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WAGE DIFFERENTIALS ASSOCIATED WITH RACE BETWEEN 2002 AND 2014 IN BRAZIL: EVIDENCE FROM A QUANTILE DECOMPOSITION

Diferenças salariais devido à raça entre 2002 e 2014 no Brasil:
evidências de uma decomposição quantílica

Gustavo Saraiva Frio*
Luiz Felipe Campos Fontes**

ABSTRACT

Throughout the 2000s Brazil went through a great phase of economic development. The present study seeks to investigate whether this movement was accompanied by a reduction in inequality in the labor market, measured here by the wage gap between whites and non-whites. To do so, three cohorts of time (2002-2004, 2007-2009 and 2012-2014) were analyzed using the microdata of the National Household Sampling Survey (*Pesquisa Nacional de Amostragem Domiciliar* - Pnad). The applied method is the counterfactual Oaxaca-Blinder along with the Recentered Influence Function Regression (RIF-Regression) so that the main determinants of wage inequalities can be detailed throughout the salary distribution. Our results showed that wage gap (totals, due to observed factors and discrimination) are higher in the higher quantiles of the distribution, that is, in professions or activities with higher wages. The results also point that the wage gap between the groups decreased during the analyzed period, which was mainly due to observable characteristics, especially educational levels. However, discrimination decreased only between the first and second triennium and in low magnitude. Apart from that, the main determinants of racial wage gap are returns related to education, experience and professions considered unregulated (self-employment and informal workers).

Keywords: Racial wage gap. Oaxaca-Blinder. Recentered Influence Function Regression.

RESUMO

Ao longo da década de 2000 o Brasil passou por uma grande fase de desenvolvimento econômico. O presente trabalho busca investigar se este movimento foi acompanhado por uma redução na desigualdade no mercado de trabalho, medido aqui pelo diferencial salarial entre brancos e não brancos. Para tanto, são analisadas três coortes de tempo (2002-2004, 2007-2009 e 2012-2014) a partir dos microdados da Pesquisa Nacional de Amostragem Domiciliar (Pnad). O método aplicado é a decomposição contra-factual Oaxaca-Blinder conjugado com o Recentered Influence Function Regression (RIF-Regression) para que se possam detalhar os principais contribuintes do fenômeno observado ao longo de toda distribuição salarial. Nossos resultados apontaram que as diferenças salariais (totais, oriundas de fatores observados e de discriminação) são maiores nos quantis mais elevados da distribuição, ou seja, em profissões ou atividades cujos salários são maiores. Os achados também apontam para uma aproximação salarial entre os grupos ao longo do período analisado, que se deu principalmente por características observáveis, a destacar os níveis de escolaridade. Entretanto, a discriminação caiu apenas entre o primeiro e o segundo triênio e em baixa magnitude. Fora isso, os principais determinantes da discriminação salarial de raça são os retornos à educação, experiência e de profissões consideradas sem regulação (trabalho autônomo e sem carteira assinada).

Palavras-chave: Diferenças salariais de raça. Oaxaca-Blinder. *Recentered Influence Function Regression*.

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1. INTRODUCTION

Brazil has recently undergone transformations in the labor market and in the socioeconomic field of a magnitude not observed in previous periods. Komatsu and Menezes Filho (2015), using data from the Monthly Employment Survey (PME), point out that from 2002 to 2014 a real growth of 17% was observed in relation to the average wage, largely as a result of the real minimum wage increases that, during these 12 years, amounted to 70%. Also noteworthy for the same period is the drop in the labor income Gini index by about 15%, the increase in the formal employment sector by 10% and the drop in unemployment from 12% to 5%. Data from the World Bank (2002-2014) show that such changes occurred together with the evolution of some social indicators, such as: a 59% increase in GDP *per capita*¹; the reduction of the population in the poverty line from 22.2% to 7.4%; and the decrease in the Gini index by 14%, reaching the level of 51.48 in 2014.

In this context, the wage difference between races should be noted, since this factor is a reflection of both social inequities and inequities in the labor market. According to Lang, Lehmann and Yeon (2012), these wage differences can have a direct impact on the socioeconomic development of a country by producing inefficiencies in the labor market through the transfer of resources between the groups. In this sense, Leite (2005) points out that wage discrimination associated with race is the main source of inequities in the Brazilian labor market.

Figure 1 (below) shows the hourly (natural log) wage density of whites and non-whites in Brazil for the 2002-2004, 2007-2009 and 2012-2014 triennia. It should be noted that there is a wage gap between the groups in the three time cohorts analyzed, since the density function of whites is always to the right of the non-white density function. However, it can be observed that over time there was some convergence between the wages of whites and non-whites, reflecting the transformations already mentioned above.

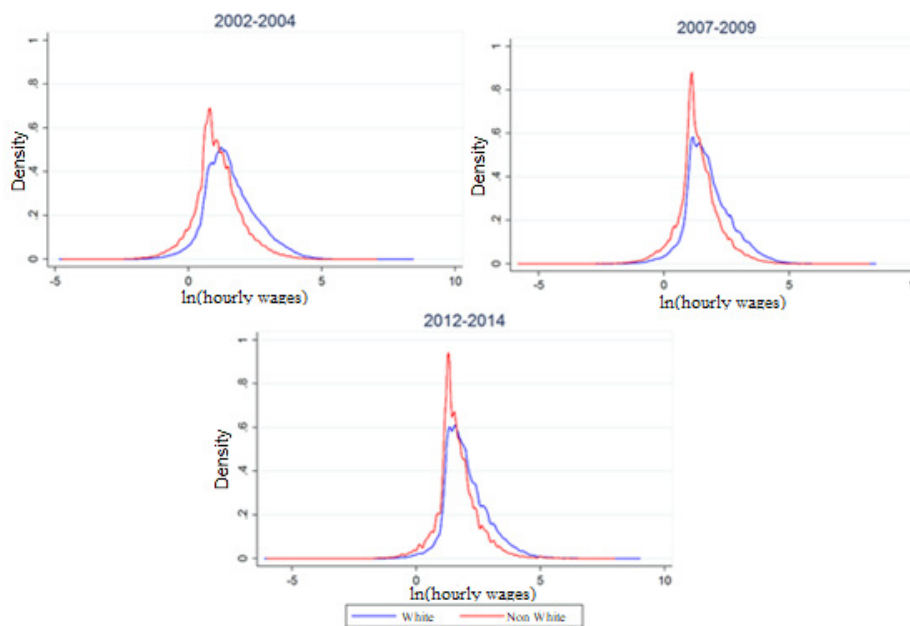
Thus, this paper aims to analyze, in detail, the apparent convergence of whites' and non-whites' wages over the period 2002-2014. To do so, we use the microdata of the National Household Sample Survey (Pnad) and the Oaxaca-Blinder counterfactual methodology (1993) combined with the Recentered Influence Function Regression (RIF-Regression) proposed by Firpo, Fortin and Lemieux (2009). This combination of techniques allows us to analyze, over the wage quantiles, whether the decrease in the wage gap between whites and non-whites was due to the productive characteristics of workers or the result of a drop in discrimination. In this sense, we want to further measure which variables contributed the most to the observed phenomenon. The quantile approach is justified in this case because of differences in the wage pattern across races throughout the distribution, as can be observed in Figure 1.

