 56.66                           |
| 10 Self-employed × Indigenous | 8.1382 | 1.8357 | 4.43                            |

(7) vs. (6) F( 1, 37402) = 3.86 [p = 0.0496]  
(8) vs. (6) F(1, 37402) = 2.83 [p = 0.0926]  
(9) vs. (6) F(1, 37402) = 5.06 [p = 0.0245]  
(10) vs. (6) F(1, 37402) = 0.16 [p = 0.6931]
Impact of the COVID-19 pandemic on the hours lost by self-employed racial minorities: evidence...

(Norman, 2020). Given the labor market disadvantages in developing countries, self-employed women may face additional challenges (Naude, 2010), especially if they are members of a racial minority. We further assess whether non-white female self-employed face additional discrimination. Using the Oaxaca-Blinder decomposition (Jann, 2008) by self-employment type and sex, Table 7, does not show any support for significant differences in hours lost by sex. Figure 4 presents plots of the discrimination factors (unexplained component) by employment type. With all the reported coefficients spanning the zero value, Fig. 5, does not reveal a major set of variables driving discrimination by sex.

4.1.4 Customer-facing self-employed and race

As an additional test, we assess whether the self-employed in the customer-facing business experienced lower work hours based on race. Using the industry dummies listed in the footnote of Table 1, we code the following sectors as customer-facing: Wholesale and retail trade; Passenger transportation; Accommodation (hotels, inns, etc.); and Foodservice (bars, restaurants, food vendors); and Hairdressers, beauty treatment, and personal services. In Table 8, the interactions between race and customer-facing coding are not significant.

4.1.5 Including those working fewer than 20 h

In our main analysis, we exclude those working fewer than 20 hours. Although we lack a set of instrumental variables to control for self-selection and reporting of fewer than 20 hours could also be due to COVID-19, we replicate the main estimates including those working fewer than 20 hours, and use the number of hours worked as a matching variable. In Table 9, the estimates are similar to those in the main estimates.

5 Discussion

Ours is one of the first studies to provide inferences on the impact of the COVID-19 pandemic on self-employed racial minorities in a developing country context. Self-employed racial minorities in developing countries with limited health and physical infrastructure, less stable macroeconomic conditions, and weaker or non-existent safety nets face distinctive challenges from the COVID-19 pandemic. Our findings, on aggregate, support the general assertion that the self-employed lost more hours of work than the employed. Those reporting race as yellow or indigenous, due to small prevalence rates, had substantially overlapping confidence intervals between the employed and the self-employed. However, blacks and mixed race individuals with higher prevalence rates among racial minorities lost a substantially higher number of hours than whites, and this decline seems most prevalent for the self-employed. In aggregate, these losses of hours represent substantial economic costs. Compared to related research on age and sex-based discrimination in self-employment (Curran & Blackburn, 2001; Leoni & Falk, 2010; Walker & Webster, 2007), we did not find evidence for variations in the decline in hours by age and sex. We further explored whether females in non-white groups face added discrimination. The Oaxaca-Blinder decomposition did not show further disadvantage for non-white females.

5.1 Theoretical implications

Our theoretical mainstays are minority enclave theory (Light et al., 1994; Wilson & Portes, 1980) and resilience theory (Bhamra et al., 2011; Branicki et al., 2018; Gunasekaran et al., 2011). Although the ethnic enclave theory generally highlights the positive aspects of interactions in an enclave, the onset of the pandemic could well lower the resilience of co-dependent enclave members because the pandemic affects all members and adversely impacts the socio-economic interactions in an enclave as a whole. Relatedly, racial differences may further weaken the ability to absorb the decline in hours with the onset of pandemic. The intersectionality across racial types in a spatial concentration may challenge the institutional-, resource-, and information-sharing fabric of economically vulnerable communities. Given that co-production in minority enclaves not only focuses on economic elements but also is embedded in socially produced space (Portes, 1998; Valenzuela-Garcia et al., 2017), the persistence of the enclave during non-crisis times may improve overall outcomes. However, the very strength of social and economic bonds could make it fragile during the pandemic.
Our findings provide indirect support for the “cost of minority enclave” during the pandemic (cf. Portes, 2014). Although our study does not focus on the post-pandemic rebound, it may be conceivable that minority ethnic enclaves will bounce back more strongly.

A significant body of work on self-employed racial minorities has highlighted the barriers faced by such entrepreneurs. Although self-employment is a model for economic mobility, autonomy, and financial independence among the self-employed from racially underrepresented groups, they also face systemic discrimination in labor and credit markets (Dixon & Telles, 2017). Self-employment may well provide a mode for labor market participation and speed up economic mobility (Wingfield, 2008). It is to be regretted that the policies enacted by governments across the world have played a much smaller role in lowering such barriers (Cornwall, 1998; Goetz et al., 2012).

Speaking to prior studies on ethnic entrepreneurship and those from racial minority groups, the findings show that the impact of the pandemic was worse for the self-employed from these groups. Although such self-employment may work in ethnic enclaves, the systematic hurdles these individuals face due to credit-market rationing (Blumberg & Letterie, 2008; Mijid & Bernasek, 2013), their smaller business footprint (Hutcheson, 1995), and limited personal and business-related economic integration (Hutcheson, 1995) ensure that such findings will continue through the period of the pandemic. Evidence from the USA shows that racial minorities have a lower participation rate in self-employment and this disparity exists due to limited access to capital and social networks (Bates, 1995; Lofstrom et al., 2014).

