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Who suffers during recessions in Brazil?

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Who Suffers During Recessions in Brazil?

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Labor Markets Division

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2019

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Who Suffers During Recessions in Brazil?

Túlio A. Cravo^I

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Abstract

While the relationship between business cycles and employment is a topic of continuing interest, it has received limited attention in the literature focusing on developing countries. This study adds to the literature as it analyzes the heterogeneous correlations of the business cycle with different age, education, and ethnic groups by gender in a developing country setting, controlling for other characteristics. Using data from Brazil's monthly PME employment surveys between 2002 and 2016, regressions are estimated to assess how business cycles affect employment in specific demographic groups. The results provide evidence of large heterogeneities among demographic groups. Interestingly, unemployment rates in levels across demographic groups are not necessarily aligned with the sensitivity of these demographic groups' (un)employment and participation rates to economic crises.

JEL Codes: E24, J21, J23, J24, J46

Keywords: Labor Market, Brazil, Developing Countries, Business Cycles, Heterogeneous Effects, Employment Dynamics

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1. Introduction

One of the most perverse results of recessions is employment destruction. Understanding employment dynamics in different demographic groups across business cycles is therefore paramount to the design of public policy that are better targeting specific demographic groups. In recent years, some studies, mainly in developed countries, provided empirical evidence on the dynamics of employment for specific demographic groups.

Most papers on the heterogeneity of labor market outcomes across demographic groups address how wages, unemployment, and employment vary in a static manner. For instance, Card and Lemieux (1997) show that for the US and Canada unemployment rates vary across demographic groups, and Card and Krueger (1993) estimate large earning differences in the US between whites and blacks. For Brazil, Garcia et al. (2009) and Salardi (2012) show the existence of wage gaps based on gender and race in favor of men and whites, and that the racial wage gap is larger than the gender wage gap. Bourginon et al. (2007) measure the impact of inequality of opportunities for different demographic groups on income and show that current earnings are determined by parental characteristics and household income. Besides, Foguel et al. (2000) estimate the existence of a wage gap between the public and private sector and show an overrepresentation of women, older, and more educated workers and an underrepresentation of non-whites in the public sector.

Another line in the literature addresses how labor market measures across demographic groups are affected during business cycles. Bredemeier and Winkler (2015) find that economic downturns in the US have a greater effect on workers who are young, women, less educated, and blue-collar. Similarly, Bachman et al. (2015) find that in Europe men and young persons are more responsive to business cycles. Kelly et al. (2016) show a rising gap between immigrants and natives in Ireland and Burnette (2017) between Native Americans and non-natives during economic crises. Reis (2017) shows that in Brazil the probability of transition from unemployment to employment varies among demographic groups and over

the business cycle. According to Dureya and Arends-Kuenning (2003), children in Brazil are less likely to drop out of school to work during an economic crisis. However, none of these studies control extensively for other demographic characteristics.

A different but important way to look at heterogeneity in the labor market is to analyze how different demographic groups respond to business cycles, while controlling for other demographic characteristics and structural changes in the composition of demographic groups. Hoynes et al. (2012) are the first to do so for different population groups in the US, providing an overall analysis about how these groups respond to business cycles in the US. Hoynes et al. (2012) use state-level panel data and provide results for the relationship between a business cycle indicator and labor market outcomes for each demographic group while controlling for other demographic characteristics. This allows the authors to isolate the sensitivity of a specific population group to cycles. Such analysis provides an idea of whether business cycles reinforce the heterogeneity of demographic groups' labor market outcomes discussed in the literature (e.g., Salardi (2014)) and is an important guide for public policy related to issues such as gender and racial discrimination, youth employment, and educational and training policies during cycles, individually targeted at specific demographic groups.

However, the validity of their results for other countries is unclear. To date there is a general lack of studies on how economic cycles affect different demographic groups controlling for other demographic factors, particularly for developing countries. However, business cycle effects on labor market outcomes can have much further reaching impacts on people's household income in developing countries, which are characterized by more volatile economies. As such, academics and policy-makers can benefit greatly from deeper knowledge about the factors influencing employment dynamics in different demographic groups during business cycles in developing countries. This paper aims to fill this gap in the literature by exploring Brazil's monthly PME employment surveys from March 2002 to February 2016, covering three economic downturns, to provide

comprehensive evidence about employment dynamics by gender, ethnicity, age, and education in a developing country.

This study adds to the literature by providing first evidence on the monthly sensitivity of particular demographic groups to the business cycle, controlling for other characteristics in a developing country context over time. Moreover, it extends the literature by not only estimating the sensitivity of demographic groups to the business cycle in terms of unemployment and employment rate, but also in terms of participation rate. Hence, this study can provide a more complete picture than the previous literature of the reaction of particular demographic groups to cyclical movements in the economy. Such empirical evidence can be important in devising a unified theory that explains employment dynamics over the business cycle. From a policy perspective, the evidence produced can help develop specific policies that aim to dampen employment fluctuations and minimize the economic and social costs of job losses during economic downturns in developing countries, which are not only based on unemployment levels of particular demographic groups but complemented by evidence on the varying sensitivity of particular groups' labor market outcomes to the business cycle when controlling for other characteristics.

This paper is structured as follows: The following section presents the data. Section 3 discusses the methodology. Section 4 presents the results, and the final section provides a conclusion with policy implications.

2. Data

This study is based on Brazilian Labor Market data from March 2002 to February 2016 stemming from monthly employment surveys (Pesquisa mensal de emprego - PME) conducted by the Brazilian Institute of Geography and Statistics (IBGE). We chose this particular period, because it is the longest possible recent data series to study the labor market sensitivity of different demographic groups to

economic fluctuations.¹ This dataset consists of 16,684,469 observations and provides detailed demographic information that allows an analysis by gender, race, age, and education. Following the literature on Brazil (e.g., Campante et al., 2004; Chadarevian, 2011; Salardi, 2012), this study distinguishes in terms of race solely between white and non-white people.² In terms of age, we use five age groups (10-17, 18-25, 26-39, 40-59, and 60 and older).³ Restricting the dataset to those individuals of working age of 10 years and above leaves us with a base sample of 14,516,079 year-month observations. Regarding educational levels, this analysis uses four categories based on the highest completed level: less than middle school graduate; middle school graduate, incomplete high school, or high school dropout; high school graduate, college dropout, or incomplete college; and college graduate, Masters graduate, and PhD graduate.⁴ Given Brazil's regional differences, this study further distinguishes between six metropolitan areas, following the PME surveys: Recife, Salvador, Belo Horizonte, Rio de Janeiro, Sao Paulo, and Porto Alegre. Following the PME surveys, unemployment is defined as being without work within the reference week, but available to accept a job and having taken some measure to look for a job in the past 365 days. The unemployment rate is calculated as the number of unemployed among the number

¹ More recent data is unavailable in the same format, as the PME survey was discontinued after February 2016 and the only labour market survey data available from that point onward stems from a monthly continuous national household sample survey conducted using a different methodology, the Pesquisa Nacional por Amostra de Domicílios Contínua (PNAD contínua). Given the different survey methodologies, we refrain from combining data from the two different surveys and consider the sole use of PNAD contínua covering a more recent period not appropriate for this study, as it provides a shorter time span and thus less cyclical variation for the analysis.

² Non-white encompasses black and brown races. In the PME employment survey data, race assignment is self-reported. This manner of race assignment comes with biases resulting in inconsistency of race assignment over time and the 'money whitens' effect, as discussed in other papers.

³ We group individuals aged 10-17 as the youngest age group, because the PME survey uses 10 as the minimum age to classify the working age population. We limit this group to 17-year olds to start the next age group at age 18, which is the legal full-time working age. Workers between 16 and 18 are considered under-aged workers (*menor trabalhador* in Portuguese), meaning that this group is only permitted to work under specific rules to guarantee that the work does not affect general development and schooling. Even younger individuals are from 14 years onward allowed to work under apprenticeship programs with further restrictions. The remainder of the sample is divided into roughly equally sized age group ranges, whereby the starting age of 26 of the next age group marks at the same time an age category in which the large majority of the population is assumed to have completed formal education. 60 is used as maximum age, as workers above age 60 start to retire, and the exact age of retirement may be biased by an individual's labour market and employment outcomes. Therefore, we do not include the 60 and above age group in the cyclical sensitivity regression analysis.