Moreover, this work progresses in order to show, in a special way, how occupation types affect discrimination, especially occupations that are not governed by the Consolidation of Labor Laws (CLT), such as employees without a formal contract or self-employed workers.

1. GDP *per capita* increased from 9.468 to 15.972 at the current purchasing power parity (PPP).

These results contribute to the intense debate on the Brazilian labor reform, recently approved by the National Congress.

Figure 1 - Density (kernel) of hourly wage (natural log) for whites and non-whites - 2002-2004, 2007-2009 and 2012-2014.



Source: Prepared by the authors using microdata from Pnad/IBGE.

The paper is divided into four more sections besides this introduction. The second section discusses the methodology used in this work. The third one presents the variables and data used, as well as an exploratory analysis of the latter. In the fourth section, we report the empirical results, and also bring a subsection for the discussion of data based on the literature. Finally, the final considerations are presented.

2. METHODOLOGY

The wage determinants have been studied for a long time by economists, based on the income equation of (Mincer, 1974):

(1)

$$\ln Y_i = \alpha + \beta_i X_i + \mu_i$$

where Y is the worker's wage i , α is a constant, β is a parameter vector associated with an explanatory variable vector, X , in addition to the error term, μ , which also contains unobservable characteristics. In this sense, the average wage differential between whites

and non-whites could be analyzed through the inclusion of a dummy variable referring to these groups. However, in this case, we would not be able to analyze whether the difference in income results from productive characteristics that differentiate white from non-white workers or are due to discrimination.

Therefore, methods of counterfactual decomposition are used, with the purpose of analyzing the determinants of wage differentials in detail. In addition, these methods have been expanded, using quantile approaches, to analyze the differences throughout the wage distribution and not only in the mean (FORTIN; LEMIEUX; FIRPO, 2011).

In this study, the Oaxaca-Blinder decomposition method is applied in combination with the Recentered Influence Function Regression (RIF-Regression) method proposed by Firpo, Fortin and Lemieux (2009), which can be used in the case of unconditional quantile distributions for the outcome variable (in our case, wages). This combination of techniques allows us to robustly analyze the wage differences between races for each quantile, as well as to decompose this difference between observable and unobservable factors, and finally, to analyze how each workers' characteristics affect these results

2.1 OAXACA-BLINDER

Based on the work of Blinder (1973) and Oaxaca (1973), the counterfactual decomposition procedure called the Oaxaca-Blinder decomposition was originated. Starting from equation 1, one can think of the estimation of wages for two groups of workers $i \in \{A, B\}$, where A denotes whites and B non-whites. In short, the wage differential is analyzed through two prisms: the part explained by productive factors and the unexplained part, which the literature usually attributes to wage discrimination.

The difference in wage average expectations is given by:

(2)

$$R = E(Y_A) - E(Y_B) = E(X_A)' \beta_A - E(X_B)' \beta_B$$

where, by assumption $E(Y_i) = E(X_i' \beta_i + \varepsilon_i) = E(X_i' \beta_i) + E(\varepsilon_i) = E(X_i)' \beta_i$, $E(\beta_i) = \beta_i$ and $E(\varepsilon_i) = 0$

Considering a coefficients matrix β^* , we can rearrange equation 2 by adding and subtracting $E(X_A)' \beta^*$ and $E(X_B)' \beta^*$, so that:

(3)

$$R = [E(X_A) - E(X_B)]' \beta^* + [E(X_A)' (\beta_A - \beta^*) + E(X_B)' (\beta^* - \beta_B)]$$

Thus, we have the decomposition into two parts, where $[E(X_A)'(\beta_A - \beta^*) + E(X_B)'(\beta^* - \beta_B)]$ is the unexplained part² of the wage differential and $[E(X_A) - E(X_B)]'\beta^*$ is the part explained by productive attributes, such as education and experience.

2.2 RIF-REGRESSION

The RIF-Regression method was developed by Firpo, Fortin and Lemieux (2009) and provides a simple way to estimate detailed decompositions of any statistical distribution for which an influence function (IF) can be computed. In this case, the procedure is similar to a traditional regression, but the dependent variable is replaced by the IF of interest. The model approach assumes that the conditional expectation of the RIF-Regression can be modeled as a linear function, as follows:

$$E[RIF(Y;v)|X] = X\gamma + \varepsilon \quad (4)$$

where parameters γ can be estimated by ordinary least squares (OLS).

In the case of unconditional quantile regressions, there is equality between $Q_\tau + IF(Y, Q_\tau)$ and $RIF(Y; Q_\tau)$ which can be rewritten as follows:

$$RIF(y; Q_\tau) = Q_\tau + \frac{\tau + 1 \{y \leq Q_\tau\}}{f_Y(Q_\tau)} \quad (5)$$

where $f_Y(\cdot)$ is the density function of the distribution, in the margin of Y , Q_τ is the τ -quantile sample of the unconditional distribution of the independent variable and $1 \{.\}$ is an indicator function.

Computationally, the point density is estimated through kernel methods. Given the coefficients of the unconditional quantile regression for each group, we have:

$$\hat{\gamma}_{g,\tau} = (\sum_{i \in G} X_i X_i')^{-1} \sum_{i \in G} \widehat{RIF}(Y_{gi}; Q_{g,\tau}) X_i \quad (6)$$

where g represents groups A and B.

Thus, it is possible to describe the unconditional quantile model in a manner equivalent to the Oaxaca-Blinder model as:

2. The unexplained part is interpreted as discrimination provided the assumption is made that there is no omission of relevant variables.

(7)

$$\hat{R}^{\tau} = E(X_A)(\hat{\gamma}_{A,\tau} - \hat{\gamma}_{B,\tau}) + (E(X_A) - E(X_B))\hat{\gamma}_{B,\tau}$$

As before, \hat{R}^{τ} has the total difference of the groups in the estimated quantile. The first part of equation 7 represents the unexplained part (attributed to discrimination) and the second part of the sum is the difference explained by productive attributes.

3. DATA

This study uses data from the National Household Sample Survey (Pnad) from the years 2002 to 2004, 2007 to 2009 and 2012 to 2014. A pseudo-panel composed of three triennia was set so that the phenomenon of racial inequality in the labor market could be analyzed over time. Thus, we can compare the three periods in order to analyze the temporal trajectory of the wage differences. The sample is composed of men and women aged 18 to 65 years. Table 1 presents the variables used in this study. Wages - deflated - are a logarithm, according to standard literature. As an explanatory variable of worker productivity, we can highlight education (Fox et al., 2015), measured in years, and two variables of experience: working time in the current job (specific experience) and the total work experience throughout life.