These challenges may limit the prospects of those from a racial minority from becoming in the first instance and then remaining self-employed in Brazil during a pandemic.

Comparing two major crises in the USA—Hurricane Katrina and the Great Recession—Neal and McCargo (2020) demonstrated that the crisis increased long-term wealth gaps among racial minorities. Higher unemployment and lockdowns could permanently set back the self-employed in these groups because not only do the prospects of their business dwindle but also the financial constraints under which their household operates intensify the decline in their self-employment outlook. Both Hurricane Katrina and the Great Recession led to the economic devastation of African American communities in the USA. Our findings show that in a different cultural and national context, self-employed racial minorities faced similar challenges during the pandemic. Since self-employed racial minorities tend to work in more customer-facing service occupations (Khunti et al., 2020; Kirby, 2020), the effects of the pandemic are likely to be even worse. Due to data limitations, there are few studies on the effects of the Spanish flu pandemic 1918-1920 on self-employed racial minorities. The more recent crisis indicates that self-employed racial minorities may face an increased gap in economic outcomes. Our results show preliminary evidence of this outcome.

The findings also confirm the general nature of race-based discrimination supported in the broader self-employment literature that is focused in the USA. Although our main findings focus on the reported effects during the COVID-19 pandemic, it is essential to note that the effects of hours lost are more severe for those who were non-white. In addition, we find evidence for a greater decline in hours of work for the self-employed. Consistent with this finding, a range of studies have found evidence of lower health among those from racial minorities in developing countries.

### 5.2 Policy implications

The findings suggest that “one-size-fits-all” policy approaches may not work in improving the conditions of the self-employed from racial minority groups. Our findings point to the need for policymakers to develop both short- and long-term strategies to address these concerns. In the short term, in addition to the economic cost of lost hours, the impact on social, filial, and health costs from the deteriorating economic conditions of the self-employed from racial minority groups must be of special concern to policymakers. In the long term, the deterioration in economic status resulting from COVID-19 may not only further increase income inequality between racial majority and minority groups, but it may also have adverse long-term economic and social consequences for the Brazilian economy.

### 5.3 Limitations

Our findings have certain limitations. First, our data are cross-sectional. Although we use the state, industry, and week of survey dummies to control for a variety of heterogeneities and use one-to-one matched data, as is the case in most
large-scale surveys, the richer details of the businesses or changes in response to the COVID-19 pandemic over time are not testable. As discussed previously in the introduction, our study does not allow for an interrupted time series analysis due to a lack of pre-COVID-19 data, nor is a difference-in-differences design feasible due to the lack of a control group. In our study, we attempted to address the limitations of the cross-sectional data using matched-pair sampling and a combination of industry-week-state fixed effects to draw inferences from reliable estimates. We also note that due to social, economic, and medical mitigation effects from governments during the early stages of the COVID-19 pandemic, the period represented from the early COVID-19 pandemic stages is particularly relevant because it is less influenced by a complex set of confounds that emerged at national and sub-national levels. We call on future studies to draw on interrupted time series design to assess the replicability of our results.

Second, a difference-in-differences design with granular reporting during the COVID-19 pandemic would be ideal. Due to the evolving COVID-19 situation, we caution that a one-time post-COVID-19 measure may not suffice due to the evolving weekly and intra-country regional variations in COVID-19 responses. Although our matching covariates include state and week of the interview to soak COVID-19 conditions with state-week-of-the-year effects, individual experiences of COVID-19 and within-state variations are not possible to model in the data. Future studies could focus on the heterogeneity in experiences of COVID-19 by examining finer-grained regions and studying meso-level effects on variegated experiences of COVID-19 among individuals within regions.

We note that our estimates do not help to assess whether the change in work hours is comparable to work hours last year. However, we do not expect self-reports of normal hours and hours worked last week to be significantly biased. Nevertheless, we observe no industry or location shocks, nor occupational switches. This remains a limitation of the study as self-employed racial minorities losing more hours based on self-reports reinforces the possibility that the decline in business activity may have continued during COVID-19. Nevertheless, we cannot make inferences on channels or mechanisms that exacerbate discrimination or disadvantage in the post-COVID-19 stage relative to the pre-COVID-19 stage. Despite these limitations, we stress that a considerable amount of data is available in the COVID-19 Supertracker from Oxford and a large number of studies rely on this design to provide early-stage evidence.

Third, our measure is a self-reported measure of the change in hours. We do not have access to additional data on hours; nor do we have information on the specific nature of their work. It is possible that fewer hours may not fully translate into lower income because hourly incomes may vary by client. However, the outcome variable—reduction in hours—is more likely to be reported reliably than income. In a developing country setting, individuals are less likely to report income reliably. Furthermore, concerning the immediate impact of COVID-19, a reduction in hours worked is a more proximal outcome. Future research could focus on both the short- and the long-term impact of COVID-19 on income. Nevertheless, further studies that focus on the weekly change in hours worked and its impact on income, social, and health outcomes will be crucial in validating our findings.