⁴ This study's classification follows de Carvalho (2016). We chose not to follow the four educational categories outlined by Hoynes et al. (2012), but to adapt the category cut-offs to better reflect the developing country education level composition in Brazil, with more aggregation at higher educational levels and more disaggregated categories at the lower education spectrum.

of people in the labor force, which consists of those employed and unemployed. Participation is defined as the number of employed people over the number of people of working age. The latter is defined as all persons at least 10 years old. Lastly, the participation rate is defined as the number of persons in the labor force over the number of persons of working age. Group specific rates are calculated by restricting the sample to the specific group.⁵ Following Hoynes et al. (2012), and as common in the literature, we use the national and metropolitan area level unemployment rates as cyclical indicators.

3. Methodology

This analysis closely follows the strategy applied by Hoynes et al. (2012), who conducted a rigorous empirical study about the heterogeneous impacts of business cycles on the labor markets with data from the US. Using Brazil's PME data, this study replicates and extends their approach, applying it for the first time to a developing country. Likewise, this study uses the aggregate unemployment rate as a cyclical indicator and estimates its effect on the unemployment and employment rate of a particular demographic group following equation (1). Additionally, we estimate the effect of the aggregate unemployment rate on the participation rate of each group:

$$(1) \quad y_{gst} = c + \beta_1 * Y_{st} + RaceGender_g + Age_g + Education_g + a_s + year * a_s + \varepsilon_{gst}$$

⁵ We additionally decompose the employment rate by formality status and calculate the informal employment rate as the number of informally employed over the whole working age population. A difference from the general group-wise employment rate calculation is that we do not restrict the denominator, the working age population, to the respective group, as the formality status is, unlike age or gender, only expressed when holding a job. Besides, we calculate an informality share, which decomposes those working into either working as informal or formal workers. This study uses two alternative definitions of formality status. The main definition used in this paper is based on information about whether or not a person contributes to social security. Military personnel and public employees are considered formal by default. According to Henley et al. (2009), who compare informality in Brazil based on varying definitions, this is the most useful measure. Alternatively, we define informality following the Brazilian Institute of Applied Economics Research (IPEA) as consisting of those who do not have a legal employment booklet (Carteira Assinada), are self-employed, or are unpaid workers.

where the subscript g stands for the respective age, race, gender, year, month, and metropolitan area demographic subgroup. $RaceGender_g$ can thus include the dummies white male, non-white male, white female, and non-white female. Similarly, subscript s stands for the respective metropolitan area and t for the month-year time period interaction.

To obtain figures on aggregate national sensitivity to the business cycle, we first estimate the model in equation (1) at the national level.⁶ Herein, $year * a_s$ is replaced solely by a year trend $year$, the metropolitan area fixed effect is dropped, and the subscript s is neglected for all other variables in the model. However, considering the expected heterogeneity among Brazil's regions, all estimations are conducted at the metropolitan level as presented in (1) as well.

In the metropolitan level regressions, the dependent variable y_{gst} represents interchangeably either the unemployment, employment, or participation rate of a specific demographic group in a particular metropolitan area in a certain year-month time period, respectively.⁷ This requires the calculation of monthly demographic group specific aggregate unemployment, employment, and participation rates.⁸ The explanatory variable Y_{st} stands for the aggregate unemployment rate in a given metropolitan area and year-month time period. $RaceGender_g$, Age_g , and $Education_g$ represent sets of dummy variables controlling for race-gender, age, and education characteristics. Furthermore, a_s and $year * a_s$ control for metropolitan area fixed effects and metropolitan area specific year trends.

The model in equation (1) is estimated separately for each demographic group, whereby the coefficient β_1 is the coefficient of interest. This coefficient

⁶ Aggregating over metropolitan areas at the national level increases the sample size of each demographic subgroup.

⁷ We also consider models estimating the sensitivity (in)formal employment to economic fluctuations. The informal employment share in these models is defined as individuals being employed informally, either as a share of the entire working age population or as a share of all employed. However, these models estimating the effect of business cycles on informality, when controlling for other characteristics, cannot be estimated at the same level of disaggregation. Additionally, dividing the observations into formal and informal workers would make group sizes too small. Therefore, these estimations only control for either education and race, or for age and race.

⁸ All estimates are based on seasonally adjusted rates.

provides information about the sensitivity of the particular demographic group to changes in the aggregate metropolitan area specific unemployment rate Y_{st} . For instance, in the estimation of the sensitivity of the non-white women demographic group as dependent variable, the control variable $RaceGender_g$ is excluded, as all observations in this estimation model are non-white women.⁹ However, the model can still control for age and educational groups.

As Neves and Barbosa (2014) report a significant increase in female labor market participation and educational level and a decrease in the male participation rate over this time frame in Brazil. Thus, we consider controlling for compositional changes of demographic groups in the labor market particularly important. Therefore, as a robustness check, we estimate a variation of the model in equation (1) including year-month fixed effects in the metropolitan area level model and separate year fixed effects and month fixed effects in the national level model. Moreover, the steep increase in the share of formal employment during the sample period presented in Holanda Barbosa Filho and Veloso (2016) suggest large structural changes in labor market composition.

4. Results and Discussion

4.1 Descriptive Results

Before starting the discussion on how various demographic groups might have been differently affected by the cyclicity of the economy controlling for other factors, Table 1 provides an overview of the heterogeneity of labor market outcomes in February 2016, the most recent month of the sample in terms of levels. Table 1 distinguishes between unemployment and employment rates, usual

⁹ The regression for the non-white women demographic group has, for instance, 4 age categories * 4 educational categories * 6 metropolitan areas * 168 year-months, which equals 16,128 demographic group observations. One such group observation would thus be non-white women, age 10-17, with less than middle school education, in Belo Horizonte, in February 2016. Another group observation would be non-white women, age 18-25, with less than middle school education, in Belo Horizonte, in February 2016. A few of the 16,128 potential demographic group observations get dropped, as by definition there are no individuals falling into a certain demographic group or generally no or too few individuals fall into specific demographic groups. For instance, there are no 10-17 year-olds that are already at the college, Masters, or PhD degree levels, and in certain year-month metropolitan areas there are few non-white women who are 40-59 year-old college, Masters, or PhD graduates.

weekly hours, and monthly income during the reference month by race and gender, educational category, and age group. Unemployment rates are lowest for white men, people with less than middle school education, and college graduates, as well as age groups above 40. While employment rates and working hours hardly differ by race within gender, the monthly income gap is striking. The average monthly income for non-white men is 1,798 Brazilian Reais (BRL), which is only 62% of the 2,896 (BRL) that white men earn on average per month.¹⁰ The mean wage gap between non-white and white women is similarly about 62%. Comparing across gender, Table 1 further demonstrates that women work slightly fewer hours but earn about one-quarter less. As expected, higher education levels raise monthly income levels and employment rates. The same holds for age. The employment rate drops only for those above age 60, likely influenced by early retirement. Distinguishing further between formal and informal workers, the results show that formal workers generally have higher average monthly incomes than informal workers and work more hours. While Table 1 provides only aggregate figures at the national level, Table A.1a in the Appendix presents heterogeneity by each of the six metropolitan areas. Figures A.3 and A.4 in the Appendix show (un)employment and participation rate heterogeneity by demographic group over time.

Whereas Table 1 provides an analysis of the heterogeneity of labor market measures for different demographic groups in February 2016, Table 2 presents the heterogeneity in changes in labor market measures between the peak of an expansion of the economy and the trough of a recession for various subgroups using the most recent recession period.¹¹ As expected, a business cycle downturn leads to a decrease in the unemployment rate and an increase in the employment

¹⁰ This converts into 453 USD and 730 USD respectively.

¹¹According to the classification of the Brazilian Business Cycle Dating Committee (CODACE) of the Brazilian Institute of Economics (IBRE), the most recent recession period lasted from the second quarter of 2014 until the fourth quarter of 2016 (CODACE, 2017). Hence, we set March 2014, the last month of the first quarter of 2014, and the last month of the preceding expansion period as peak. While December 2016, the last month of the fourth quarter of 2016, marks the end of the most recent recession period and thus the trough, we use the figures of February 2016 as a proxy for the actual trough for illustrative purposes, as it is the last month of survey data currently available.

rate for all age and education levels, genders, and ethnicities, whereas changes in participation rates vary in direction.