Table 1 - Description of variables

Variables	Description
Ln_Wages	Wage/hour natural logarithm.
Education	Worker's years of education.
Specific Experience	Worker's experience in the company they are in, in years.
Specific Experience ^ 2	Specific Experience squared.
Experience	Current worker age - the age at which they started to work, in years.
Experience ^ 2	Experience squared.
Unionized	Dummy equal to 1 if the worker is unionized and 0 if otherwise.
Metropolitan	Dummy equal to 1 if the worker lives in a metropolitan area and 0 if otherwise.
Urban	Dummy equal to 1 if the worker lives in an urban area and 0 if otherwise.
Married	Dummy equal to 1 if the worker is married and 0 if otherwise.
Male	Dummy equal to 1 if the worker is male and 0 if otherwise.
White	Dummy equal to 1 if the worker is white and 0 if otherwise.
Head of the household	Dummy equal to 1 if the worker is the head of the household and 0 if otherwise.
Born in the municipality	Dummy equal to 1 if the worker lives in the city where they were born and 0 if otherwise.
Occupationa	Dummies for the following work occupations: formal contract, military, public service, no formal contract, domestic with a formal contract, domestic without a formal contract, self-employed and employer.
CBO	Dummies for professions according to the 2002 Brazilian Occupations Classification (CBO).
UF	Dummies for federated states (UF).

Source: Prepared by the authors. ^a Occupations associated with having a formal contract or not do not comprise workers who do household chores, so there are specific dummies for domestic workers with or without a formal contract.

Some dummy variables are used in this study in order to control other factors that, despite not being productive, also affect the worker's wages³, such as: being unionized (BALDWIN; CHOE, 2014; GUIMARÃES; SILVA, 2016; LUBRANO; NDOYE, 2014; SILVA; GUIMARÃES, 2017), male (LIU et al., 2016; MICHELMORE; SASSLER, 2016), and head of the household (HERRING; HENDERSON, 2016).

Location variables such as: metropolitan (GUIMARÃES; SILVA, 2016; SILVA; GUIMARÃES, 2017), urban (MA, 2016; SENGUPTA; DAS, 2014; ZHU, 2016), being born in the city, which is a form of immigration if the answer is negative (CHENG et al., 2013; GRANDNER AND GSTACH, 2015; MA, 2016) and the state. According to IBGE, the metropolitan region consists of a set of municipalities that have public functions that, of course, require cooperation. In addition to the integrated performance of public power, it should be noted that the limitation is determined by the political-administrative limit of the households that make up the region. In turn, the urban zone is a municipal definition by law which is composed of city (municipal seat), district (district seat) or isolated urban area. Thus, there are four types of home location: in the urban area of a metropolitan area, in an urban area of a municipality outside the metropolitan region, in a municipality rural area of a metropolitan region, and in a municipality rural area outside the metropolitan region.

There are also variables on the profession of individuals, such as the type of occupation (CASTAGNETTI; ROSTI, 2013; DOUGLAS; STEINBERGER, 2015; MICHELMORE; SASSLER, 2016; WANG; GUO; CHENG, 2015) and also the professions defined in the Brazilian Occupations Classification (CBO) of 2002, which is divided into binary variables for each main subgroup, totaling 48 subgroups.

Table 2 shows the mean and standard deviation of the variables used in this study. Regarding the wage gap between races, it can be noted that in the first analyzed triennium the salary of non-whites equaled 53% of the salaries of whites. In the final period, this number rose to 61%, which reflects the salary convergence between the groups, already highlighted in the Introduction. It is also important to note that in the last three years the salaries of non-whites managed to exceed the salaries of whites in the first triennium, which indicates the large wage difference between the races. The number of observations is at the end of Table 2. It should be noted that people with missing information about any of the explanatory variables or the wage variable are not in the sample.

A possible explanation for the wage convergence (in percentage terms) between whites and non-whites is the evolution of the average education level of both groups, since this factor can be understood as one of the main determinants of wages. There is an increase of 15.71% in the education of whites and 23.89% in the education of non-whites over the triennia. Therefore, although both groups have evolved in years of study, this evolution was higher for non-whites, which may also reflect their higher salary increase when compared to whites.

Another productive factor that is determinant for wages that needs to be analyzed is the level of experience of the worker. However, it can be observed that this is very close between the groups in all analyzed periods. Whites, however, have more time in the company in which they work (specific experience), but the evolution of this variable is marginal

3. In parentheses, we explain through the literature why these variables are included.

throughout the triennia for both groups. As for unionization, non-whites remain stable in the percentage of unionization, while whites decrease by 2 percentage points. It should also be noted that, on average, the proportion of married, municipal immigrants and residents of urban and metropolitan areas is higher for whites. On the other hand, there is a higher percentage among whites who are heads of the household - as of the second period - and a higher percentage of male individuals.

Table 2 - Descriptive Statistics for whites and non-whites

Variables	2002-2004		2007-2009		2012-2014	
	White	Non-white	White	Non-white	White	Non-white
Wages	8.04 (23.18)	4.29 (9.69)	9.33 (24.64)	5.44 (14.13)	13.38 (61.94)	8.22 (31.1)
Education	9.04 (4.37)	7.14 (4.22)	9.81 (4.33)	8.07 (4.32)	10.46 (4.25)	8.81 (4.33)
Specific experience	7.28 (8.58)	7.00 (8.73)	7.59 (8.93)	7.2 (8.98)	7.84 (9.22)	7.40 (9.31)
Experience	21.96 (13.85)	21.77 (13.36)	22.27 (13.61)	22.04 (14.50)	22.74 (13.70)	22.54 (13.61)
Unionized	0.19 (0.39)	0.15 (0.35)	0.19 (0.39)	0.16 (0.37)	0.17 (0.80)	0.15 (0.36)
Metropolitan	0.41 (0.49)	0.38 (0.48)	0.40 (0.49)	0.37 (0.48)	0.41 (0.49)	0.36 (0.48)
Urban	0.89 (0.31)	0.84 (0.36)	0.88 (0.32)	0.83 (0.37)	0.90 (0.30)	0.84 (0.36)
Married	0.77 (0.42)	0.74 (0.44)	0.76 (0.43)	0.73 (0.44)	0.75 (0.43)	0.72 (0.45)
Male	0.47 (0.50)	0.49 (0.50)	0.47 (0.50)	0.49 (0.50)	0.47 (0.50)	0.49 (0.50)
Head of the household	0.40 (0.49)	0.39 (0.49)	0.40 (0.49)	0.41 (0.49)	0.41 (0.49)	0.43 (0.49)
Born in the city	0.48 (0.50)	0.50 (0.50)	0.50 (0.50)	0.51 (0.50)	0.52 (0.50)	0.54 (0.50)
Observations	217,844	216,312	256,486	221,864	197,164	251,072

Source: Prepared by the authors from microdata of the 2002-2004, 2007-2009 and 2012-2014 Pnads.

