Income Differentials in The Formal Work of Pendular Migrants in the Northeast States: A Quantile Regression Approach

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Lecturas de Economía - No. 101. Medellín, enero-junio 2024

Lecturas de Economía, 101 (enero-junio 2024), pp. 71-104

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Abstract: *In the Brazilian domestic sphere, more research is needed to address the perspective of migratory commuting associated with differentials in earnings from work, especially in the Northeast region. Therefore, this article aims to analyze the income differentials from formal work among commuting migrants from the Brazilian Northeast Region in 2009 and 2019, based on RAIS data and the use of the method of Quantile Regressions. The results showed that the characteristics of gender, race/color, length of employment, and education corroborate income differentials in the Northeastern labor market among commuters. It was verified that the positive effect on income was more remarkable, in both years, for white men with more than ten years of experience in the job and a higher level of education (master's and doctorate), mainly in the higher quantiles of the conditional distribution salary.*

Keywords: *labor income differentials, commuting migration, formal labor market, quantile regression.*
JEL Classification: J0, J15, J61.

Diferenciales de Ingresos en el Trabajo Formal de los Migrantes Pendulares en los Estados del Noreste: Un enfoque de regresión cuantil

Resumen: *En el ámbito doméstico brasilero, se observan pocas investigaciones que aborden la perspectiva del desplazamiento migratorio asociado a los diferenciales en la remuneración del trabajo, especialmente cuando se trata de la región Nordeste. En vista de eso, este artículo tiene como objetivo analizar los diferenciales de ingresos del trabajo formal entre los migrantes de la Región Nordeste de Brasil en los años 2009 y 2019, con base en datos del RAIS y el uso del método de regresión por cuantiles. Los resultados mostraron que las características relacionadas con el género, la raza/color, la duración del empleo y la educación corroboran los diferenciales de ingresos en el mercado laboral del noreste entre los viajeros. Se verificó que el efecto positivo sobre el ingreso fue mayor, en ambos años, para los hombres blancos, con más de diez años de experiencia en el trabajo y mayor nivel de educación (maestría y doctorado), principalmente en los cuantiles más altos de la distribución salario condicional*

Palabras clave: *diferenciales de ingresos laborales, migración de desplazamiento, mercado de trabajo formal, regresión cuantil.*

https://doi.org/10.17533/udea.le.n101a353064

Différences de revenus dans le travail formel des migrants pendulaires dans les États du Nord-Est: Une approche de régression par quantile

Résumé: *Dans la sphère domestique brésilienne, peu de recherches abordent la perspective du déplacement migratoire associé aux différentiels de rémunération du travail, en particulier dans la région du Nord-Est. C'est pourquoi cet article vise à analyser les écarts de revenus du travail formel parmi les migrants de la région du Nord-Est du Brésil pour les années 2009 et 2019, en se basant sur les données du RAIS et en utilisant la méthode de régression par quantile. Les résultats ont montré que les caractéristiques liées au sexe, à la race/couleur, à la durée de l'emploi et à l'éducation corroborent les écarts de revenus sur le marché du travail du Nordeste parmi les voyageurs. L'effet positif sur les revenus s'est avéré plus important, pour les deux années, pour les hommes blancs ayant plus de dix ans d'expérience professionnelle et des niveaux d'éducation plus élevés (maîtrise et doctorat), principalement dans les quantiles supérieurs de la distribution conditionnelle des salaires.*

Mots clés: *différentiels de revenus du travail, migration pendulaire, marché du travail formel, régression quantile.*

Cómo citar / How to cite this item:
da Silva, C. D. L., N., Justo, W. R., & Silva Filho, L. A. D. (2023). Income Differentials in The Formal Work of Pendular Migrants in the Northeast States: A Quantile Regression Approach. *Lecturas de Economía*, *101*, 71-104.
https://doi.org/10.17533/udea.le.n101a353064

Income Differentials in The Formal Work of Pendular Migrants in the Northeast States: A Quantile Regression Approach

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Original manuscript received on 14 March 2023; final version accepted on 11 November 2023

Introduction

From the 1980s onwards, the dynamics of urban spaces in Brazilian cities underwent significant transformations, resulting from trends in migratory flows and urban-regional dynamics throughout the country. In this process, migratory flows had a relevant influence. The reconfiguration of population dynamics was partly due to the deconcentration of economic activity over time, mainly concerning the decade mentioned above, marked by productive restructuring and regional development policies, which resulted in a rupture in the trends of migratory flows interregional (Correia & Ojima, 2017) and the emergence of new displacement axes (Lima, 2018).

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In this context, commuting in Brazil gained momentum and importance, especially in the 1980s/1990s, through the transformations that occurred in the country during this decade (Delgado et al., 2016).

Regarding its concept, commuting migration can be understood as the displacement that occurs daily between the municipality of residence of the individual and another different municipality, with the purpose of work and study (Mouraet al., 2005; Sobreira, 2007), being predominant in the main metropolitan areas, and may also extend; for smaller agglomerations (Delgado et al., 2016).

As with other types of mobility, commuting incurs financial and time costs. Thus, the decision to commute is made in an environment involving individual motivations and circumstances that change throughout life and space (de Brito et al. 2018). However, such a decision to work in a municipality other than that of residence is rational, where individuals who opt for commuting would do so for a greater wage return or a gain in well-being related to better housing conditions in the place of residence, considering the costs of commuting to work (Stutzer & Frey, 2008).

To Sobreira (2007), those who commute in general obtain a higher income when compared to those who do not travel to work in another municipality far from their residence; this is because, from the author's point of view, such mobility is associated with socioeconomic differences in society, where populations of different classes carry them out. Each location has a characteristic that conditions selectivity in such displacements.

Within the empirical perspective of migration, several works discuss the existence of income differentials between migrants and non-migrants, both in the national and international economic literature (Batista & Cacciamali, 2009; Chiswick, 1978; de Aguiar et al., 2018; de Beaumont & Yang, 2008; Gama & Machado, 2014; Santos, 2018; Santos & Lelis, 2018; Silva-Filho, 2017; Silva-Filho & Resende, 2018). These studies, however, are consensual, and in all of them, it is observed that migrants earn higher incomes than non-migrants.