Table 1: Heterogeneity in Labor Market Outcomes in February 2016

	Unemployment Rate (%)	Employment rate (%)	Usual Weekly Hours	Estimate s Hourly Income	Monthly Income (in Feb. 2016 Reais)
<i>All</i>	8.0 %	49.6 %	38	12.9	2087
<i>Race-Gender</i>					
White men	6.5 %	58.8 %	40	17.3	2896
White women	7.9 %	42.2 %	36	14.6	2222
Non-White men	7.9 %	58.3 %	40	10.6	1798
Non-White women	10.3 %	42.2 %	37	9.0	1396
<i>Education</i>					
Less than middle school graduate	6.8 %	28.1 %	38	7.4	1204
Middle school grad/High school dropout/incomplete	10.9 %	43.0 %	39	8.0	1309
High school grad/College dropout/incomplete	9.3 %	61.6 %	39	10.4	1707
College grad/Master/PhD	4.2 %	72.8 %	37	28.4	4382
<i>Age Group</i>					
10-17	38.3 %	3.5 %	29	5.8	703
18-24	20.5 %	49.2 %	38	7.5	1189
25-39	8.1 %	74.9 %	39	12.3	2010
40-59	4.6 %	67.8 %	39	14.1	2294
60 and older	1.8 %	18.3 %	37	17.8	2760
<i>Formality</i>					
Formal		38.4 %	39	14.0	2312
Informal		11.3 %	36	8.8	1329

Source: Authors' calculations based on PME survey February 2016

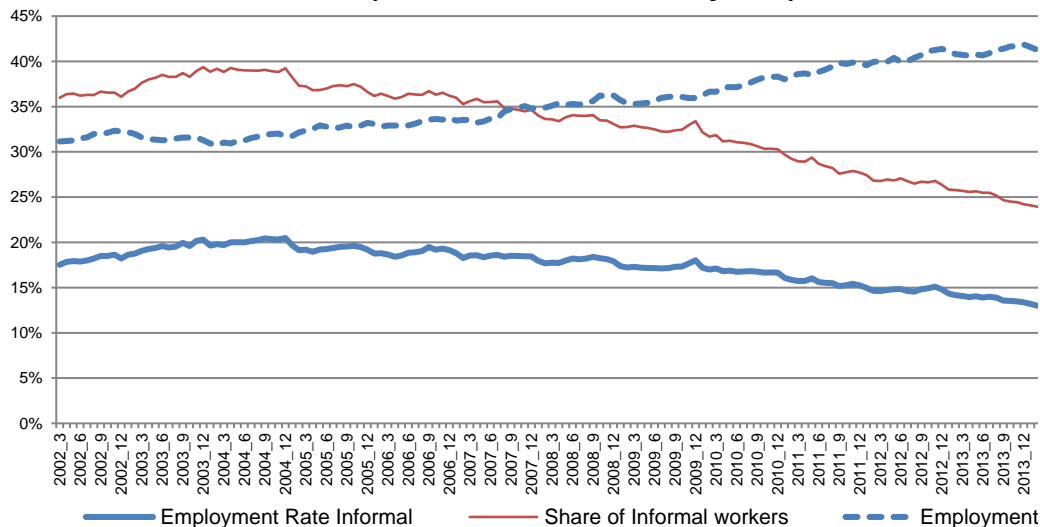
Note: Formality is based on the social security status definition following Henley et al. (2009).

While based on larger increases of the unemployment rate for white men and white women than for non-whites, white workers appear at first side harder hit by the recession. This phenomenon/observation is affected by varying degrees of changes in the participation rate by race. The twice as high percentage point decrease in the labor market participation rate for non-whites compared to whites may well more than overcompensate for changes in the rate of people out of work, and as a result let the change in the unemployment rate for non-whites appear lower. In terms of education, percentage point increases in net unemployment rates¹² are highest for the lower educated groups. By age group, rather than the youngest group, the second youngest group between 18 and 24 years old appears

¹² Net unemployment rate changes are estimated by subtracting the percentage point changes in the participation rate from the percentage point changes in the unemployment rate. This means that for the less than middle school educated group, $3.4 - (-3.2) = 6.6$

most affected. In terms of formality of employment, the recession leads to a slower decrease in the employment rate in the informal sector.¹³ Table A.2 in the Appendix illustrates that this pattern also largely holds when considering each metropolitan area separately.

Figure 1: (In)formal Employment Rate and Share of Informal Workers over Time (based on Social Security Def.)



Source: Authors' calculations based on raw PME surveys from March 2002 to February 2016
 Note: (In)formality is here defined based on social security contributions following Henley et al. (2009). Employment rate Informal (Informal workers/whole working age population), Share of Informal Workers (Informal Workers/all occupied), Employment Rate Formal (Formal workers/whole working age population)

Looking at the formality case in more detail, a plot of employment rate differentials over time, displayed in Figure 1, shows that the informal employment rate is generally decreasing over time and the formal employment rate is thus generally rising. This is an indicator of an ongoing structural change. All recession periods—2003, 2008, and the most recent recession—have led to a slowing of the pace at which the share of informal employment has been decreasing.¹⁴ This underlines the importance of controlling for time trends in equation (1).

¹³ Here, formality is defined as dependent on whether a person is contributing to social security following Henley et al. (2009).

¹⁴ Using the alternative informality definition as used by the Brazilian Institute of Applied Economic Research (IPEA), classifying instead all those as informal, who do not have a legal employment booklet (Carteira Assinada), are self-employed, or are unpaid workers similarly shows a decreasing trend of the share of informality over the whole period and is in line with findings by IPEA (2015). Only starting from the beginning of 2014, we observe

Table 2: Peak to Trough Changes March 2014 to Feb 2016 Recession Levels (by Gender, Race Education, Age, and Formality Status)

	Δ Unemployment Rate (in percentage points)	Δ Employment Rate (in percentage points)	Δ Participation Rate (in percentage points)
All	3.1	-3.4	-1.7
<i>Race-Gender</i>			
White men	3.8	-3.6	-1.2
White women	3.3	-1.7	-0.1
Non-White men	2.6	-4.9	-3.2
Non-White women	2.5	-3.1	-2.0
<i>Education</i>			
Less than middle school graduate	3.4	-4.1	-3.2
Middle school grad/High school dropout/incomplete	4.4	-4.0	-2.0
High school grad/College dropout/incomplete	3.5	-4.8	-2.6
College grad/Master/PhD	1.6	-3.7	-2.4
<i>Age Group</i>			
10-17	10.3	-2.0	-1.8
18-24	8.3	-7.4	-2.6
25-39	3.3	-3.5	-0.7
40-59	2.6	-1.5	0.4
60 and older	1.1	-2.1	-2.0
<i>Formality</i>			
Formal		-1.8	
Informal		-1.6	

Source: Authors' calculations based on seasonally adjusted (ArimaX11) PME surveys, March 2014 and February 2016

Note: Formality is based on the social security status definition following Henley et al. (2009)

Nevertheless, a static analysis of differences in levels or changes in levels of various rates likely provides biased results, as discussed in Barnichon and Mesters (2017) and Hoynes et al. (2012). First, an analysis relying on levels cannot control for other characteristics. Second, it does not account for changes in the composition of distinct demographic groups, such as population growth of certain groups or rising labor force participation of women over time. Therefore, the next section provides estimates that control for both of these potential sources of bias.

differences in the trend of the share of informality between the two measures, whereby the share of informality following the IPEA definition increases starting with the start of the recession in 2014 (see Appendix Figure A.1), whereas it only decreases to less than the trend when following our definition based on social security contributions.

4.2 Regression Results

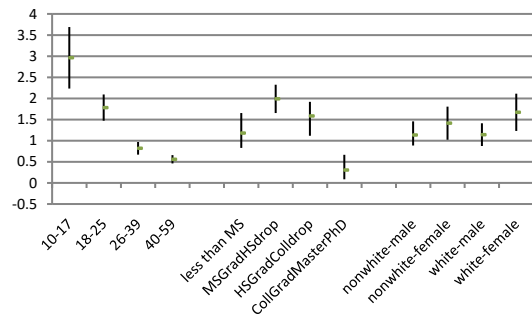
In separate regressions, we estimate each major demographic group's sensitivity of labor market measures to national and metropolitan unemployment rates, as explained in section 3. This allows us to analyze the sensitivity of unemployment, employment, and participation rate for each specific demographic group over the business cycle, for which the national and metropolitan area unemployment rates act as a proxy. Importantly, we control for demographic characteristics to account for any differences in the composition of demographic groups. The point estimates for 72 regressions estimated using national aggregated data and a panel for the main metropolitan areas of the country are presented in Figure 2.