Note: Averages above parentheses and standard deviation between parentheses.

Table 3 shows the distribution of occupations during the triennia. It should be noted that the occupations with the highest percentage of workers are: employment with a formal contract, without a formal contract and self-employed, in descending order of participation. For the former, the participation of whites is higher than that of non-whites in all triennia. In addition, whites showed an increase of 8.7 percentage points in their participation among employees with a formal contract, reaching 43.85% of the total in the last period. Non-whites increased by 10.36 percentage points, reaching 37.86% of total workers in the period 2012-2014.

Table 3 - Participation of occupations by race

Occupation	2002-2004		2007-2009		2012-2014	
	White	Non-white	White	Non-white	White	Non-white
Employee with a formal contract	35.15%	27.5%	39.98%	32.33%	43.85%	37.86%
Military	0.4%	0.37%	0.36%	0.35%	0.43%	0.43%
State Public Service	8.1%	6.44%	8.56%	6.8%	8.84%	6.94%
Employee without a formal contract	15.55%	20.54%	14.25%	18.64%	12.37%	16.01%
Domestic worker with a formal contract	1.95%	2.36%	1.85%	2.43%	1.82%	2.46%
Domestic worker without a formal contract	4.28%	7.31%	4.05%	6.9%	3.35%	5.63%
Self-employed	21.67%	24.01%	19.98%	22.06%	19.88%	22.09%
Employer	5.98%	2.56%	5.98%	2.68%	5.36%	2.3%
Other occupations	6.92%	8.91%	4.99%	7.81%	4.10%	6.28%

Source: Prepared by the authors from microdata of the 2002-2004, 2007-2009 and 2012-2014 Pnads.

Employees without a formal contract declined considerably over the analyzed period, however, non-whites always have a higher participation in these types of jobs, as do domestics workers without a formal contract. Self-employed workers decline from the first to the second triennium and then remain stable, but non-whites again have a higher relative rate in this occupation. It should be noted that these occupations are not regulated by the CLT (Consolidation of Labor Laws), so this fact can facilitate discrimination, especially in relation to professions where the minimum wage is paid.

In this sense, occupations can play an important role in explaining the wage gap between races, since there is a higher participation of whites in relation to non-whites in occupations with formal contracts (CLT), which generally pay higher salaries than occupations that are not regulated by the CLT - in relation to these, participation is higher for non-whites. Nonetheless, non-whites, with respect to whites, had a greater increase in participation in jobs with a formal contract and lower participation in unregulated occupations. Thus, the dynamics observed in the increasing participation of the groups in these occupations may also have led to reductions in the salary differences between them.

As for the military, there is a very small number of whites and non-whites present in this occupation. In addition, the relative is very similar between both groups, becoming equal in the third triennium. In occupations associated with public service, there is a majority of whites, as already pointed out in the literature (CAMPANTE; CRESPO; LEITE, 2004; VAZ; HOFFMANN, 2007). Finally, employers are, as expected, mostly whites, which can also explain part of the wage gap between races. In those occupations, the dynamic has barely changed along the triennia. Other types of occupations (such as own-use production work) are arranged in the "Other occupations" line; there was a clear reduction in the relative percentage of this group for both whites and non-whites - however, these workers, because they did not have a salary, are not in the descriptive statistics, neither in the results.

4. RESULTS

The first empirical analysis to be carried out in this study consisted of the estimation of income equations, by means of RIF-regression, for whites and non-whites, nine salary quantiles and for the triennia 2002-2004, 2007-2009 and 2012-2014. For the sake of brevity, Table 4 presents only the result in the mean, that is, in the fifth quantile of the wage distribution. It should be noted that, among the productive factors, education seems to be the most impacting regarding wage gains and this coefficient is higher for whites *vis-à-vis* non-whites in all the analyzed periods, which already seems to reflect the discrepancy between groups. Also in relation to the wage returns associated with education, it is noted that it decreased for both races over the analyzed triennia, which may be due to the increase in the average education level, previously seen in the descriptive data analysis. Other productive characteristics - specific experience and experience - also provide positive wage returns which are favorable to whites, although the coefficient related to specific experience presents a discrepancy well above the coefficient related to experience, when comparing the races. It should also be noted that the wage returns of specific experience and experience increase at decreasing rates, which is captured by the negative coefficient of these variables squared for both races and for all analyzed periods.

Table 4 - Income equation (RIF-Regression) in the mean, for all proposed triennia

Variables	2002-2004		2007-2009		2012-2014	
	Whites	Non-whites	Whites	Non-whites	Whites	Non-whites
Education	0.066* (0.001)	0.046* (0.001)	0.061* (0.001)	0.039* (0.000)	0.058* (0.001)	0.037* (0.000)
Specific Experience	0.029* (0.001)	0.020* (0.000)	0.026* (0.001)	0.015* (0.000)	0.024* (0.001)	0.015* (0.000)
Specific Experience ^ 2	-0.001* (0.000)	-0.0004* (0.000)	-0.0005* (0.000)	-0.0003* (0.000)	-0.0004* (0.000)	-0.0003* (0.000)
Experience	0.019* (0.000)	0.016* (0.001)	0.020* (0.000)	0.016* (0.000)	0.018* (0.001)	0.016* (0.000)
Experience ^ 2	-0.0002* (0.000)	-0.0002* (0.000)	-0.0003* (0.000)	-0.0002* (0.000)	-0.0003* (0.000)	-0.0002* (0.000)
Unionized	0.117* (0.004)	0.104* (0.004)	0.110* (0.004)	0.095* (0.004)	0.099* (0.005)	0.080* (0.004)
Metropolitan	0.169* (0.004)	0.123* (0.005)	0.138* (0.004)	0.105* (0.004)	0.122* (0.004)	0.096* (0.004)
Urban	0.112* (0.007)	0.078* (0.006)	0.102* (0.007)	0.054* (0.005)	0.097* (0.007)	0.056* (0.004)
Married	0.090* (0.004)	0.066* (0.004)	0.077* (0.004)	0.057* (0.003)	0.063* (0.004)	0.052* (0.003)
Male	0.103* (0.005)	0.062* (0.005)	0.155* (0.004)	0.093* (0.004)	0.175* (0.004)	0.138* (0.003)
Head of Household	0.145* (0.004)	0.118* (0.004)	0.103* (0.004)	0.077* (0.003)	0.095* (0.004)	0.059* (0.003)