Fourth, our analysis is limited to Brazil and, with the political rhetoric during May 2020, the findings are unique to the context studied. Indeed, inferences may vary from to country. In addition, race is self-reported in the data. Related evidence on incongruence in reporting, outsider perception of race, and complex ethno-racial dynamics add further to heterogeneity. Fifth, in many socio-cultural contexts, experiences based on race, gender, religion, and a variety of social attributes occur at the intersectionality of these dimensions. Our research did not focus on intersectionality as a theoretical mainstay and concentrated on hours of work lost during the pandemic and race. The role of intersectionality is not explored and, therefore, remains a limitation of this study. Although we controlled for and matched participants on age, sex, socioeconomic circumstances, and pandemic related factors, the intersectionality of individual characteristics should explain the additional variance, and more importantly, provide richer theoretical understanding.

6 Conclusion

There are growing concerns that small businesses may not fully recover from the economic malaise of the COVID-19 pandemic. Our research, which draws on minority enclave theory and resilience theory indicates that more careful consideration must be given to the self-employed from racial minority groups in developing countries. Prior evidence from other
countries shows that systemic and social hurdles limit the participation and progress of racial minorities in self-employment. With the self-employed sustaining lower and more volatile income than the employed, business closures and reduction in hours could spell permanent decline in the economic standing of the self-employed. Our findings show that precarity may have been exacerbated for such groups during the COVID-19 pandemic and furthermore, they pinpoint the need for greater responsiveness from policymakers in devising policies that are more conducive to this group's long-term wellbeing.

### Table 4

| State                  | Decline in hours worked | White | Black | Yellow | Mixed race | Indigenous | Age | Female | COVID-19 self-reported symptom index | Income deciles |
|------------------------|-------------------------|-------|-------|--------|------------|------------|-----|--------|--------------------------------------|----------------|
| Rondônia               | 3.6                     | 0.5   | 0.28  | 0.08   | 0.01       | 0.62       | 0   | 37.85  | 1.26                                 | 0.4            |
| [8.43] [0.50]          |                         | [0.45]| [0.28]| [0.10]  | [0.09]     | [0.00]     | [11.03]| [0.44] | [1.37]                               |
| Acre                   | 7.22                    | 0.51  | 0.19  | 0.07   | 0.01       | 0.72       | 0.01 | 38.84  | 1.29                                 | 0.63           |
| [11.37] [0.50]         |                         | [0.39]| [0.25]| [0.11]  | [0.45]     | [0.09]     | [10.32]| [0.45] | [1.91]                               |
| Amazonas               | 5.31                    | 0.51  | 0.2   | 0.04   | 0.01       | 0.73       | 0.02 | 38.14  | 1.28                                 | 1.08           |
| [10.37] [0.50]         |                         | [0.40]| [0.21]| [0.11]  | [0.44]     | [0.12]     | [10.82]| [0.45] | [2.53]                               |
| Roraima                | 6.59                    | 0.51  | 0.21  | 0.09   | 0.01       | 0.66       | 0.02 | 37.74  | 1.27                                 | 0.65           |
| [11.61] [0.50]         |                         | [0.41]| [0.29]| [0.08]  | [0.47]     | [0.15]     | [11.18]| [0.45] | [1.94]                               |
| Pará                   | 5.31                    | 0.47  | 0.21  | 0.09   | 0.01       | 0.68       | 0   | 37.58  | 1.27                                 | 0.78           |
| [10.18] [0.50]         |                         | [0.41]| [0.29]| [0.11]  | [0.47]     | [0.07]     | [10.96]| [0.44] | [2.01]                               |
| Amapá                  | 10.04                   | 0.52  | 0.17  | 0.07   | 0.01       | 0.75       | 0   | 36.59  | 1.25                                 | 1.56           |
| [13.70] [0.50]         |                         | [0.38]| [0.26]| [0.08]  | [0.44]     | [0.00]     | [10.08]| [0.44] | [2.98]                               |
| Tocantins              | 4.19                    | 0.49  | 0.26  | 0.1    | 0.01       | 0.63       | 0   | 38.51  | 1.25                                 | 0.24           |
| [8.98] [0.50]          |                         | [0.44]| [0.30]| [0.11]  | [0.48]     | [0.00]     | [11.07]| [0.43] | [0.79]                               |
| Maranhão               | 6.19                    | 0.51  | 0.21  | 0.12   | 0.01       | 0.66       | 0   | 37.79  | 1.28                                 | 0.54           |
| [10.34] [0.50]         |                         | [0.41]| [0.32]| [0.07]  | [0.47]     | [0.06]     | [11.03]| [0.45] | [1.54]                               |
| Piauí                  | 6.68                    | 0.51  | 0.26  | 0.13   | 0         | 0.61       | 0   | 39.54  | 1.29                                 | 0.22           |
| [10.69] [0.50]         |                         | [0.44]| [0.34]| [0.04]  | [0.49]     | [0.00]     | [11.12]| [0.46] | [1.05]                               |
| Ceará                  | 7.91                    | 0.49  | 0.26  | 0.05   | 0         | 0.68       | 0   | 39.75  | 1.31                                 | 0.6            |
| [11.99] [0.50]         |                         | [0.44]| [0.22]| [0.07]  | [0.47]     | [0.05]     | [11.15]| [0.46] | [1.62]                               |
| Rio Grande do Norte    | 7.66                    | 0.52  | 0.08  | 0.02   | 0.52       | 0.52       | 0   | 38.56  | 1.28                                 | 0.21           |
| [11.77] [0.50]         |                         | [0.49]| [0.28]| [0.05]  | [0.50]     | [0.04]     | [10.99]| [0.45] | [0.85]                               |
| Paraíba                | 7.87                    | 0.49  | 0.38  | 0.06   | 0.56       | 0.56       | 0   | 39.31  | 1.24                                 | 0.49           |
| [11.54] [0.50]         |                         | [0.49]| [0.23]| [0.06]  | [0.50]     | [0.07]     | [10.73]| [0.43] | [1.38]                               |
| Pernambuco             | 6.77                    | 0.5   | 0.34  | 0.09   | 0.01       | 0.56       | 0   | 39.78  | 1.31                                 | 0.44           |
| [11.52] [0.50]         |                         | [0.47]| [0.29]| [0.10]  | [0.50]     | [0.06]     | [10.60]| [0.46] | [1.51]                               |
| Alagoas                | 7.27                    | 0.5   | 0.25  | 0.07   | 0.01       | 0.66       | 0.01 | 38.91  | 1.25                                 | 0.33           |
| [11.67] [0.50]         |                         | [0.43]| [0.26]| [0.10]  | [0.48]     | [0.11]     | [10.72]| [0.43] | [1.18]                               |
| Sergipe                | 7.48                    | 0.51  | 0.21  | 0.09   | 0         | 0.7        | 0   | 38.57  | 1.23                                 | 0.22           |
| [10.78] [0.50]         |                         | [0.40]| [0.29]| [0.00]  | [0.46]     | [0.04]     | [10.58]| [0.42] | [0.87]                               |
| Bahia                  | 7.38                    | 0.49  | 0.18  | 0.23   | 0.01       | 0.58       | 0   | 38.78  | 1.27                                 | 0.22           |
| [11.70] [0.50]         |                         | [0.38]| [0.42]| [0.08]  | [0.49]     | [0.05]     | [10.99]| [0.44] | [0.78]                               |
| Minas Gerais           | 5.35                    | 0.5   | 0.42  | 0.11   | 0         | 0.46       | 0   | 40.3   | 1.28                                 | 0.18           |
| [10.20] [0.50]         |                         | [0.49]| [0.32]| [0.06]  | [0.50]     | [0.04]     | [11.12]| [0.45] | [0.71]                               |
Table 4 (continued)