The first row of Figure 2 shows results using national level data (Figures a to c), and the second row shows the metropolitan level data (Figures d to f). Each point in the figure is the coefficient β_1 of equation (1). For instance, Figures 2a and 2d show the results for the regressions capturing the sensitivity of group specific unemployment to the cyclical condition (expressed by the national unemployment rate in a and by the metropolitan area unemployment rate in d) for each age, education, and race/gender group. Controlling for metropolitan areas has the advantage of bringing more heterogeneity into the data and adds observations to each major demographic group's regression. As we generally observe similar patterns at national and metropolitan area levels, this implies that the sensitivity is not affected by the fewer observations at the national level and smaller within group sample sizes at the metropolitan area level. However, the metropolitan area level coefficients have smaller confidence intervals. The observed smaller confidence intervals of the coefficients at the metropolitan area level and level differences of the coefficients as compared to the national level suggest the existence of inter-metropolitan area differences in the sensitivity of certain demographic groups' responsiveness to business cycles, highlighting the importance of controlling for metropolitan areas in the regression to obtain more precise estimates. Therefore, results are presented at both levels.

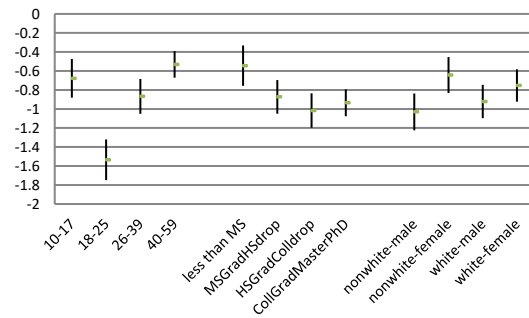
Figure 2: Plots of Coefficients using specification with year trend

National Level: Impact of national unemployment (model specification with year trend)

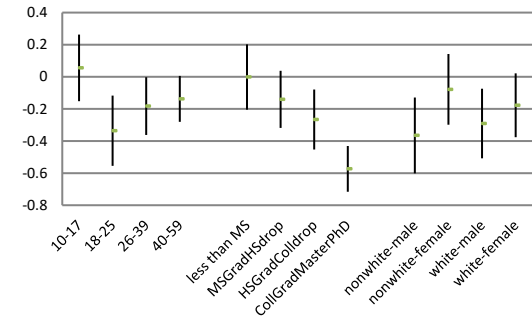
a) on group unemployment



b) on group employment

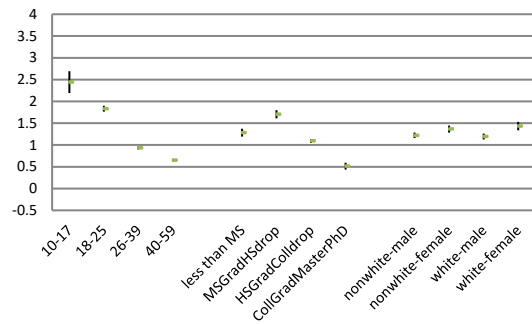


c) on group participation

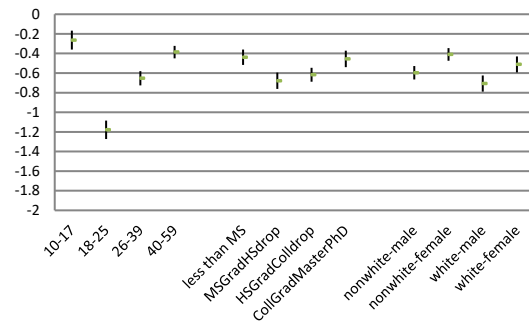


Metropolitan Level: Impact of metropolitan unemployment (model specification with metropolitan area specific year trend)

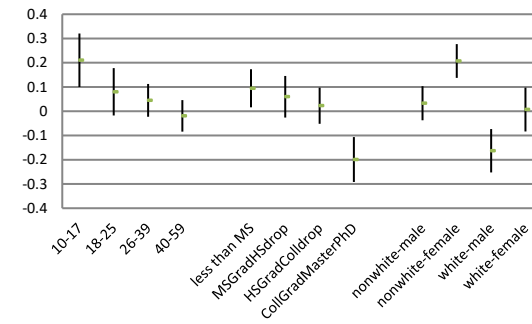
d) on group unemployment



e) on group employment



f) on group participation



Source: Authors' calculations based on seasonally adjusted (ArimaX11) PME surveys, March 2002 to February 2016

Note: The coefficients are displayed as dots, whereas the bars represent the 95% confidence intervals.

The first point estimate in Figure 2a indicates that a 1 percentage point increase in the unemployment rate leads to a 3 percentage point increase in the unemployment rate of the demographic group between 10 and 17 years old. The results for other age groups indicate that older workers are less sensitive to aggregate unemployment. This is in line with findings by Hoynes et al. (2012) in the US and Bachman et al. (2015) in Europe, who likewise find that younger age groups are harder hit by crisis.

Next, results for demographic groups constructed based on education and race/gender, are presented. Less educated workers (less than middle school attainment) are not very sensitive to labor market conditions, a result that is in line with the raw data presented in Table 1. A possible explanation could be that firms can save more in terms of wages as presented in Table A1a when dismissing the slightly more educated rather than the lower paid least educated workers. Alternatively, one may argue that the category of the least educated are employed in basic but more essential positions. This would be in line with findings by Reis (2017) that the least educated face relatively shorter unemployment spells compared to the more educated. This is also in line with a report in *The Economist* (2016) that routine middle-educated jobs are most affected by automation over time, rather than unskilled, non-routine work such as cleaning.

As also found for the US in Hoynes et al. (2012), the group that suffers more is made up of workers who have completed middle school or are high school dropouts; the responsiveness of more qualified workers is of lesser intensity. This is moreover in line with findings by Haltiwanger et al. (2017) in the US that younger and less than high school educated workers are more likely to be dismissed during economic downturns than older workers.¹⁷ Interestingly, our results suggest that the unemployment rate of women is more responsive to labor market conditions than the unemployment rate of men for the white and non-white population. The

¹⁷ Hoynes et al. (2012) and Haltiwanger et al. (2017) do not further subdivide the less than high school educated into less than middle school educated workers.

responsiveness of white and non-white males to unemployment is the same, indicating that labor market conditions do not appear to affect these groups differently. Despite the indication from Table 1 that non-white males have a higher level of unemployment, this does not seem to be related to higher sensitivity during business cycles (controlling for other demographic characteristics).

Corresponding regressions using employment and participation rates as dependent variables can help us further investigate some results found so far. The unemployment rate of the demographic group between 10 and 17 years old is the most sensitive to changes in unemployment among all demographic groups. This pattern is observed at national (Figure 2a) and metropolitan level (Figure 2d). Nevertheless, Figures b and e show that the employment rate of the same demographic group is not as sensitive to the unemployment rate as expected. This might be explained by the increase in the participation rate of this demographic group when unemployment increases, as indicated in Figures 2c and 2f. This result suggests that youngsters are forced into the labor market to help their families. This result opposes findings from an earlier analysis on Brazil by Dureya and Arends-Kuenning (2003) that children are not more likely to work during economic crisis as their opportunity costs likewise fall. The joint analysis also helps us to better understand the similar sensitivity of white and non-white males to unemployment. At the national level, we show that the sensitivity of the white male and non-white male unemployment rate is the same; however, Figures 2b and 2c show that the mean sensitivity of the employment and participations rates of white males to business cycles is slightly lower than that of non-white males. This suggests that the sensitivity of the unemployment rate of non-white males would be higher if non-white males were not deciding to withdraw from active labor market participation at a higher rate than white males. The same also holds in an alternative specification of the model that controls for year and month fixed effects instead of a year trend (see Figure A.2).