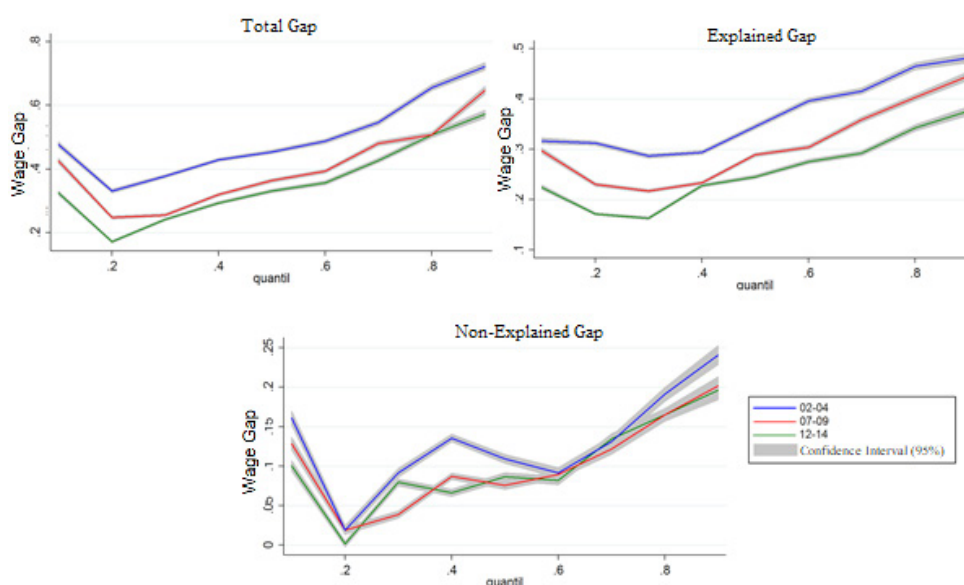
Born in the city	-0.044*	-0.059*	-0.042*	-0.050*	-0.041*	-0.051*
	(0.004)	(0.003)	(0.004)	(0.003)	(0.004)	(0.003)
Constant	0.583*	0.781*	0.705*	1.086*	1.124*	1.223*
	(0.067)	(0.083)	(0.069)	(0.062)	(0.087)	(0.077)
Observations	217,844	216,312	221,864	256,486	197,164	251,072
Adjusted R2	0.372	0.320	0.364	0.295	0.340	0.273

Note: Robust standard error in parenthesis. * $p < 0,01$, ** $p < 0,05$. They are also regression controls: occupation dummies, UF and CBO.

The other RIF-regression coefficients show that the workers with the highest salaries are male, married, heads of household, unionized, municipal immigrants and residents of urban and metropolitan areas. All of the variables mentioned above favor whites in relation to non-whites and, with the exception of the coefficient referring to the male sex, the others had a decrease over the analyzed triennia for reasons that still have to be studied in the literature.

It should be noted that the problem of discrimination, as indicated in Table 4, is not exclusive of whites and non-whites, but also of men and women. The difference between male and female also grows over time varying from 10.3% to 17.5% for whites and from 6.2% to 13.8% for non-whites. This result also appears in the literature that focuses on gender differentials (CASTAGNETTI; ROSTI, 2013; FRIO; UHR; UHR, 2017).

Figure 2 - Quantile decomposition of wage differential between races



Source: Prepared by the authors. Results in percentage.

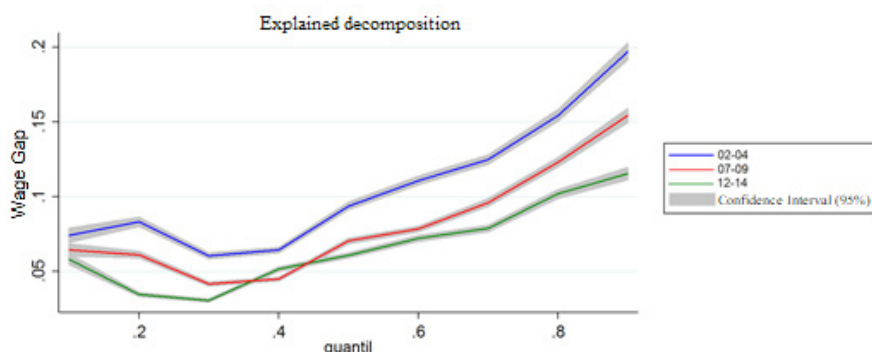
Once the quantum efficiency equations are estimated, we proceed to the Oaxaca wage decomposition, in order to analyze the wage differential between whites and non-whites, as well as its explained and unexplained components. The results for the 9 quantiles

and for the three triennia proposed in this study are presented in Table A.1 of the appendix and in Figure 2.

When we analyze the total wage differential between races, it is clear in Figure 2 that this component increases along the quantiles of the wage distribution, regardless of the analyzed period. Investigating the phenomenon along the time cohorts, we can observe the salary convergence between the groups, confirming the exploratory analysis already performed in the article. This decrease seems to have been more marked between the first and second triennia, as well as proportional among wage quantiles - with the exception of the eighth, between the second and the third triennium. In this sense, it should be noted that in the period 2002-2004, the income of whites was 72% higher than that of non-whites, in the ninth wage quantile. In the period 2012-2014, the estimated difference was 52%.

The explained difference drastically decreases over the triennia. On average, the percentage difference decreased by 10 percentage points. The unexplained difference decreased (in low magnitude) between the first and second third triennia and then remained constant, suggesting persistence in racial discrimination in the labor market. It should be noted that the unexplained part of the differential grows from the second quantile and keeps increasing as the population advances along the wage distribution, in which the discrimination goes from nonexistent in the second quantile to 25% in the last one. In this sense, the discriminatory effect seems to be higher among activities paying higher wages.

Figure 3 - Wage decomposition explained for education



Source: Prepared by the authors. Results in percentage.

It should be noted that the main cause of the wage differential by observable variables is years of education, especially when the highest salaries are again analyzed (Figure 3, Table 5). Thus, in general, whites earn more than non-whites, because they have higher education levels. However, by analyzing the wage decomposition explained by this variable over the triennia, we confirm the hypothesis previously raised in the descriptive data analysis that education would be one of the main responsible factors for the decrease in the salary gap between whites and non-whites over the last decade. When analyzing the mean, there is a reduction in the wage differential from 9.4% to 6.1% due to this productive factor. This effect starts to increase in the fifth quantile, reaching its highest value at the end of the wage distribution, where the decrease in the wage gap between whites and non-whites

dropped from 19.7% to 11.5% between 2002-2004 and 2012-2014. However, even if it decreases over time in the quantiles and in the mean, the wage difference due to education remains high.