| State                   | Decline in hours worked | White | Black | Yellow | Mixed race | Indigenous | Age | Female | COVID-19 self-reported symptom index | Income deciles |
|-------------------------|-------------------------|-------|-------|--------|------------|------------|-----|--------|--------------------------------------|----------------|
| Espírito Santo          | 6.06                    | 0.49  | 0.4   | 0.1    | 0.01       | 0.49       | 0.01| 40.04  | 1.32                                | 0.3            |
|                         | [10.82]                 | [0.50] | [0.49] | [0.30] | [0.07]     | [0.50]     | [0.07]| [11.08] | [0.47]                              | [1.05]         |
| Rio de Janeiro          | 7.64                    | 0.49  | 0.5   | 0.12   | 0          | 0.38       | 0   | 41.82  | 1.33                                | 0.3            |
|                         | [11.91]                 | [0.50] | [0.50] | [0.32] | [0.06]     | [0.48]     | [0.04]| [11.19] | [0.47]                              | [1.18]         |
| São Paulo               | 6.26                    | 0.51  | 0.64  | 0.07   | 0.02       | 0.27       | 0   | 42.25  | 1.32                                | 0.26           |
|                         | [11.09]                 | [0.50] | [0.48] | [0.25] | [0.15]     | [0.44]     | [0.04]| [11.18] | [0.47]                              | [0.95]         |
| Paraná                  | 4.87                    | 0.51  | 0.7   | 0.03   | 0.01       | 0.26       | 0   | 40.93  | 1.33                                | 0.14           |
|                         | [9.82]                  | [0.50] | [0.46] | [0.17] | [0.12]     | [0.44]     | [0.04]| [11.14] | [0.47]                              | [0.61]         |
| Santa Catarina          | 3.95                    | 0.5   | 0.85  | 0.03   | 0          | 0.12       | 0   | 40.56  | 1.34                                | 0.17           |
|                         | [8.84]                  | [0.50] | [0.36] | [0.16] | [0.06]     | [0.33]     | [0.04]| [11.01] | [0.47]                              | [0.72]         |
| Rio Grande do Sul       | 5.01                    | 0.49  | 0.85  | 0.04   | 0          | 0.11       | 0   | 40.86  | 1.35                                | 0.22           |
|                         | [9.75]                  | [0.50] | [0.36] | [0.19] | [0.03]     | [0.32]     | [0.04]| [11.37] | [0.48]                              | [0.74]         |
| Mato Grosso do Sul      | 3.91                    | 0.51  | 0.46  | 0.06   | 0.01       | 0.46       | 0.01| 41.54  | 1.27                                | 0.13           |
|                         | [8.71]                  | [0.50] | [0.50] | [0.24] | [0.09]     | [0.50]     | [0.10]| [11.24] | [0.45]                              | [0.67]         |
| Mato Grosso             | 3.59                    | 0.49  | 0.36  | 0.11   | 0.01       | 0.51       | 0   | 40.68  | 1.26                                | 0.16           |
|                         | [8.92]                  | [0.50] | [0.48] | [0.31] | [0.11]     | [0.50]     | [0.04]| [11.23] | [0.44]                              | [0.83]         |
| Goiás                   | 5.05                    | 0.51  | 0.35  | 0.09   | 0.02       | 0.54       | 0   | 40.15  | 1.28                                | 0.17           |
|                         | [10.11]                 | [0.50] | [0.48] | [0.29] | [0.12]     | [0.50]     | [0.02]| [11.20] | [0.45]                              | [0.74]         |
| Distrito Federal        | 5.87                    | 0.51  | 0.41  | 0.12   | 0.01       | 0.46       | 0   | 40.46  | 1.32                                | 0.25           |
|                         | [10.91]                 | [0.50] | [0.49] | [0.32] | [0.10]     | [0.50]     | [0.04]| [10.55] | [0.47]                              | [0.97]         |
| Total                   | 5.73                    | 0.5   | 0.49  | 0.08   | 0.01       | 0.42       | 0   | 40.3   | 1.3                                 | 0.29           |
|                         | [10.55]                 | [0.50] | [0.50] | [0.27] | [0.09]     | [0.49]     | [0.05]| [11.14] | [0.46]                              | [1.10]         |