Using the metropolitan area Panel d in Figure 2, we likewise show that white male and non-white male sensitivity to the business cycle in terms of

unemployment is similar. However, Figures e and f show that unlike the national level case, the employment and participation rates of white males are at the mean more sensitive to cycles than non-white males. This result also holds when considered apart from the year trend adding year-month fixed effects to the model to control, in a more detailed manner, for structural and compositional changes over time (see Figure A.2). While controlling for year-month fixed effects has the advantage of removing further bias from changes in the long run demographic structure, it also partly removes the macroeconomic cyclicity in which we are particularly interested. Besides, these alternative specification confidence intervals are much larger; thus, any potential difference in sensitivity is less precisely estimated. Moreover, including year-month fixed effects, these findings differ from the clear larger changes in the unemployment and participation rates for non-white males presented in Tables 2 and A.2 for the national and metropolitan area level respectively and highlight the importance of controlling for regional heterogeneity and demographic characteristics.

A persistent wage gap in favor of men and white Brazilians throughout the income distribution, as estimated by Garcia et al. (2009), may be an explanation for why men and white workers are more likely to drop out of the labor market. Their larger potential wealth and savings from the higher wages earned can be used to bridge inactive periods during crises. Further support for a continued racial and gender wage gap during this sample period is also provided, as earlier mentioned in Table A.1. Particularly in Rio de Janeiro, white men's monthly income is more than double the amount non-white women earn and almost double the earnings of non-white men.

Comparing the sensitivity of white and non-white women's unemployment rates to cycles in Figure 2 shows similar interesting deviations from the static findings of Tables 1. Figure 2a suggests that unemployment rate for white women is at the mean slightly more responsive to cycles when controlling for other characteristics, rather than that of non-white women, who are the ones who experience according to Table 1 higher levels of unemployment. This pattern

persists for the metropolitan area model in Figure 2d, but the difference in sensitivity diminishes, leaving white women only very minimally more if not equally sensitive than non-white women to cycles. As in the case of men, we also consider a different specification controlling for year and month fixed effects at national and metropolitan area levels respectively, presented in Panels a and c of Figure A.2 in the Appendix. These panels show very similar sensitivity levels compared to those in the main specification. While not in line with the findings in terms of static levels, these findings are in line with the larger static change in the unemployment rate of white women between the peak and trough of the most recent crisis presented in Table 2. However, the sensitivity of the employment and participation rate to changes in the unemployment rate in Figures 2b and c and Figures 2e and f suggest the opposite from what the static percentage point change in those rates in Table 2 may suggest. Non-white women's employment rates are, when controlling for other characteristics, less responsive to changes in the overall national or metropolitan area unemployment rate than that of white women. In addition, the participation rate of non-white women always tends to be less reduced or even increased when compared to white women. As in the case of white versus non-white men, also the lower sensitivity of non-white women's participation rate may be the result of a greater need for non-white women to work to support the household, which can also explain non-white women's generally higher labor market participation rate as presented in Table 1.

A potential counter to the argument that lower total household incomes for non-white individuals results in fewer funds to bridge unemployment spells is to consider racial-intermarriage, whereby the income difference is more balanced at the household level. However, Telles (1993) and Ribeiro and Da Silva (2009) show that while racial intermarriage is becoming increasingly more common, representing one in three marriages by the year 2000, such marriages are largely of couples of similar skin color rather than between white and black individuals. Therefore, racial wage gaps may despite rising racial inter-marriage nevertheless still significantly affect total household income and savings. This finding may also

provide support for the existence of an added worker effect for women, non-whites, and youngsters when other groups might be discouraged from participating in the labor force, as discussed for women in Lundberg (1985) for the case of the US and observed in a developing country context by Parker and Skoufias (2004) during the peso crisis in Mexico.

Although Figures 2 and A.2 distinguish by race and gender, the responsiveness of the individual groups suggests that the gender component is more sensitive than the race component. In spite of lower gender than racial wage gaps estimated by Garcia et al. (2009), that may suggest differently, women's unemployment rates are more sensitive to changes in the overall unemployment rate at the national level (Panel a) and at the metropolitan area level (Panel d). At the same time, women's employment and participation rates appear less responsive to changes in the unemployment rate than that of men. The sensitivity of the unemployment rate for women seems therefore to a lesser extent, reduced through unemployed individuals becoming inactive, as in the case of men. The higher sensitivity of women's unemployment rate is in line with Bahçe and Memiş' (2014) findings for Turkey that women become more likely to be marginally attached to the labor market during economic downturns than men, but contradicts findings for Europe by Bredemeier and Winkler (2015) and Hoynes et al. (2012) for the US. Indeed, Bachman et al. (2015) find that men are more likely to become unemployed during recessions. However, the lower responsiveness of the participation rate of women than men during recessions in Brazil contradicts their findings that among the marginally attached, women in Turkey are more likely to move out of the labor force than men. Hence, there appears to be no internationally consistent pattern. Brazilian women's greater responsiveness in terms of unemployment might be partly explained by the rapid increase of women participating in the labor market. Among other factors, this increase has been attributed to the wider availability of child care facilities (Holanda Barbosa and Melo Costa, 2017). Moreover, these authors' findings that the probability of women's participation in the labor market increases with the availability of daycare facilities

shows peaks in particular in years with large business cycle fluctuations, which supports the argument that women enter the labor market also as a backup during crisis.

Overall, these results suggest that the static levels of the unemployment, employment, and participation rates over the business cycle for particular demographic groups, and changes in these rates between economic peaks and troughs, do not necessarily match the group's sensitivity to business cycle fluctuations when controlling for other characteristics. Figure 2 suggests broadly four different responses to cycles: First, the oldest group and those with a college degree, and to a lesser extent also the group with less than middle school education, appear hardly sensitive to business cycles in terms of all three rates. Second, the middle school, but less than high school educated category appears highly sensitive to business cycles in terms of unemployment and employment rates. Third, the findings that the participation rate of youngsters aged 10-17 and women (when compared to men) rises with unemployment suggests that these groups are forced to participate in the labor force in crisis times. Fourth, non-whites' are in terms of levels, as Table 1 shows, face higher unemployment rates than whites and women. Nevertheless, non-whites appear to have consistent workers in terms of participation rates, as their employment situation seems less sensitive to the cyclicity of the labor market when controlling for other characteristics. Moreover, according to Reis (2017), non-whites appear to move more quickly from unemployment back into employment than whites.¹⁸

¹⁸ We expect informality to increase during recessions. In addition to the main results, estimations of the sensitivity of formality status to the business cycles are displayed in Figure A.4 and show that the share of informal workers rises in economic downturns for non-white and white individuals. We do not perform estimations for formality status using the same demographic group disaggregation used earlier to control for the full array of demographic characteristics due to sample size limitations as a result of the additional formality status dimension.

5. Conclusion and policy implications

This study estimates, for the first time, how various business cycles correlate with monthly labour market outcomes of different demographic groups in a developing country context. Using monthly PME employment survey data for the period of March 2002 to February 2016, we estimate the unemployment, employment, and participation rates for different demographic groups. We also estimate the sensitivity of each demographic group's rates over the business cycle, controlling for other demographic characteristics. Findings highlight the importance of controlling for demographic, regional, and compositional characteristics when estimating different demographic groups' responsiveness to business cycle fluctuations.

Controlling for other demographic characteristics and compositional changes, white women suffer more in terms of unemployment than men. Purely looking at level changes suggests the opposite. Interestingly, while in levels unemployment rates for white and non-white men differ, there appears to be no difference in their sensitivity to business cycles when controlling for other characteristics. While white women face lower unemployment rates in levels than non-white women, our findings suggest that women's unemployment rates are, in general, much more responsive to crises than that of men. This opposes findings by Hoynes et al. (2012) who show that in the US men and non-whites are more responsive to business cycles. Moreover, the participation rate of non-whites and women appears less sensitive to cycles, which may be explained by lower capacity to bridge inactivity spells with savings due to lower accumulated wealth as a result of the persisting wage gaps. Generally, the youngest and those with intermediate schooling level (middle school but less than high school) are the hardest hit by economic crises. While those with intermediary education also drop out of the labour market at high rates, youngsters and women hardly respond in terms of participation rate. The highest educated and oldest demographic groups appear least sensitive to business cycles. In contrast to earlier findings that children are

less likely to drop out of school to work during crises because of likewise lower opportunity costs of working, our findings suggest the opposite. When controlling for other characteristics, the labour market participation rate of 10-17 year olds increases with the unemployment rate.