As for commuting, according to Santos and Lelis (2018), only some studies in Brazil seek to explore the income earned by workers associated with commuting. This gap is even more remarkable when considering research

on the country's Northeast region. However, some studies in the literature attest to the existence of income differentials in favor of those who choose to commute compared to those who do not commute (Lameira, 2016; Santos, 2018; Santos & Lelis, 2018; Sidrim & Fusco, 2019).

It is worth noting, however, that to date, no study analyzes wage differentials due to migratory commuting in formal work. In Brazil, commuting in formal work can be verified through a micro database from the Ministry of Labor. Thus, it is possible to know which employed people work in a municipality and live in another municipality different from the one where they work. Furthermore, the uniqueness of this article occurs when it is observed that all the literature on migratory commuting in Brazil considers other databases and does not analyze the formal sector of the country's economy. Knowing that this sector is what ensures social guarantees for workers in the country, investigating commuting in formal work is relevant as an object of this investigation.

It should also be noted that this article aims to observe wage differentials throughout the conditional distribution of income, since there is, in the migratory commuting of formal work in the Northeast, a migration to large urban centers of people with low levels of employment opportunities. work in its surroundings, as there still is, however, there is a commuting mobility from large urban centers to the periphery of people with high levels of formal qualifications who live in the centers and work in the surrounding cities. Therefore, analyzing the points of the conditional distribution of work through quantile regressions is appropriate for this investigation. In this sense, its originality ensures academic relevance to a study of this nature to understand the dynamics of migratory commuting in formal work in the Northeast.

Given the above, this study aims to analyze the impacts of socioeconomic and demographic characteristics on the differentials in income from formal work among commuting migrants in Northeast Brazil. The study is based on the RAIS database and uses the Quantile Regression method. Furthermore, the current search justifies contributing empirically to the base of knowledge about commuting migrations; given the lack of studies whose themes are focused on this perspective of migratory commuting and the formal labor

market in the Brazilian Northeast, this work thus becomes a pioneer in the subject and advances on such literature.

In addition to this introduction, the article is structured in five sections. The second section presents the methodological procedures, such as the description of the data and the econometric method used. The third section presents descriptive statistics and discussions in light of current literature; the results and discussions are presented in the following section. Furthermore, finally, in the fifth section, there are the final considerations.

I. Methodological Procedures

This section aims to demonstrate the methodological procedures adopted in the study, where the data source and the econometric method will be described. Thus, the database used was taken from the Annual List of Social Information (RAIS) of the Secretariat for Social Security and Employment of the Ministry of Labor and Social Security. This data source was chosen because it has information on workers inserted in the formal labor market throughout the national territory and because it constitutes an essential source for analyzing the migratory flows of workers for formal work in Brazil.

A. Coverage area and time frame

The chosen study area corresponds to the Northeast Region of Brazil, considering all its federal states with a time frame that comprises the years 2009 and 2019, according to the availability of RAIS data.

B. Description of variables

The variables used in the present study are described in Table 1. These variables have both socioeconomic and demographic characteristics that can influence the differentials in earnings from work and are widely accepted by the national literature on migrations and differentials in earnings, being used as control variables both on the migration decision and on labor income differentials (Freguglia, 2007; Gama & Hermeto, 2017; Maciel & Oliveira, 2011; Silva Filho, 2017; Silva-Filho; 2019).

Table 1. *Description of the variables used based on the 2009/2019 RAIS*

Migrates	Binary (1) for people who lived in a different municipality than where they worked in 2009 and 2019, respectively; (0) for those residing in the same municipality of work according to the RAIS in 2009 and 2019.
Sex	Binary (1) for individuals declared male; (0) for female.
Age	Age of the reference person in the research.
White man	For white race/color men.
White woman	For women of white race/color.
Yellowman	For men of race/color yellow.
Woman yellow	For women of race/yellow color.
Black man	For black race/color men.
Black woman	For women of black race/color.
Man brown	For men of mixed race/color.
Woman brown	For women of mixed race/color.
Farming	For formal workers allocated in the agricultural sector.
Industry	For formal workers allocated in the industry sector.
Construction	For formal workers allocated in the civil construction sector.
Trade sector	For formal workers allocated in the trade sector.
Services	For formal workers allocated in the service sector.
Public administration	For formal workers allocated to public administration.
Education, culture and health services, and other services.	For formal workers allocated in the education, culture, and health services sector and other services.
Domestic services	For formal workers allocated in the domestic services sector.
Disabled person	For formal workers with disabilities.
Industry opting for the simple national	For formal workers allocated in companies that opted for taxation of the simple national.
Micro	For formal workers in micro-enterprises.
Small	For formal workers of small companies.
Average	For formal workers in medium-sized companies.
Big	For formal workers of large companies.
Up to 1 year	For workers who have been in employment for up to one year.

Continued

Table 1. *Continuation*

More than 1 to 2	For workers who have been in employment for one to two years.
More than 2 to 3	For workers who have been in employment for two to three years.
More than 3 to 5	For workers who have been in employment for three to five years.
More than 5 to 10	For workers who have been in employment for five to ten years.
More than 10	For workers who have been in employment for more than ten years.
Uneducated or with incomplete primary education	For people who had no education or had at least incomplete primary education.
Complete primary education and incomplete secondary education	For people who had completed elementary school and incomplete high school.
Complete high school and incomplete higher education	For people who had completed high school and incomplete higher education.
Complete higher education	For people who had completed higher education.
Master's degree	For people who have a master's degree.
Doctorate	For people who had doctorates.
Income from work	Income per hour worked.

Source: Own elaboration based on data from the RAIS 2009/2019.