Standard deviations in brackets
Table 5  OLS estimates for self-employed subsample; high-dimensional fixed effects estimates for matched pair sample  

|                                      | DV = decline in hours worked | (1)       | (2)       | (3)       | (4)       | (1)       |
|--------------------------------------|----------------------------|-----------|-----------|-----------|-----------|-----------|
| Self-employed type, own account [ref. self-employment type, employer] |                          | 2.446***  | 2.425***  |           |           |           |
|                                      |                            | (0.265)   | (0.266)   |           |           |           |
| Black (ref. white)                   |                            | 0.503     | 0.362     |           |           |           |
|                                      |                            | (0.376)   | (0.376)   |           |           |           |
| Yellow                               |                            | − 1.535*  | − 1.608*  |           |           |           |
|                                      |                            | (0.849)   | (0.845)   |           |           |           |
| Mixed race                           |                            | 0.347*    | 0.267     |           |           |           |
|                                      |                            | (0.211)   | (0.211)   |           |           |           |
| Indigenous                           |                            | 1.421     | 1.287     |           |           |           |
|                                      |                            | (1.840)   | (1.848)   |           |           |           |
| Self-employed type, employer × black |                          | 0.645     |           |           |           |           |
|                                      |                            | (1.324)   |           |           |           |           |
| Self-employed, employer × yellow     |                            | − 0.516   |           |           |           |           |
|                                      |                            | (1.900)   |           |           |           |           |
| Self-employed, employer × mixed race |                            | 0.435     |           |           |           |           |
|                                      |                            | (0.513)   |           |           |           |           |
| Self-employed, employer × indigenous |                            | 12.47     |           |           |           |           |
|                                      |                            | (10.05)   |           |           |           |           |
| Self-employed type, own account × white |                        | 2.530***  |           |           |           |           |
|                                      |                            | (0.311)   |           |           |           |           |
| Self-employed type, own account × black |                        | 2.857***  |           |           |           |           |
|                                      |                            | (0.468)   |           |           |           |           |
| Self-employed, own account × yellow  |                            | 0.707     |           |           |           |           |
|                                      |                            | (0.971)   |           |           |           |           |
| Self-employed, own account × mixed race |                      | 2.768***  |           |           |           |           |
|                                      |                            | (0.341)   |           |           |           |           |
| Self-employed, own account × indigenous |                     | 2.844     |           |           |           |           |
|                                      |                            | (1.776)   |           |           |           |           |
| Age                                  |                            | 0.0297*** | 0.0329*** | 0.0304*** | 0.0334*** | 0.0333*** |
|                                      |                            | (0.00848) | (0.00847) | (0.00849) | (0.00847) | (0.00848) |
| Female                               |                            | 0.151     | 0.0996    | 0.160     | 0.108     | 0.110     |
|                                      |                            | (0.201)   | (0.201)   | (0.201)   | (0.201)   | (0.201)   |
| Complete elementary but not high school |                        | 0.0739    | 0.107     | 0.0998    | 0.127     | 0.120     |
|                                      |                            | (0.287)   | (0.286)   | (0.287)   | (0.286)   | (0.286)   |
| High school                          |                            | − 0.0903  | − 0.00606 | − 0.0527  | 0.0229    | 0.0237    |
|                                      |                            | (0.248)   | (0.248)   | (0.248)   | (0.248)   | (0.248)   |
| Some college                         |                            | 0.267     | 0.434     | 0.345     | 0.496     | 0.487     |
|                                      |                            | (0.411)   | (0.411)   | (0.412)   | (0.412)   | (0.411)   |
| College                              |                            | − 0.362   | − 0.0965  | − 0.262   | − 0.0170  | − 0.0202  |
|                                      |                            | (0.336)   | (0.336)   | (0.338)   | (0.338)   | (0.339)   |
| Graduate school                      |                            | − 0.871*  | − 0.539   | − 0.772   | − 0.462   | − 0.451   |
|                                      |                            | (0.517)   | (0.517)   | (0.518)   | (0.518)   | (0.518)   |
| COVID-19 self-reported symptom index |                        | 0.466***  | 0.464***  | 0.464***  | 0.463***  | 0.464***  |
|                                      |                            | (0.100)   | (0.0999)  | (0.100)   | (0.1000)  | (0.1000)  |
### Table 5 (continued)