Hence, the findings suggest that solely looking at levels and changes in levels does not suffice to inform policy-makers regarding the sensitivity of particular demographic groups to business cycles. It is therefore important that policy-makers jointly consider the sensitivity, levels, and changes in levels of labour market outcomes and the size of each demographic group when designing labour market policies to smoothen the cyclical fluctuations of labour market outcomes.

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7. Appendix

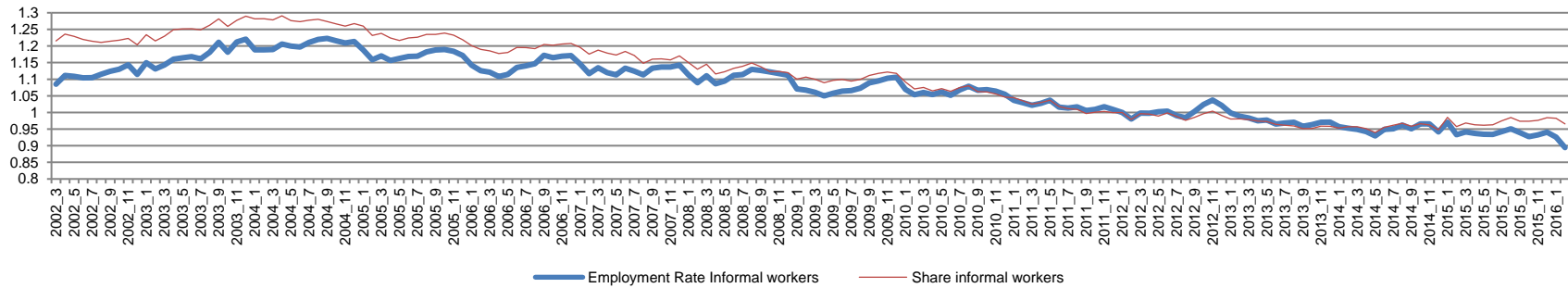
Table A.1: Heterogeneous Labor Market Outcomes (by Region, Gender, Race Education, Age, and Formality Status in February 2016

Category	Unemployment Rate (%)								Employment rate (%)								Usual Weekly Hours						Monthly Income (in Feb. 2016 Reais)											
	All	Recife	Salvador	Belo Horizonte	Rio de Janeiro	São Paulo	Porto Alegre	All	Recife	Salvador	Belo Horizonte	Rio de Janeiro	São Paulo	Porto Alegre	All	Recife	Salvador	Belo Horizonte	Rio de Janeiro	São Paulo	Porto Alegre	All	Recife	Salvador	Belo Horizonte	Rio de Janeiro	São Paulo	Porto Alegre						
All	8 %	10 %	13 %	7 %	5 %	9 %	6 %	50 %	44 %	48 %	49 %	49 %	51 %	51 %	38	39	39	38	39	39	36	37	37	36	37	38	34	2087	1600	1609	2026	2365	2297	2256
<i>Race-Gender</i>																																		
White men	7 %	9 %	11 %	7 %	4 %	8 %	5 %	59 %	54 %	55 %	57 %	59 %	59 %	61 %	40	40	41	40	40	41	39	2896	2149	3060	3059	3378	3013	2615						
White women	8 %	9 %	13 %	7 %	6 %	9 %	7 %	42 %	39 %	38 %	41 %	40 %	44 %	44 %	36	37	37	36	37	38	34	2222	1658	2113	2242	2705	2281	2061						
Non-White men	8 %	11 %	11 %	7 %	5 %	9 %	8 %	58 %	52 %	57 %	57 %	59 %	62 %	58 %	40	40	40	40	41	41	37	1798	1543	1607	1874	2015	1835	1840						
Non-White women	10 %	12 %	14 %	8 %	7 %	13 %	10 %	42 %	36 %	42 %	43 %	42 %	44 %	45 %	37	37	37	37	37	37	34	1396	1263	1288	1437	1518	1443	1372						
<i>Education</i>																																		
Less than middle school graduate	7 %	8 %	9 %	5 %	5 %	8 %	6 %	28 %	27 %	30 %	30 %	27 %	28 %	30 %	38	39	38	38	39	39	38	1204	910	943	1224	1240	1389	1308						
Middle school grad/High school dropout/incomplete	11 %	13 %	17 %	9 %	6 %	14 %	10 %	43 %	35 %	42 %	45 %	42 %	43 %	49 %	39	40	38	39	39	40	38	1309	1034	1008	1339	1283	1541	1358						
High school grad/College dropout/incomplete	9 %	13 %	14 %	9 %	6 %	10 %	7 %	62 %	56 %	57 %	61 %	59 %	65 %	66 %	39	39	39	39	40	40	37	1707	1384	1389	1710	1802	1803	1987						
College grad/Master/PhD	4 %	5 %	7 %	5 %	3 %	4 %	3 %	73 %	71 %	70 %	71 %	70 %	76 %	73 %	37	38	39	37	38	38	32	4382	3350	3702	4155	4935	4440	4964						
<i>Age Group</i>																																		
10-17	38 %	43 %	41 %	33 %	32 %	44 %	25 %	4 %	1 %	5 %	4 %	2 %	4 %	6 %	29	23	26	29	25	32	30	703	470	540	679	619	773	845						
18-24	20 %	27 %	28 %	18 %	15 %	23 %	15 %	49 %	39 %	42 %	48 %	44 %	55 %	57 %	38	38	37	38	38	39	37	1189	1007	943	1170	1227	1333	1272						
25-39	8 %	11 %	13 %	7 %	6 %	9 %	7 %	75 %	66 %	70 %	73 %	75 %	78 %	77 %	39	40	39	39	40	40	37	2010	1553	1544	1987	2260	2179	2205						
40-59	5 %	6 %	7 %	4 %	3 %	6 %	3 %	68 %	61 %	66 %	66 %	69 %	69 %	68 %	39	39	39	39	39	39	37	2294	1742	1811	2264	2526	2529	2513						
60 and older	2 %	0 %	6 %	2 %	1 %	2 %	3 %	18 %	18 %	16 %	17 %	21 %	17 %	18 %	37	37	37	36	37	39	35	2760	1893	1942	2453	3183	3198	2945						
<i>Formality Status</i>																																		
Formal								38 %	32 %	33 %	40 %	37 %	41 %	42 %	39	40	41	39	40	40	37	2312	1840	1888	2179	2651	2482	2455						
Informal								11 %	13 %	15 %	9 %	12 %	11 %	9 %	36	35	35	36	36	37	35	1329	999	987	1369	1514	1593	1366						

Source: Authors' calculations based on PME survey February 2016

Note: Formality status is based on social security status definition

Figure A.1: Informal Employment Rate and Share of Informal Workers over Time (based on alternative informality definition)



Source: Author's estimations based on PME surveys, March 2002 to February 2016

Note: As in IPEA (2015) Figure A.3 (January 2012=1). Informality is defined as those who do not have a legal employment booklet (Carteira Assinada), are self-employed, or are unpaid workers

Table A.2: Peak to Trough Changes March 2014 to February 2016 - Recession Levels (by Gender, Race Education, Age, and Formality Status) by metropolitan area