C. Descriptions of the Quantile Regression Method

The Quantile Regression method was proposed by Bassett and Koenker (1978). Since then, it has been widely used in studies of an empirical nature that seek to analyze how the quantiles of a dependent variable change with variations in the independent variables. Thus, they make it possible to verify the impact of the explanatory variables (independent) on the different points of the conditional distribution of the explained variable (dependent), making it possible to explore more significant amounts of information from the data. Furthermore, they differ from the Ordinary Least Squares (OLS) method, which only estimates the average effect of a variable on the conditional distribution of a dependent variable.

The use of Quantile Regressions, according to Buchinsky (1998), allows for reducing the presence of Outliers by percentiles and presents more fair estimates, that is, robust when compared to Ordinary Least Squares (OLS), which present only average estimates.

Therefore, this study resorts to Quantile Regression to estimate the effects of socioeconomic and demographic characteristics on the earnings differentials commuters, in quantiles of y_i (10, 50, 90), Quantile ten, fifty (median), and ninety. Estimations based on these points are intended to explore the lower and upper tails, the middle, and the left and right tails of the conditional distribution of earnings, verifying disparities in labor income existing in such quantiles.

In this study, the explained or dependent variable assumes the function of the natural logarithm of labor income (ln_rendatrab), which is explained through a set of socioeconomic and demographic characteristics of individuals and their work occupations (sex and race/color, age, age², sector of occupation, size of establishment, length of employment and education). The aim is to analyze the effects of each of these variables on the quantiles of the distribution of labor income for commuters for formal work in the Northeast.

Thus, if $(x_i y_i)$, $i = 1, \ldots, n$, represents a random sample of commuting formal workers in the Northeast, in which it x_i assumes the function of a vector of $(K \times 1)$ explanatory variables and $y_i$is the dependent variable to be explained at the various points of the conditional distribution of income, the θ-ésimo quantile of the explained variable y_i is described as follows:

$$F^1 = \inf \{y : F(y) \geq 0\} \tag{1}$$

where F is described as an unconditioned distribution function of (y). If there is a linear relationship between the explained variable y and its explanatory variables (x), the mathematical representation of the equation is presented and expressed by:

$$y_i = x_i' \beta + \mu_i \tag{2}$$

Thus, in (2), β it refers to a vector of estimated parameters and the quantiles $y_i(10, 50, 90)$ conditional distribution of labor income defined from the

quantiles of the conditional distribution of errors, as follows the equation below:

$$Pr\left(y_i \leq \frac{y}{x_i}\right) = F_{\mu\theta}\left(y - \frac{x'\beta_\theta}{x_i}\right),\ 1 = 1, \ldots, n \tag{3}$$

From the mathematical representation of equation (3), the Quantile Regression model can be defined as follows:

$$Q_\theta\left(\frac{y_i}{x_i}\right) = x_i'\beta_\theta + F^1\left(\theta\right) \tag{4}$$

Quantile Regression, the quantiles y_i (10, 50, 90)must be read as unconditional, being the solution of a maximization problem. Therefore, the β_θ quantile regression estimator (equation 4) needs to be defined from an objective function:

$$\min_\beta \frac{1}{n}\left\{\sum_{i:y_i \geq x_i'\beta} \theta\left|y_i - x_i'\beta\right| + \sum_{i:y_i < x_i'\beta}(1-\theta)\left|y_i - x_i'\beta\right|\right\} = \min_\beta \frac{1}{n}\sum_{i=1}^{n}\rho_\theta(u_{\theta_i}) \tag{5}$$

Differently from what we have in estimates by Ordinary Least Squares, with estimation by Quantile Regression, there is the minimization of absolute values of the variables since the solution is obtained through linear programming. Therefore, the model presented in equation (6) represents a conditional function of each quantile of the explained variable y given a matrix x of explanatory variables, defined below:

$$Q_{yi}\left(\frac{\theta}{x}\right) = X\beta\left(\theta\right),\ \text{onde}\ \theta = [0, 1] \tag{6}$$

In this way, at each of the quantiles the effect of the explanatory variables contained in y_i(10, 50, 90), on the explained variable $y(\ln_{\text{rendatrab}})$, at each

point of the conditional distribution of income earned in formal work by commuting migrants is captured x.

Where, for everyone i, w as the neperian logarithm of labor income, while the covariates are defined in frame 1[1].

II. Commuting Migration and Insertion of Formal Work in The Northeast

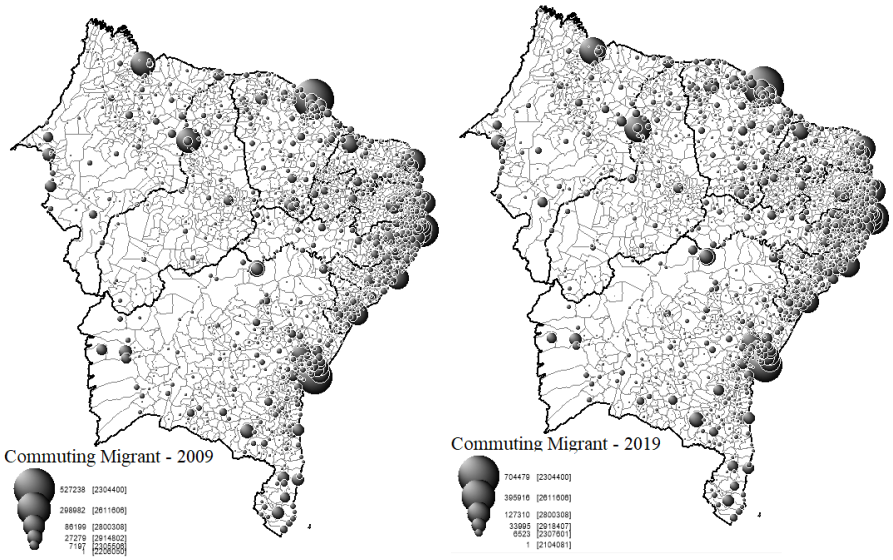
This section presents, through a quantitative approach, the occurrence of commuting due to formal work, as well as the average income from this work in the municipalities of the Northeast in the years 2009 and 2019.