| Variables | DV = decline in hours worked |
|-----------|-----------------------------|
|           | (1)        | (2)        | (3)        | (4)        | (1)        |
| Income_10 |            |            |            |            |            |
|           | 0.0764**   | 0.161***   | 0.0815**   | 0.164***   | 0.164***   |
|           | (0.0353)   | (0.0365)   | (0.0353)   | (0.0366)   | (0.0366)   |
| House own (still paying) [ref. house already paid] | | | | | |
|           | 0.337      | 0.313      | 0.334      | 0.312      | 0.305      |
|           | (0.330)    | (0.329)    | (0.330)    | (0.330)    | (0.329)    |
| Rented    | 0.897***   | 0.837***   | 0.879***   | 0.824***   | 0.820***   |
|           | (0.248)    | (0.247)    | (0.248)    | (0.247)    | (0.247)    |
| Assigned by employer | −0.598    | −0.663     | −0.649     | −0.705     | −0.698     |
|           | (0.565)    | (0.564)    | (0.567)    | (0.565)    | (0.565)    |
| Provided by family members | 1.850***   | 1.753***   | 1.844***   | 1.748***   | 1.751***   |
|           | (0.343)    | (0.343)    | (0.344)    | (0.343)    | (0.343)    |
| Industry sector × week of the interview in May × state | Included | Included | Included | Included | Included |
| Constant  | 5.422***   | 2.701***   | 5.151***   | 2.519***   | 2.437***   |
|           | (0.522)    | (0.600)    | (0.542)    | (0.613)    | (0.626)    |
| Observations | 19,430    | 19,430     | 19,430     | 19,430     | 19,430     |
| R-squared | 0.152      | 0.156      | 0.153      | 0.156      | 0.156      |

Robust standard errors in parentheses

***p < 0.01, **p < 0.05, *p < 0.1

### Table 6

| Variables                               | DV = decline in hours worked |
|-----------------------------------------|-----------------------------|
|                                         | (1)        | (2)        |
| Self-employed                           |            | 3.492***   |
|                                         | (0.387)    | (0.315)    |
| Age                                     | 0.0323***   | 0.0362***   |
|                                         | (0.00603)  | (0.00516)  |
| Female                                  | 0.204      | 0.312**    |
|                                         | (0.126)    | (0.151)    |
| Self-employed × age                     | 0.00773    | −0.213     |
|                                         | (0.00941)  | (0.229)    |
| Self-employed × female                  |            |            |
|                                         | Included    | Included    |
| Controls                                | Included    | Included    |
| Industry sector × week of the interview in May × state | Included (1,820 categories) | Included (1820 categories) |
| Constant                                | 1.558***   | 1.262***   |
|                                         | (0.341)    | (0.338)    |
| Observations                            | 39,252     | 39,252     |
| R-squared                               | 0.130      | 0.130      |

Robust standard errors in parentheses

***p < 0.01, **p < 0.05, *p < 0.1
Table 7  Female discrimination—Oaxaca-Blinder decomposition based on matched-pair sample

| Variables                                      | Self-employed type—employer (1) | Self-employed type—own account (4) | Self-employed type—own account (6) |
|-----------------------------------------------|---------------------------------|-----------------------------------|-----------------------------------|
|                                               | Overall  Explained  Unexplained | Overall  Explained  Unexplained   | Overall  Explained  Unexplained   |
| Male                                          | 6.370*** (0.350)                | 8.423*** (0.152)                  |                                  |
| Female                                        | 7.118*** (0.469)                | 8.612*** (0.237)                  |                                  |
| Difference in loss of hours (male minus female) | −0.748 (0.585)                  | −0.189 (0.281)                    |                                  |
| Explained                                     | −0.444* (0.268)                 | −0.312* (0.165)                   |                                  |
| Unexplained                                   | −0.303 (0.605)                  | 0.123 (0.305)                     |                                  |
| Age                                           | 0.0168 (0.0230)                 | −0.00989 (0.00941)                | 1.350 (1.057)                    |
| Black (ref. white)                            | 0.00339 (0.0402)                | 0.0450* (0.0249)                  | −0.268* (0.145)                  |
| Yellow                                        | 0.0519 (0.0584)                 | 0.00589 (0.00855)                 | −0.261 (0.268)                   |
| Mixed race                                    | −0.0325 (0.0365)                | −0.0111 (0.0139)                  | −0.141 (0.0986)                  |
| Indigenous                                    | −0.0417 (0.0912)                | −0.0118 (0.0667)                  | −0.585** (0.230)                 |
| Complete Elementary but not high school [ref. Elementary or less] | −0.114 (0.0941)                 | −0.00822 (0.0372)                 | 0.0604 (0.0809)                  |
| High school                                   | −0.00435 (0.0139)               | −0.0461** (0.0181)                | −0.0911 (0.102)                  |
| Some college                                  | 0.0644 (0.0438)                 | 0.0569*** (0.0213)                | −0.721 (0.569)                   |
| College                                       | 0.00841 (0.0162)                | −0.00626 (0.00962)                | −0.154 (0.116)                   |
| Graduate school                               | −0.00261 (0.0133)               | −0.00810 (0.00701)                | 0.00866 (0.151)                  |
| COVID-19 self-reported symptom index          | 0.00149 (0.00507)               | −6.19e-05 (0.00245)               | −0.0176 (0.0347)                 |
| Income_10                                     | 0.00346 (0.0100)                | 0.0155 (0.00948)                  | −0.120 (0.0900)                  |
| House own (still paying) [ref. House already paid] | −0.399* (0.235)                | −0.402** (0.158)                  | −0.700 (1.600)                   |
| Rented                                        | −0.237 (5.072)                  | 1.966 (19.12)                     |                                  |
| Assigned by employer                          | 6.370*** (0.350)                | 8.423*** (0.152)                  |                                  |
| Provided by family members                    | 7.118*** (0.469)                | 8.612*** (0.237)                  |                                  |
Table 7 (continued)