Table 5 - Detailed decomposition of the wage difference explained between whites and non-whites, in the mean and in the distribution tails

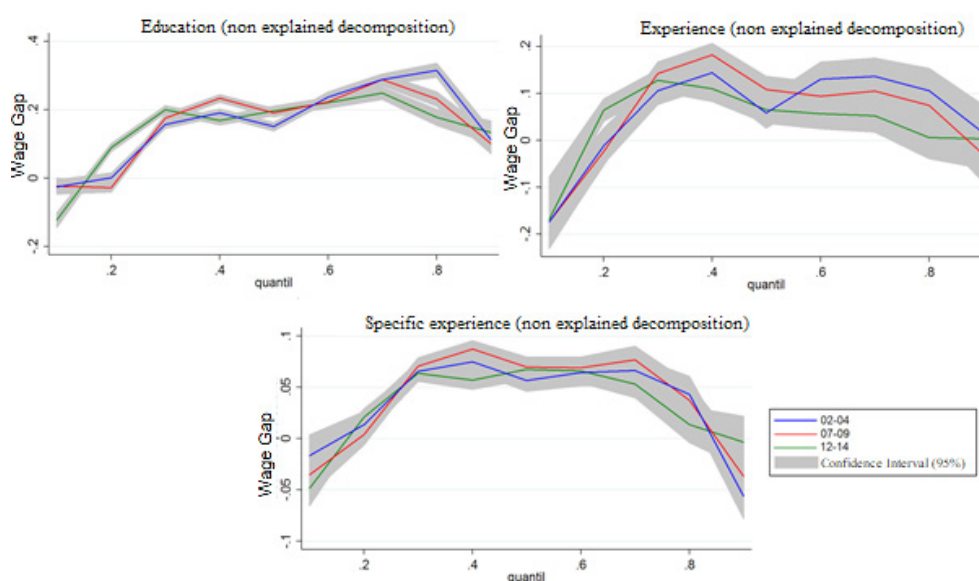
Variable	2002-2004			2007-2009			2012-2014		
	Q.10	Q.50	Q.90	Q.10	Q.50	Q.90	Q.10	Q.50	Q.90
Years of education	0.074*	0.094*	0.197*	0.064*	0.070*	0.154*	0.058*	0.061*	0.115*
	(0.002)	(0.001)	(0.003)	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)
Specific Experience	0.005*	0.008*	0.015*	0.008*	0.008*	0.017*	0.009*	0.009*	0.016*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)
Experience	0.001	0.001	0.002	0.002*	0.002*	0.004*	0.002*	0.003*	0.004*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
Unionized	-0.003*	0.005*	0.018*	-0.002*	0.003*	0.011*	-0.002*	0.002*	0.006*
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
Metropolitan	0.005*	0.004*	0.004*	0.004*	0.002*	0.003*	0.007*	0.003*	0.005*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Urban	0.004*	0.003*	0.005*	0.005*	0.002*	0.006*	0.008*	0.002*	0.006*
	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
Married	0.002*	0.002*	0.002*	0.002*	0.002*	0.002*	0.001*	0.001*	0.002*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Male	-0.006*	-0.002*	-0.007*	-0.006*	-0.004*	-0.010*	-0.008*	-0.006*	-0.012*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)
Head of Household	-0.002*	-0.002*	-0.003*	-0.002*	-0.002*	-0.003*	-0.002*	-0.002*	-0.004*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Born in the city	0.001*	0.001*	0.001*	0.000*	0.000*	0.000*	0.001*	0.000*	0.001*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Statutory	-0.003*	0.002*	0.013*	-0.003*	0.002*	0.017*	-0.002*	0.003*	0.015*
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)
Employee without a formal contract	0.028*	0.014*	-0.008*	0.029*	0.009*	-0.009*	0.024*	0.004*	-0.006*
	(0.001)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
Domestic worker without a formal contract	0.033*	0.011*	-0.014*	0.036*	0.005*	-0.013*	0.028*	0.000	-0.008*
	(0.001)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
Self-employed	0.022*	0.003*	-0.010*	0.021*	0.001*	-0.010*	0.021*	-0.001*	-0.008*
	(0.001)	(0.000)	(0.001)	(0.001)	(0.000)	(-0.001)	(0.001)	(0.000)	(0.000)
Employer	-0.003*	0.009*	0.043*	-0.004*	0.007*	0.041*	-0.004*	0.007*	0.036*
	(0.001)	(0.000)	(0.002)	(0.000)	(0.000)	(0.002)	(0.000)	(0.000)	(0.002)

Note: Standard error in parenthesis. * $p < 0,01$, ** $p < 0,05$. Regression controls also include: UF dummies, CBO and other occupations (military, formal contract and domestic workers with a formal contract).

Other variables have a much less significant effect in explaining the wage difference between whites and non-whites, and, moreover, they remain practically constant throughout

the analyzed triennia. Nevertheless, experience, specific experience, being unionized, metropolitan and living in urban areas are some of the factors that contribute to increase the wage gap between races. Among the occupations, it should be noted at the end of the salary distribution that when the individual is both the employer or statutory, both occupations favor whites. This suggests that in these occupations activities that pay the highest wages are more often taken by white employees. Interestingly, however, occupations with less legal regulation (domestic workers without a formal contract and self-employed workers) also favor whites, however, only at the beginning of the wage distribution.

Figure 4 - Unexplained wage decomposition for education, experience and specific experience



Source: Prepared by the authors. Results in percentage.

The decomposition of unexplained effects is presented in Table 6. Again, education is the component that most affects the wage differential between whites and non-whites, but in the unexplained part of the total difference (Figure 4 helps to visualize the result better). This suggests that, by keeping everything else constant, the wage returns associated with education are higher for whites than for non-whites. There is extensive literature on the subject, ranging from access to education by non-whites to the heterogeneous education quality available to the groups (ANDRADE; DACHS, 2007; GISI, 2006; GUIMARÃES, 2013; OSORIO, 2013; ROSEMBERG, 2013). Concerning the effects along the distribution, it is observed that these are low in the first two quantiles, suggesting that in activities that pay close to the minimum wage the education return does not seem to have as much relevance as it does in the unexplained effect of the wage difference between races. However, from the third quantile the effects are already very high and remain almost constant until the tail end to the right of the distribution. Evaluating the triennia, we can even note the progress of this component in explaining the wage discrimination that progresses from the average of 15.1% to 19.6% between 2002-2004 and 2012-2014.