Figure 1 shows the concentration of commuting migrants in the formal labor market in the municipalities of the Northeast region in 2009 and 2019. Those who carry out migratory commuting are concentrated in a more significant proportion, mainly in the municipalities that are part of the capitals of each state and, nevertheless, to a lesser extent in the municipalities surrounding these metropolises. Among them, Fortaleza, the capital of the state of Ceará, is highlighted, followed by the municipality of Recife, the capital of Pernambuco, and Salvador in Bahia, as the main ones in terms of higher concentration.

Moreover, it is also observed that in the rest of the other states that form the Northeast region, in what belongs to their capitals, the same dynamics of these flows can be verified; the capitals of these states are where commuting migrants for formal work go the most, this goes against what the national literature points out, that commuting predominates in urban agglomerations, mainly in metropolitan regions (Cintra et al., 2009; Delgado et al., 2016). Thus, it is associated with the integration and functional interdependence that characterize conurbation regions, namely, metropolitan regions or clusters specialized in a specific economic activity (Oliveira & Givisiez, 2018).

[1] In estimating the Quantile Regression, the variables "person with a disability" and "industries opting for Simples Nacional" were disregarded, as they are not relevant, according to the economic literature, in determining wages.

Figure 1. *Commuting migrants inserted in the formal labor market in municipalities in the Northeast, 2009/2019*



Source: Own elaboration based on RAIS data – 2009/2019.

Concerning 2019, there is a certain homogeneity in the concentration of formal commuting workers in all states of the Northeast. However, in this period, there was a more significant intensification of these flows both in the metropolitan areas of each state and in some municipalities in their interior, for the latter, probably due to the development of economic activity. In this regard, as highlighted on the map, the case of the municipalities that form the Mesoregion of the São Francisco Valley in Bahia, particularly Juazeiro. Such dynamics in this municipality are associated with the development of irrigated agriculture in the Juazeiro/Petrolina Pole, which contributed to the expansion of production and productivity of crops intended for the foreign market instead of food production (da Silva & de Souza, 2018).

Furthermore, there is a significant concentration of commuting migrants in some cities in southern Bahia and the extreme west of Bahia, the latter being an integral part of the dynamics of MATOPIBA's agribusiness.

It is also observed that for both years, Mossoró, located in the Mesoregion of the West Potiguar, stands out among the other municipalities in the state, which are far from the capital and present a considerable concentration of commuting migrants in the formal labor market. Along the same lines, the city of Imperatriz, located in Maranhão, also stands out regarding commuting migrants. Indeed, this concentration is associated with the city's economy, which is based on the tertiary sector, represented mainly by trade and services. Recently, a new industrialization process has begun centered on furniture production and the presence of an industry focused on pulp and paper production (Borges et al, 2014).

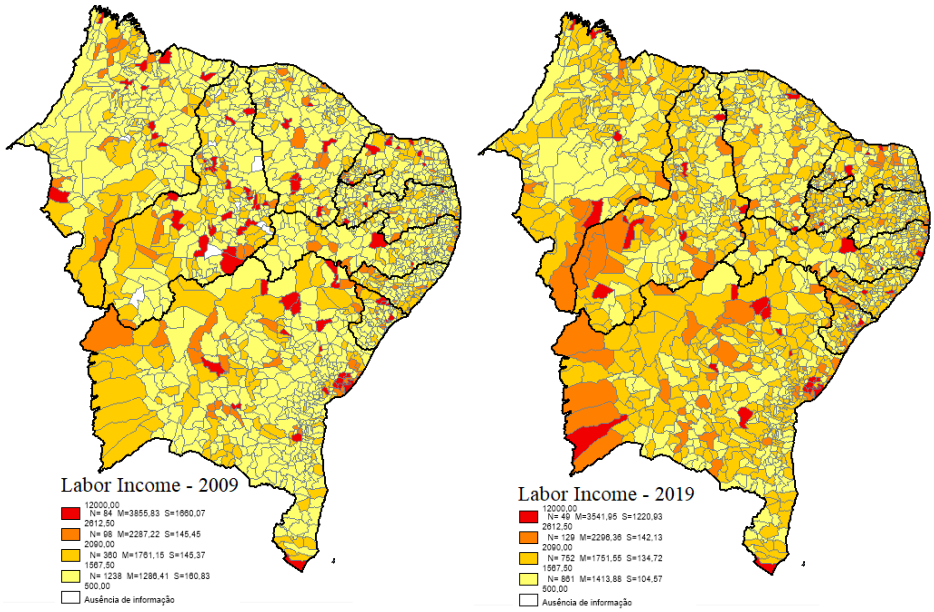
In addition to these, it should be noted that among the other central metropolitan regions of each state that make up the Northeast region concerning the concentration of formal commuting workers, the capital, São Luís obtained a relative share of the flows of commuting migrants in formal work for both periods mentioned in the study, as well as in neighboring municipalities. The result is linked to the great concentration of formal employment in the expanding sectors of civil Construction and Commerce (Holanda & Júnior, 2015).

In both years, the metropolitan areas of Fortaleza, Recife, and Salvador showed the same trend in the concentration of commuting migrants in the formal labor market among the other regions of the Northeast. The dynamics of these municipalities in becoming the largest concentrations of commuting migrants in the entire Northeast region are mainly related to their population aspects, such as density and economic aspects, GDP, sectors of activities, and a higher income from work, which constitute attractive factors for the occurrence of pendulum movements.

Thus, from what was ascertained, there is a greater concentration of commuting migrants, mainly in the largest municipalities, in terms of economic dynamics, that is, the capitals of each state in the Northeast, especially in its metropolitan areas. However, it should be noted that as we move away from these large metropolises, there is a reduction in the concentration of commuting migrants, except for some municipalities that maintain solid economic activity on the rise.

Figure 2 shows the average income from formal work according to the municipalities in the Northeast region in 2009 and 2019. higher income from formal work compared to those on a smaller scale.

Figure 2. *Average income from formal work in the municipalities of the Northeast, 2009/2019*



Source: Own elaboration based on data from RAIS, 2009/2019.