| Variables                                      | Self-employed type—employer | Self-employed type—own account |
|------------------------------------------------|-----------------------------|--------------------------------|
|                                                 | (1)                         | (2)                           | (3) | (4) | (5) | (6) |
| Overall Explained Unexplained                   | Overall Explained Unexplained |
| Combined industry, region, and the week of the survey in May 2020 | −0.748 (0.585)              | −0.189 (0.281)                |
| Constant                                        | −0.444* (0.268)             | −0.312* (0.165)               |
| Observations                                    | 2704                        | 2704                          | 2704 | 17,087 | 17,087 | 17,087 |

Robust standard errors in parentheses

***p < 0.01, **p < 0.05, *p < 0.1
Table 8  Customer-facing business—OLS estimates with High-dimensional fixed effects estimates for matched pair sample

| Variables                                      | (1)                     |
|------------------------------------------------|-------------------------|
| DV = decline in hours worked                   |                         |
| White × customer facing                        | − 1.421                 |
|                                                 | (1.840)                 |
| Black × customer facing                        | − 0.918                 |
|                                                 | (1.864)                 |
| Yellow × customer facing                       | − 2.956                 |
|                                                 | (2.007)                 |
| Mixed race × customer facing                   | − 1.074                 |
|                                                 | (1.836)                 |
| Age                                            | 0.0304***               |
|                                                 | (0.00849)               |
| Female                                         | 0.160                   |
|                                                 | (0.201)                 |
| Complete elementary but not high school [ref. Elementary or less] | 0.0998                  |
|                                                 | (0.287)                 |
| High school                                    | − 0.0527                |
|                                                 | (0.248)                 |
| Some college                                   | 0.345                   |
|                                                 | (0.412)                 |
| College                                        | − 0.262                 |
|                                                 | (0.338)                 |
| Graduate school                                | − 0.772                 |
|                                                 | (0.518)                 |
| COVID-19 self-reported symptom index           | 0.464***                |
|                                                 | (0.100)                 |
| Income_10                                      | 0.0815**                |
|                                                 | (0.0353)                |
| House own (still paying) [ref. house already paid] | 0.334                   |
|                                                 | (0.330)                 |
| Rented                                         | 0.879***                |
|                                                 | (0.248)                 |
| Assigned by employer                           | − 0.649                 |
|                                                 | (0.567)                 |
| Provided by family members                     | 1.844***                |
|                                                 | (0.344)                 |
| Industry sector × week of the interview in May × state | Included               |
| Constant                                       | 6.572***                |
|                                                 | (1.908)                 |
| Observations                                   | 19,430                  |
| R-squared                                      | 0.153                   |