Table 6 - Detailed decomposition of unexplained wage difference between whites and non-whites, in the mean and in the tails

Variable	2002-2004			2007-2009			2012-2014		
	Q.10	Q.50	Q.90	Q.10	Q.50	Q.90	Q.10	Q.50	Q.90
Years of education	-0.026*	0.151*	0.113*	-0.023**	0.191*	0.101*	-0.123*	0.196*	0.134*
	(0.010)	(0.006)	(0.014)	(0.012)	(0.006)	(0.015)	(0.011)	(0.007)	(0.017)
Specific Experience	-0.017	0.057*	-0.056*	-0.035*	0.070*	-0.037*	-0.048*	0.067*	-0.004
	(0.010)	(0.005)	(0.011)	(0.010)	(0.005)	(0.012)	(0.009)	(0.005)	(0.013)
Experience	-0.174*	0.059*	0.016	-0.174*	0.108*	-0.029	-0.123*	0.065*	0.004
	(0.029)	(0.016)	(0.030)	(0.027)	(0.015)	(0.030)	(0.023)	(0.015)	(0.032)
Unionized	0.008*	0.002**	-0.018*	0.008*	0.002**	-0.011*	0.012*	0.003*	0.004
	(0.001)	(0.001)	(0.003)	(0.001)	(0.001)	(0.003)	(0.001)	(0.001)	(0.003)
Metropolitan	-0.024*	0.018*	0.026*	-0.043*	0.012*	0.031*	-0.059*	0.010*	0.072*
	(0.004)	(0.002)	(0.005)	(0.004)	(0.002)	(0.005)	(0.003)	(0.002)	(0.005)
Urban	0.027	0.029*	0.005	0.029**	0.041*	-0.019	-0.096*	0.036*	-0.026*
	(0.017)	(0.008)	(0.013)	(0.015)	(0.007)	(0.013)	(0.014)	(0.008)	(0.015)
Married	-0.022*	0.018*	0.006	-0.009	0.014*	-0.002	-0.019*	0.008**	-0.003
	(0.007)	(0.004)	(0.009)	(0.007)	(0.004)	(0.008)	(0.006)	(0.004)	(0.009)
Male	-0.079*	0.025*	0.010	-0.064*	0.037*	0.000	-0.075*	0.022*	-0.008
	(0.007)	(0.004)	(0.009)	(0.006)	(0.003)	(0.007)	(0.005)	(0.003)	(0.009)
Head of Household	-0.037*	0.014*	0.028*	-0.027*	0.013*	0.020*	-0.021*	0.018*	0.017*
	(0.005)	(0.003)	(0.007)	(0.004)	(0.003)	(0.006)	(0.004)	(0.002)	(0.006)
Born in the city	0.026*	0.007*	0.007	0.021*	0.004*	-0.002	0.028*	0.005**	0.009
	(0.004)	(0.002)	(0.005)	(0.004)	(0.002)	(0.006)	(0.004)	(0.002)	(0.006)
Statutory	0.007*	0.005*	-0.050*	0.007*	0.003*	-0.045*	0.008*	0.003*	-0.020*
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)
Employee without a formal contract	0.022*	0.030*	-0.021*	0.028*	0.022*	-0.027*	0.058*	0.013*	-0.014*
	(0.002)	(0.002)	(0.003)	(0.002)	(0.001)	(0.003)	(0.002)	(0.001)	(0.003)
Domestic worker without a formal contract	0.012*	0.027*	-0.000	0.017*	0.017*	-0.002**	0.039*	0.011*	-0.001
	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Self-employed	0.076*	0.053*	-0.065*	0.073*	0.041*	-0.050*	0.123*	0.034*	-0.037*
	(0.003)	(0.002)	(0.004)	(0.003)	(0.002)	(0.004)	(0.003)	(0.002)	(0.004)
Employer	0.002*	0.001*	-0.020*	0.002*	0.002*	-0.015*	0.002*	0.001*	-0.012*
	(0.000)	(0.000)	(0.002)	(0.000)	(0.000)	(0.002)	(0.000)	(0.000)	(0.001)

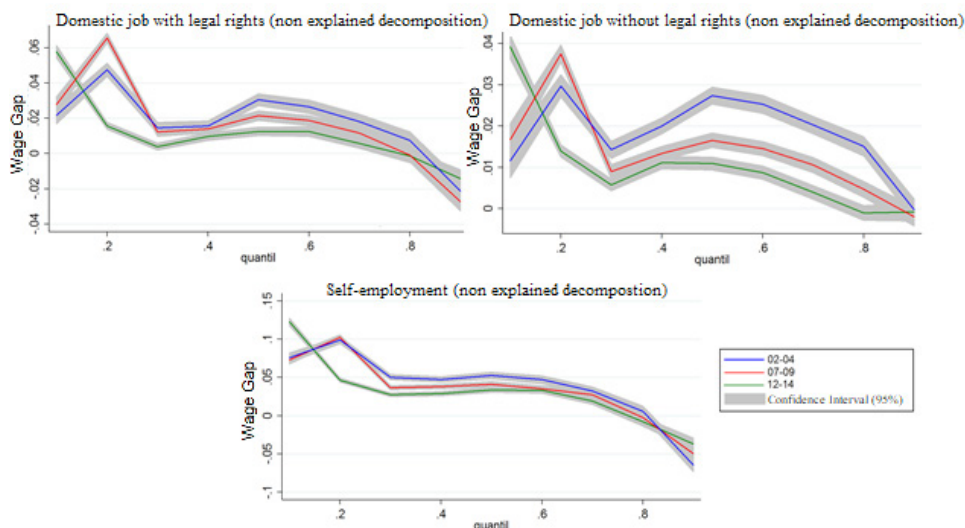
Note: Standard error in parenthesis. * $p < 0,01$, ** $p < 0,05$. Regression controls also include: UF dummies, CBO and other occupations (military, workers with a formal contract and domestic workers with a formal contract)

Other productive factors are also shown in Figure 4. Both experience and specific experience are relevant determinants of wage differentials. In this sense, the income paid to the more experienced workers and those with more years of experience within the company in which they work seem to favor whites. The effect of these variables over the triennia remained close to constant, where in 2012-2014 they determined around 6.5%, on average, of the unobserved wage gap between races. Interestingly, the specific experience favors non-whites at the edge of the distribution (except in the last period, when there are no

significant differences in terms of race among those who are paid more). Controls for gender, unionization, metropolitan region, married, head of household have significant effects on the mean and even greater effects on the tails. It is worth mentioning that living in the urban area increases discrimination, ranging from 2.9% to 4.1%.

The occupation type deserves special mentioning, as it seems to strongly affect discrimination. Non-white workers, with the same characteristics as whites, have significantly lower wages in traditionally less regulated occupations, such as work without a formal contract, domestic work without a formal contract, and self-employment (Figure 5). The average determinant of the unexplained wage decomposition of these variables is 3%, 2.7% and 5.3%, respectively. However, when analyzing the wage distribution, we can see that these values gain magnitude in the second quantile, where for the same variables, the values reach approximately 6%, 4% and 10%, respectively. In this sense, we suggested that in these occupations, less qualified jobs are more susceptible to wage discrimination against non-whites. In these cases, as there is direct contact between the contracting and the contracted parties, a possible tendency towards racial discrimination can be present, since this working relationship is not regulated by formal laws. However, it should be emphasized that these were the only analyzed variables where one can notice a decrease in the effect not observed along the wage quantiles, with emphasis on the first ones.

Figure 5 - Unexplained wage decomposition for work without a formal contract, domestic work without a formal contract and self-employment



Source: Prepared by the authors. Results in percentage.