In 2009, the number of municipalities that were part of the smaller scale was 1238, reducing to 861 municipalities in 2019, meaning an improvement in average income. Concerning the municipalities that were part of the scale with the highest average income from formal work 2009, the numbers were 84, increasing to 49 municipalities in 2019, showing a deconcentration of the average income from formal work.

It is possible to observe that the states of Ceará and Piauí, notably, comparing the two years of analysis of the study, were the ones that had the highest number of municipalities allocated in other scales of average income from formal work. For the year 2009, the municipalities in Ceará with the highest

average income from work were the municipalities of General Sampaio, Catunda, Banabuiú, Catarina, Saboeiro, Antonina do Norte, Granjeiro and Missão Velha, whereas, in 2019, these municipalities in Ceará reduced for more minor scales of medium income, while others emerged and stood out on a larger scale, as in the case of São Gonçalo do Amarante and Jati, the latter being associated with the transposition works of the São Francisco River to the Cinturão das Águas in Ceará. Jati is an eligible municipality, which in turn contributes to improvements in the economy, and, therefore, in the average labor income of the municipality.

In this same line of analysis, the states of Bahia, Sergipe, Pernambuco, Alagoas, and Paraíba were the ones that suffered minor changes in the highest scales of average labor income over the two years of analysis. In 2009 and 2019, the Bahian municipalities of Sobradinho, Jaguarari, Andorinha, Barrocas, and those around Salvador remained on the average income scale of formal work about the highest income scale. In 2019, there was a significant improvement in the average income from formal work for municipalities in the Far West of Bahia integrated into the soy export complex.

Furthermore, in the states of Maranhão and Rio Grande do Norte, there was a deconcentration of average income from formal work for the municipalities included in the scale with the highest average income from work when comparing the years of analysis. In 2009, the Maranhão municipalities of Godofredo Viana, Capinzal do Norte, Governador Archer, Senador Alexandre Costa, and Estreito were some of the other municipalities that stood out in the scale of higher average income from formal work. Of these, only the municipalities of Godofredo Viana and Capinzal do Norte remained in 2019 on the same income scale mentioned above, and the others reduced to lower average income scales. Furthermore, there is also an emergence of several municipalities with the improvement in the scale of the average income from formal work, compared to 2009, in general terms for the entire state.

Comparing the two maps, it is possible to verify the predominance of the smaller scale of average income from formal work represented by the light-yellow color, indicating an average income of R $500.00 for most municipalities in the Northeast region. It is also verified that the municipalities within this scale 2009 emerged in 2019 to a second smaller scale, represented

by the darker yellow color, indicating an average income range of R $1 567.50. It was also found that the municipalities in 2009 that were part of the scale with the highest average income from formal work, represented by red, indicating an average income of R $2 612.50, started to be allocated in 2019 to a second larger scale middle-income, represented by the color yellow, with an average income between R$ 2 090.00[2].

However, these results highlighted a supposed deconcentration of Northeast municipalities' average income from formal work when comparing 2009 with 2019. It is also observed that, in some municipalities, mainly in areas with more incredible economic performance, the average income from work is either in the highest income range or in the second highest due to the performance of its economy. Thus, they become the main destinations of formally employed people who commute.

III. Socioeconomic and Demographic Characterization of Commuting Migrants and Non-Commuting Migrants in the Northeast – 2009/2019

Table 1 presents the descriptive statistics of the variables used, presenting the socioeconomic and demographic characteristics of commuting migrants and non-commuting migrants of formal work in the Northeast region of Brazil for the years 2009 and 2019.

In 2009, it was observed that 68% of the formally employed were both commuting migrants, predominantly male and non-commuting migrants, with an average age of 33.56 years (commuting migrants) and 33.22 years (non-migrants). In 2019, this participation went to 64% for commuting migrants and 56% for non-migrants, indicating a reduction in the participation of men in commuting and the formal labor market and, in effect, an improvement in the participation of women in the pendular migratory dynamics. These results are in line with the findings by Gama and Machado (2014), and Silva-Filho (2019); the latter showed that for the state of Bahia, greater participation of men concerning migrant women and non-migrants in the condition of formal occupation of work in the municipalities of Bahia, for the years 2000 and 2010.

[2] Monetary values are in 2019 BRL and were deflated by the INPC.

Table 2. *Socioeconomic and demographic characterization of commuting migrants and non-commuting migrants in the Northeast, 2009/2019*

Variables	2009		2019	
	Commuting Non-Migrant (%)	Commuting Migrant (%)	Commuting Non-Migrant (%)	Commuting Migrant (%)
Sex	0.68	0.68	0.56	0.64
Age	33.22	33.56	35.9	35.67
White man)	20.7	17.9	15.3	12.3
White woman)	12.4	10.5	13.2	8.6
Yellow man)	0.8	0.7	0.3	0.5
Woman (yellow)	0.4	0.3	0.3	0.4
Black man)	4.6	4.3	3.4	4.2
Black woman)	1.4	1.3	two	1.8
Man (brown)	41.7	44.9	36.8	46.7
Woman (brown)	17.9	20.1	28.7	25.6
Farming	5.5	6.3	6.8	4.2
Industry	21.9	17.5	8.5	18.1
Construction	11.8	11	4.4	8.5
Trade sector	20.4	27.4	23.6	25.3
Services	25.2	23.9	25.4	29
Public administration	5	3	4.8	3.6
Education, culture, health and other services	10.2	10.9	26.5	11.2
Domestic services	0	0	0	0
Disabled person	1	0.6	0.5	1.4
Industry opting for the simple national	18	31.4	58.3	20.8
Micro	25.5	39.8	53.3	29.7
Small	21.1	25.5	24.6	23.9
Average	21.8	17.9	8.4	21.5
Big	31.6	16.8	13.7	24.9
Up to 1 year	49.7	49.6	38.5	33.4

Continued

Table 2. *Continuation*

Variables	2009		2019	
	Commuting Non-Migrant (%)	Commuting Migrant (%)	Commuting Non-Migrant (%)	Commuting Migrant (%)
More than 1 to 2	16.8	16.7	17.9	16.4
More than 2 to 3	9	9	10.4	10.2
More than 3 to 5	9.8	9.7	12.2	13
More than 5 to 10	8.8	8.7	14	16.8
More than 10	6	6.2	7	10.2
Uneducated or with incomplete primary education	24.2	23.4	9.7	12.1
Complete primary education and incomplete secondary education	19.8	21.6	11.7	13.6
Complete high school and incomplete higher education	47.9	47.6	61.6	61.6
Complete higher education	7.9	7.2	16.2	12.2
Master's degree	0.2	0.2	0.6	0.4
Doctorate	0.1	0	0.2	0.1
Income from work	1897.64	1754.39	1835.96	2081.78

Source: Own elaboration based on data from the RAIS 2009/2019.