Category	Δ Unemployment Rate Peak March 2014 to February 2016 Recession Level (in percentage points)								Δ Employment Rate Peak March 2014 to February 2016 Recession Level (in percentage points)								Δ Participation Rate Peak March 2014 to February 2016 Recession Level (in percentage points)							
	All	Recife	Salvador	Belo Horizonte	Rio de Janeiro	São Paulo	Porto Alegre		All	Recife	Salvador	Belo Horizonte	Rio de Janeiro	São Paulo	Porto Alegre		All	Recife	Salvador	Belo Horizonte	Rio de Janeiro	São Paulo	Porto Alegre	
All	3.1	5.3	3.6	3.4	3.3	3.5	4.3		-3.4	-2.4	-3.0	-5.3	-2.5	-3.9	-2.6		-1.7	0.3	-1.0	-3.5	-1.6	-2.0	-0.5	
<i>Race-Gender</i>																								
White men	3.8	5.9	4.0	3.5	3.1	4.0	5.3		-3.6	-4.3	-2.3	-6.1	-3.6	-2.6	-2.0		-1.2	-0.9	0.5	-4.2	-2.3	0.1	1.0	
White women	3.3	5.9	2.6	3.9	1.8	4.3	6.7		-1.7	-1.6	-1.5	-4.2	-0.4	-2.0	-3.8		-0.1	1.1	-0.7	-2.3	0.9	0.4	-0.7	
Non-White men	2.6	5.7	6.6	3.8	1.6	2.6	3.0		-4.9	-5.7	-11.6	-6.1	-3.8	-5.4	-1.7		-3.2	-2.5	-7.8	-4.2	-3.1	-3.3	0.3	
Non-White women	2.5	3.1	6.0	2.4	1.5	2.6	3.7		-3.1	1.1	-4.1	-4.6	-1.9	-3.8	-2.8		-2.0	2.6	-0.5	-3.7	-1.5	-2.9	-1.3	
<i>Education</i>																								
Less than middle school graduate	3.4	3.8	1.3	2.1	2.7	3.8	3.0		-4.1	-3.0	-3.0	-5.6	-3.2	-5.0	-2.3		-3.2	-1.9	-3.0	-4.8	-2.7	-3.8	-1.3	
Middle school grad/High school dropout/incomplete	4.4	7.5	4.4	4.7	1.3	5.7	5.8		-4.0	-3.3	-1.2	-7.5	-2.5	-5.1	-4.6		-2.0	-0.5	0.8	-5.3	-2.1	-2.5	-1.5	
High school grad/College dropout/incomplete	3.5	6.4	4.6	3.9	2.0	3.7	3.5		-4.8	-5.4	-4.0	-7.0	-4.8	-4.3	-4.2		-2.6	-1.7	-0.8	-4.3	-3.6	-1.9	-1.5	
College grad/Master/PhD	1.6	2.1	1.7	2.2	1.7	1.0	2.2		-3.7	-0.9	-3.5	-4.7	-3.7	-2.7	-3.9		-2.4	0.8	-2.1	-2.9	-2.3	-2.1	-2.2	
<i>Age Group</i>																								
10-17	10.3	14.6	4.2	13.5	11.4	9.9	3.3		-2.0	-1.4	-0.1	-2.9	-1.5	-2.3	-1.6		-1.8	-1.1	0.3	-2.5	-1.4	-2.3	-1.7	
18-24	8.3	11.4	7.6	8.8	4.3	8.5	10.0		-7.4	-8.2	-5.2	-11.8	-4.6	-6.5	-7.8		-2.6	-2.4	-0.3	-7.1	-3.0	-0.5	-0.9	
25-39	3.3	6.0	3.4	3.5	2.1	3.3	4.1		-3.5	-2.6	-2.8	-5.7	-3.2	-3.5	-3.0		-0.7	2.0	-0.3	-2.9	-1.3	-0.6	0.3	
40-59	2.6	4.6	2.9	2.5	1.5	3.0	1.7		-1.5	-1.2	-1.5	-3.2	-1.7	-1.0	-1.1		0.4	1.7	0.9	-1.4	-0.7	1.7	0.2	
60 and older	1.1	-0.8	5.0	1.5	0.9	0.8	2.4		-2.1	-2.2	-4.3	-3.2	0.3	-3.8	-0.2		-2.0	-2.3	-3.4	-3.0	0.2	-3.9	0.4	
<i>Formality Status</i>																								
Formal									-1.8	-1.1	-2.7	-3.5	-0.8	-2.0	-1.2									
Informal									-1.6	-1.3	-0.1	-1.8	-1.6	-1.9	-1.3									

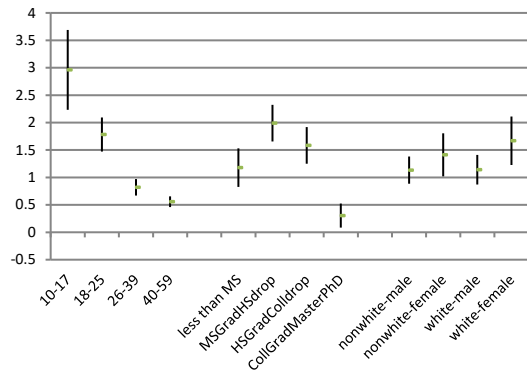
Source: Authors' calculations based on seasonally adjusted (ArimaX11) PME surveys March 2014 and February 2016

Note: Calculations are based on largest possible sample. Formality status is based on social security status definition

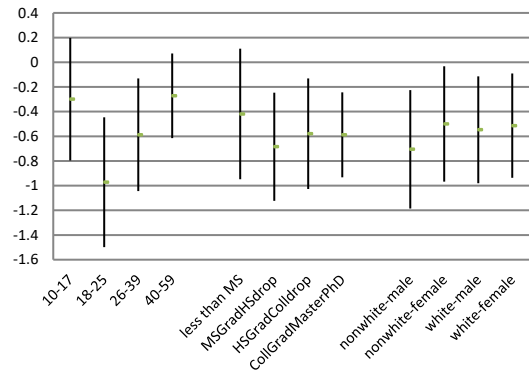
Figure A.2: Plots of Coefficients

National Level: Impact of national unemployment (model with year and month fixed effects)

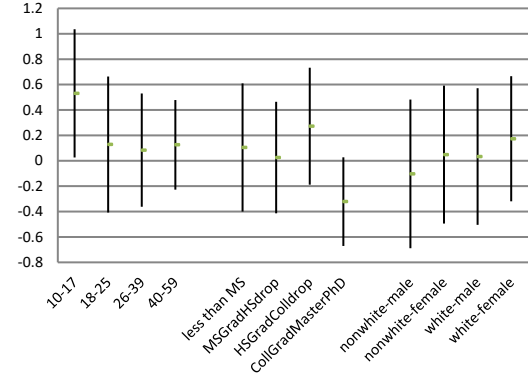
a) on group unemployment



b) on group employment

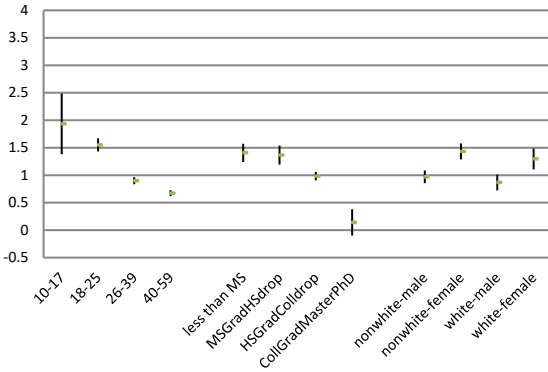


c) on group participation

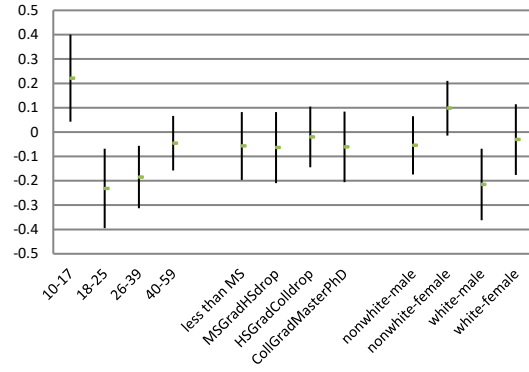


Metropolitan Level: Impact of metropolitan unemployment (model with year-month fixed effects and year trend)