Robust standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$
|                                               | (1)           | (2)           | (3)           | (4)           | (5)           | (6)           | (7)           | (8)           | (9)           |
|-----------------------------------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| **Self-employed**                             | 3.562***      | 3.595***      | 3.601***      | 3.607***      |
|                                               | (0.100)       | (0.101)       | (0.102)       | (0.102)       |
| **Black (ref. white)**                        | 0.445**       | 0.765***      | -0.251        | 0.112         |
|                                               | (0.196)       | (0.193)       | (0.209)       | (0.205)       |
| **Yellow**                                    | -0.0134       | -0.119        | -0.267        | -0.339        |
|                                               | (0.561)       | (0.558)       | (0.578)       | (0.571)       |
| **Mixed race**                                | 0.325***      | 0.501***      | -0.0912       | 0.125         |
|                                               | (0.107)       | (0.106)       | (0.124)       | (0.123)       |
| **Indigenous**                                | -0.846        | -0.606        | -1.963**      | -1.681*       |
|                                               | (0.928)       | (0.893)       | (0.975)       | (0.943)       |
| **Employed × black**                          | 0.239         |               | -0.309        |
|                                               | (0.221)       |               | (0.233)       |
| **Employed × yellow**                         | 0.291         |               | -0.00519      |
|                                               | (0.756)       |               | (0.774)       |
| **Employed × mixed race**                     | 0.250**       |               | -0.0486       |
|                                               | (0.126)       |               | (0.142)       |
| **Employed × indigenous**                     | -2.127***     |               | -3.202***     |
|                                               | (0.571)       |               | (0.740)       |
| **Self-employed × white**                     | 3.290***      |               | 3.386***      |
|                                               | (0.140)       |               | (0.142)       |
| **Self-employed × black**                     | 4.664***      |               | 3.994***      |
|                                               | (0.325)       |               | (0.336)       |
| **Self-employed × yellow**                    | 2.861***      |               | 2.792***      |
|                                               | (0.796)       |               | (0.816)       |
| **Self-employed × mixed race**                | 4.034***      |               | 3.679***      |
|                                               | (0.155)       |               | (0.169)       |
| **Self-employed × indigenous**                | 4.414***      |               | 3.395*        |
|                                               | (1.792)       |               | (1.791)       |
| **Age**                                       | 0.0280***     | 0.0311***     | 0.0279***     | 0.0313***     | 0.0314***     |
|                                               | (0.00502)     | (0.00495)     | (0.00503)     | (0.00496)     | (0.00496)     |
| **Female**                                    | 0.197         | 0.218*        | 0.192         | 0.220*        | 0.218*        |
|                                               | (0.121)       | (0.120)       | (0.121)       | (0.120)       | (0.120)       |
| **Complete elementary but not high school [ref. elementary or less]** | 0.145         | 0.149         | 0.138         | 0.154         | 0.159         |
|                                               | (0.170)       | (0.167)       | (0.170)       | (0.167)       | (0.167)       |
| **High school**                               | 0.0396        | -0.00352      | 0.0321        | 0.00728       | 0.00143       |
|                                               | (0.151)       | (0.148)       | (0.151)       | (0.149)       | (0.149)       |
| **Some college**                              | 0.334         | 0.336         | 0.317         | 0.356         | 0.362         |
|                                               | (0.245)       | (0.241)       | (0.246)       | (0.242)       | (0.242)       |
| **College**                                   | 0.0916        | 0.106         | 0.0679        | 0.133         | 0.138         |
|                                               | (0.201)       | (0.199)       | (0.203)       | (0.200)       | (0.200)       |
| **Graduate school**                           | -0.448        | -0.443        | -0.475        | -0.410        | -0.409        |
|                                               | (0.309)       | (0.304)       | (0.310)       | (0.305)       | (0.305)       |
| **COVID-19 self-reported symptom index**      | 0.345***      | 0.351***      | 0.347***      | 0.351***      | 0.351***      |
|                                               | (0.0583)      | (0.0574)      | (0.0583)      | (0.0573)      | (0.0574)      |
| **Income_10**                                 | 0.114***      | 0.104***      | 0.112***      | 0.106***      | 0.104***      |
Table 9 (continued)

| DV = decline in hours worked | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|-----------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| House own (still paying)    |     |     |     |     | 0.162 | 0.188 | 0.167 | 0.188 | 0.186 |
| [ref. house already paid]   |     |     |     |     | (0.195) | (0.191) | (0.195) | (0.191) | (0.191) |
| Rented                      | 0.574*** | 0.569*** | 0.583*** | 0.567*** | 0.566*** |
|                             | (0.145) | (0.142) | (0.146) | (0.143) | (0.142) |
| Assigned by employer        | −0.753** | −0.882*** | −0.743** | −0.891*** | −0.908*** |
|                             | (0.307) | (0.306) | (0.307) | (0.307) | (0.307) |
| Provided by family members  | 1.355*** | 1.322*** | 1.358*** | 1.323*** | 1.325*** |
|                             | (0.205) | (0.202) | (0.205) | (0.202) | (0.202) |
| Constant                    | 3.797*** | 5.407*** | 3.509*** | 3.670*** | 3.194*** |
|                             | (0.0597) | (0.0720) | (0.0798) | (0.0859) | (0.305) |
| Industry sector × week of the interview in May × state | | | | Included (1828 categories) | Included (1828 categories) | Included (1828 categories) | Included (1828 categories) |
| Observations                | 41,880 | 41,880 | 41,880 | 41,880 | 41,563 | 41,563 | 41,563 | 41,563 |
| R-squared                   | 0.029 | 0.000 | 0.030 | 0.030 | 0.096 | 0.123 | 0.096 | 0.123 | 0.124 |

Robust standard errors in parentheses

*** p < 0.01, ** p < 0.05, * p < 0.1
Fig. 3 Scree plot from principal component analysis

| Component   | Eigenvalue | Difference | Proportion | Cumulative |
|-------------|------------|------------|------------|------------|
| Component 1 | 1.6315     | 0.4025     | 0.1813     | 0.1813     |
| Component 2 | 1.2290     | 0.0556     | 0.1366     | 0.3178     |
| Component 3 | 1.1734     | 0.1510     | 0.1304     | 0.4482     |
| Component 4 | 1.0224     | 0.0175     | 0.1136     | 0.5618     |
| Component 5 | 1.0049     | 0.1024     | 0.1117     | 0.6735     |
| Component 6 | 0.9025     | 0.0578     | 0.1003     | 0.7737     |
| Component 7 | 0.8446     | 0.0750     | 0.0938     | 0.8676     |
| Component 8 | 0.7697     | 0.3475     | 0.0855     | 0.9531     |
| Component 9 | 0.4222     | .          | 0.0469     | 1          |
**Fig. 4** Margin effects by self-employment type

**Fig. 5** Oaxaca-Blinder decomposition for males vs. females by category of self-employment
Data availability The data are available upon request for reproducing the reported estimates in the paper.

Code availability The code is available upon request for reproducing the reported estimates in the paper.

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