Regarding education, 47.6% of the formally employed who carry out migratory commuting mostly have completed high school and incomplete higher education, while non-commuting migrants have a slightly higher percentage, with 47.9%. In 2019, a significant increase in this percentage was noted for both groups, with each in the order of 61.6%. It is essential to highlight that, comparing the years of study, greater participation of both groups in the other higher levels of education is observed, indicating an improvement in education and a reduction in the participation of these groups in lower levels of education, converging with the results pointed out by other works (Correia, 2020; Ramalho & Brito, 2016; Sidrim, 2018; Sidrim & Fusco, 2019).

In addition, it notes that commuting migrants with higher education increased from 7.2% in 2009 to 12.2% in 2019, while non-commuting migrants increased from 7.9% to 16.2% respectively. However, the results indicate that for the years referred to in this study, non-commuting migrants have, on average, a higher level of education (more schooling) compared to commuting migrants, converging with results presented by de Brito et al. (2018).

Concerning average income from work[3], it is possible to identify that non-commuting migrants in 2009 earned an average income of R $1 897.64, which is relatively higher than that of the commuting migrants, which was only R $1 754.39. However, this relationship changes when compared to the year 2019, where the average income earned by the group of non-commuting migrants reduces to R$ 1 835.96, while there is an improvement in the average income for commuting migrants, increasing to R $2 081.78.

Over the period covered in this analysis, it appears that the group of non-commuting migrants in the condition of formal occupation in the labor market in 2009 earned an average income from work higher than the group of commuting migrants of R $143.30, while in 2019, commuting migrants had a higher average income from work compared to commuting non-migrants in the order of BRL 245.82, which may indicate an inversion of positions. This result is consistent with the findings by da Silva-Filho et al. (2021) for the Midwest region of Brazil.

IV. Results and Discussions

This section aims, using the Quantile Regression Method (QR), to analyze and capture the effect of socioeconomic and demographic characteristics on the income differentials of commuting workers in the formal economy in what comprises the Northeast region of Brazil in the period 2009 and 2019 in different income quantiles (10, 50 and 90). Indeed, using that method has advantages as it makes it possible to compare income differentials and returns to commuting in different quantiles of the conditional distribution of income

[3] The income considered in this study is real income. Thus, the values presented in terms of average earnings from work were monetarily corrected and deflated, and therefore a comparison between years can be made.

(Maciel & Oliveira, 2011). In this way, the 10th, 50th, and 90th percentiles of the conditional wage distribution will be investigated, that is, the lowest wages earned by workers in the first ten percent of wages, in the median, and the higher wages received by workers in the ninety percent of income.

Thus, observing Table 2[4], Considering the variables that refer to individual characteristics, it is noted that men of race/yellow color earned higher wages than those of the reference category (white man) in all quantiles of the conditional distribution of wages, as well as it appears that the greater the wage distribution, the greater the differential earned by them in 2009. On the other hand, it is observed that regardless of race and color, women earn lower incomes than men, highlighting black women at the 0.90 quantiles as those earning the lowest income from work, earning 41% less.

Concerning 2019, at quantile 0.10, only yellow, black, and brown men earned wages higher than white men (reference category), but this cannot be said for the other quantiles analyzed and for women. On the median, women of the yellow race/color earned the lowest salaries than those in the omitted category and concerning the others. Likewise, in the 0.90 quantiles of income, black women. Based on these results, it is evident that the characteristics related to sex and race/color harm wage differentials, especially when observing the highest income quantiles, where income inequalities are more attenuated, ranging from meeting with the findings in the economic literature (Carvalho et al., 2006; de Brito et al., 2018; Gama & Hermeto, 2017; Matos & Machado, 2006; Silva-Filho et al., 2018).

[4] The variables "Yellow Man" at quantiles 0.50 and 0.90 for the year 2019; "Public Administration" at quantile 0.10 in 2019 did not show statistical significance. Only the variable "Yellow Woman" at quantile 0.10 in the year 2019 showed statistical significance at the 10% level. And the variable "Black Man" at the 0.50 quantile for 2019 obtained statistical significance at the 5% level.

Table 3. *Differentials in earnings from work among commuting migrants in formal work in the Northeast according to socioeconomic and demographic characteristics, 2009/2019*