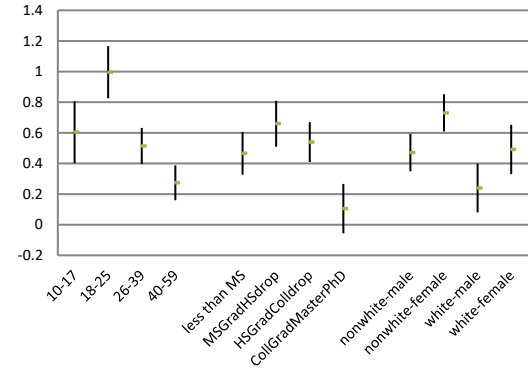
d) on group unemployment



e) on group employment



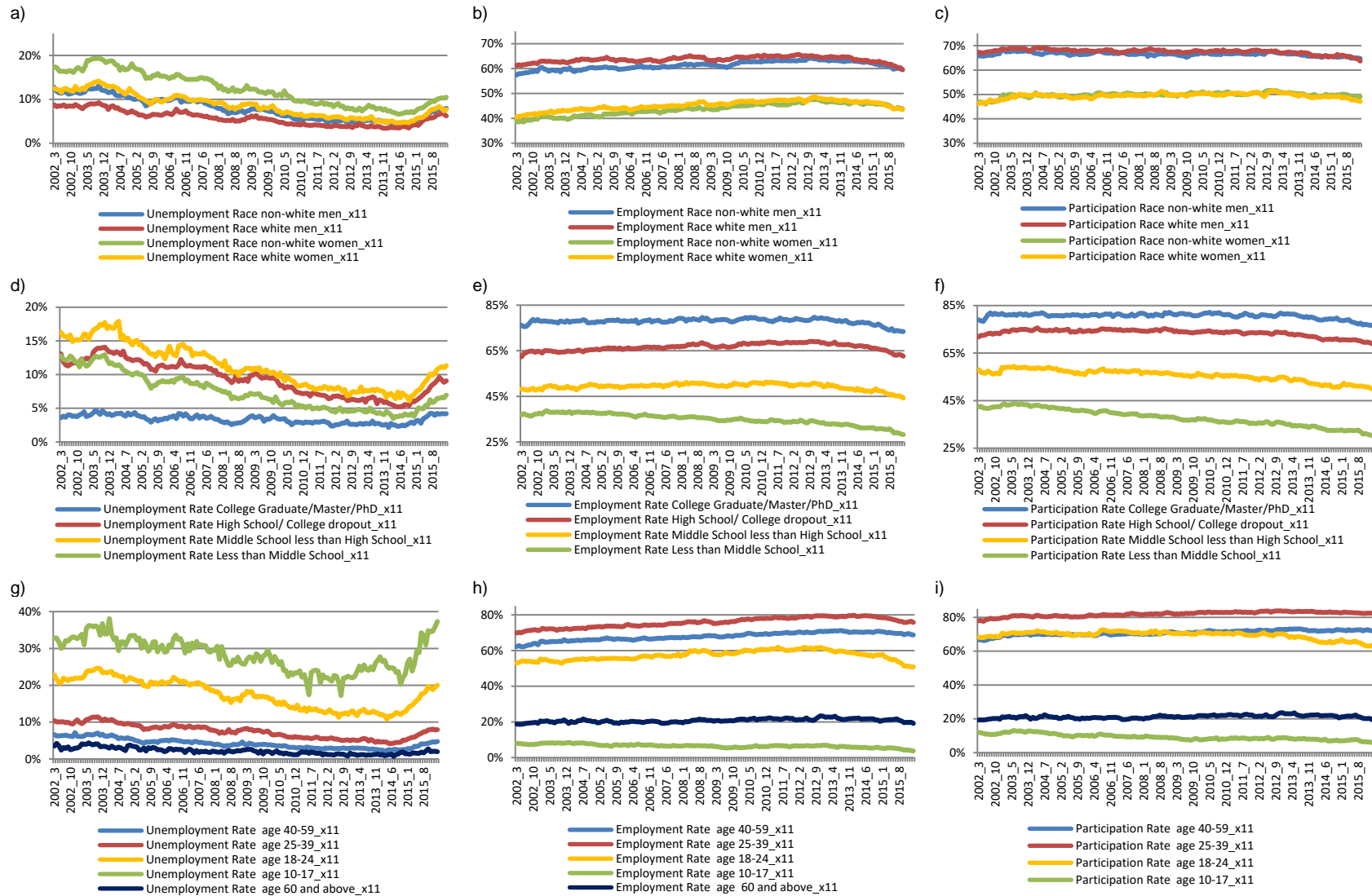
f) on group participation



Source: Authors' calculations based on seasonally adjusted (ArimaX11) PME surveys March 2014 and February 2016.

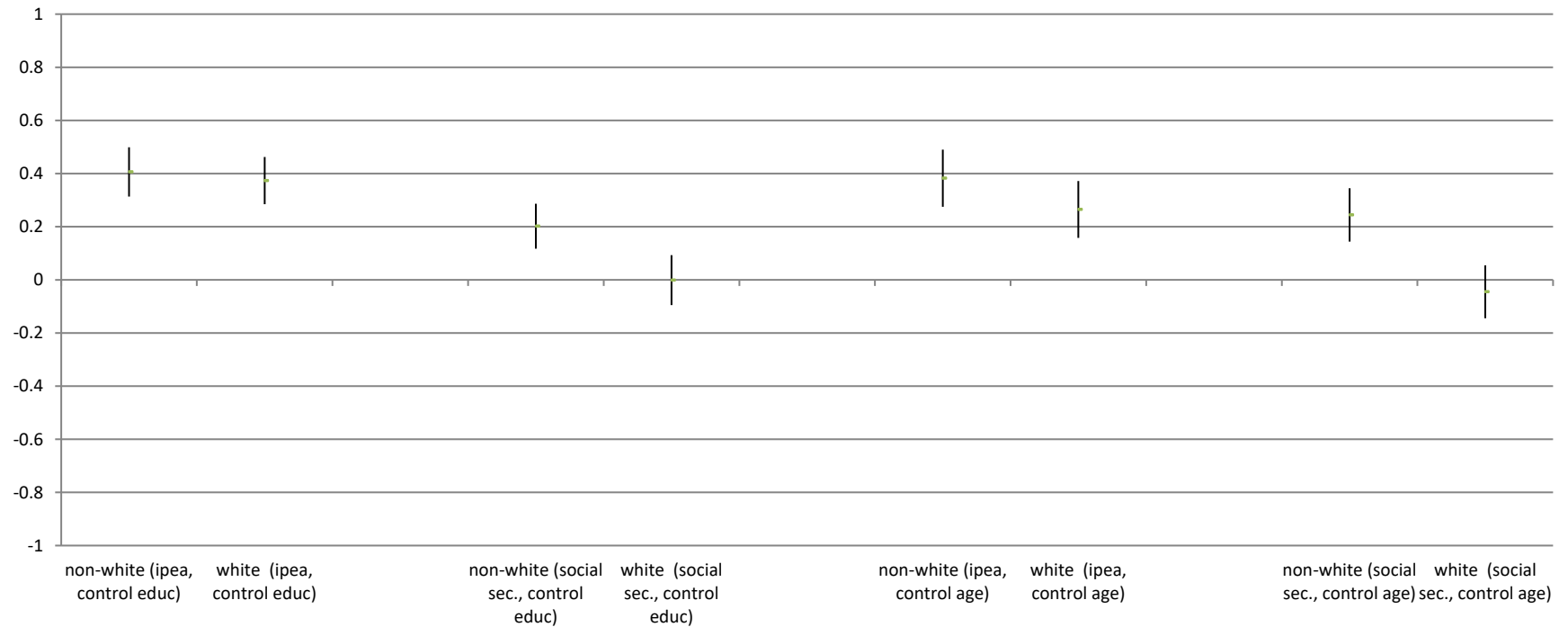
Note: These calculations are based on the largest possible sample. The coefficients are displayed as dots, whereas the bars represent the 95% confidence intervals.

Figure A.3: Unemployment, Employment, and Participation Rates by Demographic Group over Time (seasonally adjusted rates)



Source: Authors' own estimations based on balanced sample raw data of PME surveys March 2002 till February 2016

Figure A.4: Plot of Coefficients: Metropolitan Level: Impact of metropolitan level unemployment on the informality share by race
(model specification with metropolitan area specific time trend)



Source: Authors' calculations based on seasonally adjusted (ArimaX11) PME surveys March 2014 and February 2016.
 Note: These calculations are based on the largest possible samples. The abbreviations 'ipea' and 'soc.sec.' indicate the estimation of models with the group informality share as the dependent variable, calculated either based on IPEA's definition or based on the social security contribution status definition. The abbreviations 'control educ' and 'control age' indicate that these estimations only control for educational or age group respectively and not for the full array of demographic characteristics as in the models estimating the impact of metropolitan level unemployment on subgroup unemployment, employment, or participation rate.