5. DISCUSSION AND FINAL CONSIDERATIONS

This paper aimed to analyze the wage inequalities between whites and non-whites in the Brazilian labor market during the period 2002-2014. A counterfactual decomposition methodology (Oaxaca-Blinder) was used along with a quantile regression approach (RIF-Regression) and PNAD microdata. Our results showed that wage differences (totals, due to

observed factors and discrimination) are higher in the higher quantiles of the distribution, that is, in professions or activities whose wages are higher. In addition, we noticed a marked decrease in the wage gap between races, determined basically by observable characteristics, mainly the proximity between whites and non-whites in terms of level of education. On the other hand, wage discrimination appears to have declined very little over the analyzed period. There is a moderate decrease in the mean in this effect between 2002-2004 and 2007-2009, which then remained constant until 2012-2014. Works such as Mora (2008), Cacciamali; Tatei and Rosalino (2009), Silva; Carvalho and Neri (2006) show, as well as this article, the persistence of wage discrimination between races over time, an effect not only observed in Brazil, but also in other countries, such as the USA (see DOUGLAS; STEINBERGER, 2015).

Our results are complementary to some studies found in the literature, with similar methodologies and proposals. Differing from the works cited above, Salardi (2016), when analyzing the wage gap between races in the period 1987-2006 (with Pnad data) found as a result a decrease in the discriminatory effect over the analyzed period, which according to our work did not last for the remainder of the last decade. Álvarez (2013), using the 2001 and 2011 Pnad data and the wage decomposition of Melly, found that between the first and the second analyzed period there was a decrease in the wage gap between the races, mainly provided by observable characteristics, while the unobservable determinants remained more constant. Moreover, even after using another quantum econometric methodology, their results along salary quantiles are similar to those found in the present study: the observed and unobserved total differences decrease until the second quantiles, then increase proportionally to the higher quantiles of the distribution. This same behavior of the effects of wage decomposition along the distribution is also observed in Freitas Filho and Sampaio (2015) where the authors use the same methodology of the present study only with data from the 2010 Census, without comparing different periods.

It is also important to highlight the role of education in reducing inequalities in the labor market. Our study shows that education is the main determinant of the wage gap between races, both in the decomposition by explained factors and in the decomposition by unexplained factors (the effect in this case is due to different wage returns associated with education). These results are also in line with Salardi (2016), Álvarez (2013) and Freitas Filho and Sampaio (2015). However, in the present study we show that during the analyzed period (2002-2014) this productive factor was the main responsible for the decrease in the wage gap between whites and non-whites. It is interesting to note that the decrease in the wage gap due to the increase in years of education occurred with greater magnitude in the higher levels of the distribution, that is, in relation to higher paying jobs. Between 2002 and 2014, the fall due to this productive factor was approximately 8 p.p. in the ninth quantile. As higher-paid occupations generally employ workers with at least higher education, this result may be related to the focus given over the decades of 2000 and 2010 to higher education policies, among those, the creation of racial quotas deserves to be highlighted. In this sense, the importance of active policies in the area of education in order to reduce socioeconomic inequalities becomes evident. Corroborating such a discussion, there is a concern that whites have greater returns associated with education than non-whites. It is therefore imperative that a higher quality public primary education is sought, favoring the less fortunate and giving them more opportunities to enter higher education.

Emphasis is also given to the role of occupations in wage discrimination, a result hitherto little discussed in the literature. Our results suggest that there is a greater tendency of wage discrimination between races, especially in activities that pay less (beginning of wage distribution), such as in domestic work without a formal contract, other jobs without a formal contract, and autonomous jobs. The hypothesis was that such effect may be the result of the direct contact between the contracting and contracted parties whose working relationship is not regulated by formal laws. In this case, the contracting party could assert this possible tendency towards discrimination. Freitas Filho and Sampaio (2015) also observe an important component to explain discriminatory effects of wages, only comparing men and women. However, it should be noted that the Oaxaca-Blinder, Oaxaca-Ransom, and other models estimate the differential component that is not explained by the productive attributes. The literature on the subject, however, attributes this part of the differential to discrimination. The labor economics literature looks for ways to increase R^2 so that wages are better understood, but the innate ability, which is the main component to explain wages, is not observable, so the R^2 found here are similar to that of the specific literature (BALDWIN; CHOE, 2014; DOUGLAS; STEINBERGER, 2015; HERRING; HENDERSON, 2016).

Finally, it should be noted that, among the variables analyzed to evaluate the discriminatory effect of wages, occupations without regulation were the only ones that showed a decrease in their effect over the analyzed period. This decrease was higher in the professions paying lower wages, which, because they are less valued, could favor even more discrimination against non-whites. In this sense, the decrease observed in this effect may be a reflection of a process of social inclusion experienced in the period of analysis. We suggest that future studies focus on such occupations in order to better understand the mechanism that operates in the wage discrimination of race experienced in these professions.

We also suggest that in future studies such a methodology should be replicated for the gender wage differential, in order to highlight the differential that is determined by the types of occupations, since the literature still finds unexplained differences between men and women, however, no studies were identified that consider the type of occupation as an explanatory factor for Brazil.

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APPENDIX A

Table A.1 - Oaxaca decomposition in the (10-90) quantiles of wage distribution

Quantile	2002-2004			2007-2009			2012-2014		
	Difference	Explained	Unexplained	Difference	Explained	Unexplained	Difference	Explained	Unexplained
10	0.477*	0.316*	0.161*	0.425*	0.297*	0.128*	0.325*	0.224*	0.100*
	(0.004)	(0.003)	(0.004)	(0.004)	(0.003)	(0.004)	(0.004)	(0.002)	(0.003)
20	0.331*	0.312	0.019*	0.248*	0.230*	0.019*	0.172*	0.171*	0.001
	(0.003)	(0.002)	(0.003)	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)
30	0.378*	0.286*	0.092*	0.256*	0.217*	0.039*	0.242*	0.163*	0.079*
	(0.003)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)
40	0.429*	0.294*	0.136*	0.320*	0.233*	0.087*	0.294*	0.228*	0.066*
	(0.003)	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
50	0.454*	0.345*	0.109*	0.364*	0.289*	0.075*	0.332*	0.245*	0.086*
	(0.003)	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)
60	0.487*	0.396*	0.092*	0.393*	0.304*	0.089*	0.357*	0.275*	0.082*
	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)	(0.002)	(0.003)
70	0.546*	0.415*	0.131*	0.480*	0.359*	0.121*	0.427*	0.292*	0.134*
	(0.004)	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)
80	0.656*	0.465*	0.191*	0.558*	0.403*	0.155*	0.507*	0.342*	0.165*
	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)	(0.004)	(0.004)	(0.003)	(0.004)
90	0.722*	0.481*	0.241*	0.647*	0.445*	0.201*	0.572*	0.376*	0.196*
	(0.006)	(0.005)	(0.006)	(0.006)	(0.004)	(0.006)	(0.006)	(0.004)	(0.006)

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