Variables	Dependent variable: $ln_{rendatrab}$					
	(Qtl. 0.10- 2009)	(Qtl. 0.10 - 2019)	(Qtl. 0.50 - 2009)	(Qtl. 0.50 - 2019)	(Qtl. 0.90 - 2009)	(Qtl. 0.90 -2019)
White woman	-0.025 ***	-0.013 ***	-0.135 ***	-0.075 ***	-0.322 ***	-0.189 ***
	(0.0003)	(0.0003)	(0.001)	(0.001)	(0.003)	(0.003)
Black man	-0.004 ***	0.003 ***	-0.013 ***	-0.004 **	-0.101 ***	-0.066 ***
	(0.001)	(0.0005)	(0.001)	(0.002)	(0.003)	(0.005)
Black woman	-0.026 ***	-0.009 ***	-0.144 ***	-0.082 ***	-0.410 ***	-0.270 ***
	(0.0004)	(0.0004)	(0.001)	(0.002)	(0.005)	(0.005)
Yellowman	0.016 ***	0.006 ***	0.069 ***	-0.006	0.098 ***	-0.018
	(0.002)	(0.002)	(0.003)	(0.006)	(0.011)	(0.017)
Yellow woman	-0.015 ***	-0.002 *	0.021 ***	-0.090 ***	-0.306 ***	-0.213 ***
	(0.002)	(0.001)	(0.003)	(0.005)	(0.011)	(0.017)
Brown man	-0.003 ***	0.002 ***	-0.005 ***	0.006 ***	-0.080 ***	-0.031 ***
	(0.0003)	(0.0003)	(0.001)	(0.001)	(0.002)	(0.003)
Brown woman	-0.029 ***	-0.010 ***	-0.144 ***	-0.070 ***	-0.395 ***	-0.223 ***
	(0.0003)	(0.0003)	(0.001)	(0.001)	(0.002)	(0.003)
Age	0.004 ***	0.002 ***	0.013 ***	0.008 ***	0.035 ***	0.021 ***
	(0.0001)	(0.00004)	(0.0001)	(0.0002)	(0.0004)	(0.0005)
Age^2	-0.00003 ***	-0.00002 ***	-0.0001 ***	-0.0001 ***	-0.0002 ***	-0.0001 ***
	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00001)	(0.00001)
Industry	0.027 ***	0.023 ***	0.053 ***	0.026 ***	0.080 ***	-0.099 ***
	(0.001)	(0.0004)	(0.001)	(0.001)	(0.003)	(0.004)
Construction	0.066 ***	0.035 ***	0.196 ***	0.184 ***	0.255 ***	0.081 ***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.003)	(0.005)

Variables	Dependent variable: $ln_{rendatrab}$					
	(Qtl. 0.10- 2009)	(Qtl. 0.10 - 2019)	(Qtl. 0.50 - 2009)	(Qtl. 0.50 - 2019)	(Qtl. 0.90 - 2009)	(Qtl. 0.90 -2019)
Trade sector	0.049 ***	0.034 ***	0.049 ***	0.042 ***	-0.075 ***	-0.117 ***
	(0.001)	(0.0004)	(0.001)	(0.001)	(0.003)	(0.003)
Services	0.043 ***	0.038 ***	0.078 ***	0.077 ***	0.031 ***	-0.040 ***
	(0.001)	(0.0004)	(0.001)	(0.001)	(0.003)	(0.003)
Public Administration	0.099 ***	0.009	0.223 ***	0.070 ***	0.303 ***	0.150 ***
	(0.001)	(0.007)	(0.002)	(0.002)	(0.005)	(0.008)
Education, culture, health, and other services.	0.042 ***	0.037 ***	0.123 ***	0.128 ***	0.061 ***	0.174 ***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.004)	(0.005)
Domestic services	0.019 ***	0.006 ***	-0.021 ***	-0.032 ***	-0.180 ***	-0.332 ***
	(0.001)	(0.001)	(0.005)	(0.003)	(0.0022)	(0.005)
Small	0.029 ***	0.015 ***	0.093 ***	0.066 ***	0.173 ***	0.121 ***
	(0.0002)	(0.0003)	(0.001)	(0.001)	(0.002)	(0.002)
Average	0.052 ***	0.037 ***	0.179 ***	0.183 ***	0.297 ***	0.354 ***
	(0.0003)	(0.001)	(0.001)	(0.002)	(0.002)	(0.005)
Big	0.051 ***	0.176 ***	0.187 ***	0.336 ***	0.234 ***	0.256 ***
	(0.0003)	(0.002)	(0.001)	(0.001)	(0.002)	(0.005)
More than 1 to 2	0.019 ***	0.006 ***	0.017 ***	0.012 ***	-0.006 ***	-0.018 ***
	(0.0002)	(0.0002)	(0.001)	(0.001)	(0.002)	(0.002)
More than 2 to 3	0.034 ***	0.018 ***	0.040 ***	0.030 ***	0.047 ***	0.017 ***
	(0.0003)	(0.0004)	(0.001)	(0.001)	(0.002)	(0.003)
More than 3 to 5	0.040 ***	0.030 ***	0.080 ***	0.053 ***	0.084 ***	0.042 ***
	(0.0004)	(0.0003)	(0.001)	(0.001)	(0.002)	(0.003)
More than 5 to 10	0.052 ***	0.040 ***	0.099 ***	0.090 ***	0.146 ***	0.107 ***
	(0.0004)	(0.0004)	(0.001)	(0.001)	(0.003)	(0.003)

Variables	Dependent variable: $\ln_{rendatrab}$					
	(Qtl. 0.10- 2009)	(Qtl. 0.10 - 2019)	(Qtl. 0.50 - 2009)	(Qtl. 0.50 - 2019)	(Qtl. 0.90 - 2009)	(Qtl. 0.90 -2019)
More than 10	0.092 ***	0.073 ***	0.312 ***	0.220 ***	0.403 ***	0.299 ***
	(0.001)	(0.001)	(0.002)	(0.002)	(0.003)	(0.004)
Complete primary education and incomplete secondary education	0.032 ***	0.011 ***	0.076 ***	0.034 ***	0.197 ***	0.081 ***
	(0.0003)	(0.0003)	(0.001)	(0.001)	(0.002)	(0.003)
Complete high school and incomplete higher education	0.063 ***	0.024 ***	0.189 ***	0.095 ***	0.552 ***	0.237 ***
	(0.0003)	(0.0003)	(0.001)	(0.001)	(0.002)	(0.002)
Complete higher education	0.373 ***	0.141 ***	1,239 ***	0.805 ***	1,833 ***	1,306 ***
	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)	(0.005)
Master's degree	0.955 ***	1,005 ***	2021 ***	1,638 ***	2,620 ***	2,083 ***
	(0.044)	(0.018)	(0.011)	(0.010)	(0.028)	(0.0022)
Doctorate	0.610 ***	1,544 ***	2,175 ***	2,029 ***	3,127 ***	2,194 ***
	(0.042)	(0.025)	(0.030)	(0.014)	(0.0141)	(0.020)
Constant	2,841 ***	3,082 ***	2,709 ***	3,000 ***	2,697 ***	3,173 ***
	(0.001)	(0.001)	(0.002)	(0.003)	(0.008)	(0.010)
Comments	3,374,922	1,367,917	3,374,922	1,367,917	3,374,922	1,367,917

Note: Significances: *10%; **5%; and ***1%. In parentheses, the *p*-value.

Source: Own elaboration based on data from RAIS 2009/2019.

Despite the coefficient of the age variable, it is verified that, both in 2009 and in 2019, earnings grew with increasing age in the quantiles analyzed, as expected. However, the effect is more significant for the first year than the second since there is a slight reduction in the coefficients in 2019. However, the growth of earnings takes place up to a certain level since, when age becomes relatively high, earnings start to decrease, as shown by the results of its quadratic form "age^2", which in turn was also expected, and verified in other studies (Gama & Hermeto, 2017; Silva-Filho, 2017).

About the sectors of activity, it appears in 2009 that formal workers employed in public administration earned, on average, the highest wages compared to those employed in agriculture (reference category) in all quantiles of the conditional distribution of wages. While at the 0.50 quantile (median) and the 0.90 quantiles, those employed in the domestic services sector achieved the lowest salary levels, respectively, 2.1% and 18% less. These findings partially corroborate the results found by Santos Júnior et al. (2005), de Brito et al. (2018), and Santos (2018).

Considering 2019, compared to workers in the agricultural sector, workers allocated in other categories obtain incomes higher than these. Since, at a quantile of 0.10, the highest salaries on average were achieved by those employed in the service sector (3.8% more), similar to what was found by Julião and Rocha (2020). On the median, as verified by Santos and Lelis (2018), those allocated to civil construction earned, on average, the highest earnings from work (18.4% more) than the other categories and the reference category. In the highest quantile of income, the 0.90 quantile, the highest earnings from work were achieved by those allocated to education, culture, health, and other services. As in 2009, the lowest wages on average were earned by those employed in domestic service activities both at the median and at the 0.90 quantiles. This result can be justified by the fact that the activity of domestic services is considered a menial occupation and one of the subsectors with the worst remuneration, even if the salary in kind is considered, as pointed out by Melo (1998).

Concerning the length of stay on the job of the workers, it appears that, in both years, except for those who were on the job between 1 and 2 years,

in the quantile 0.90, those who were on the job for more than one year earn, on average, higher earnings than those who stay less than a year in their jobs (reference category). It is also noted that, as the length of stay in the job increases, the wages earned by workers rise compared to the reference category, being more expressive for workers who were in the job whose period is over ten years in all the analyzed quantiles. These results are like the findings of other studies, such as those by Silva-Filho et al. (2017a) which showed increasing wage returns in the ranges of time in employment and the highest wages being earned by workers with employment time over ten years.

Regarding the variables that reflect education, the positive signs of their coefficients indicate a positive relationship between education and earnings from work in both years. In 2009, it stood out in the 0.10 quantile that formally employed with a master's degree, on average, earned the highest wages compared to the reference category (workers without education or with incomplete primary education), making about 95.5% more income. In the median (quantile 0.50) and the quantile 0.90, it is noted that the higher the level of education, the greater the income from work earned by commuting migrant workers in the Northeast, with those who had a doctoral degree, on average, achieving the highest wages. In 2019, the results were like those of 2009, where salary returns grew as the level of education increased. Therefore, the highest salaries, on average, were earned by those who had completed a doctorate in all field's quantiles analyzed.

This result, in addition to corroborating the theory of human capital proposed by Schultz (1961) and Becker (1962), where individuals seek to invest in higher levels of formal education to increase their productivity and obtain higher income, also demonstrates that schooling, among the observable characteristics of individuals, is one of the ones that have the most significant impact on income differentials, converging with other studies both in the international and national literature (de Aguiar et al., 2018; Chiswick, 1999; de Beaumont & Yang, 2008; Loureiro, 2018; Mincer, 1974; Silva-Filho et al., 2017a; Silva-Filho et al. 2021).

Conclusions

The present work aimed to investigate the effects of socioeconomic and demographic characteristics on the income differentials of formal commuting workers in the Northeast region of Brazil in the years 2009 and 2019. The regression method used quantiles based on RAIS data to achieve this purpose. This article presents an unprecedented contribution to the literature on income differentials from the formal work of commuting migrants in the northeast, as there is no investigation to date that uses this database and this empirical approach, justified by the dynamics of the commuting migration periphery-center and center-periphery.

The initial evidence demonstrated by the descriptive statistics revealed that the commuting migrants of formal work in the Northeast, as well as the group of non-commuting migrants, were, in both years, male, predominantly of brown color, employed in the commerce and services sector, allocated to microenterprises, and were in employment for up to one year. They also had similar levels of education, with complete high school and incomplete higher education significantly improving their education level. Regarding income from work, it was found that commuting workers earned lower payments than those who did not opt for migratory commuting in the first year, but in the last year analyzed, the income earned became higher.

Quantile regressions found that the characteristics related to gender, race/color, and time in the job and education corroborated positive effects on the income differentials among northeastern commuters, especially at higher income quantiles.

In general, in 2009, it was observed that the highest earnings from work were earned by yellow men, regardless of race and color, with men earning higher wages than women, with these disparities being more expressive in the upper (or higher) quantiles of the conditional wage distribution. In addition, higher-income differentials were also found for those allocated in the public administration sector, with a more extended period of employment (over ten years), who had the highest levels of education (master's and doctorate).

As for 2019, the results are like those contacted in the first year of analysis. Again, the variables corresponding to sex and race/color could express greater returns in terms of income, especially for white men, in the highest quantiles of the conditional wage distribution. Likewise, it is worth noting that higher levels of education, such as a doctorate and more experience at work, result in higher earnings for commuting workers at different points in the conditional distribution of profits from work.

Finally, this article provides actual results for the empirical literature that deals with commuting migrations. The contributions are made to show the impacts exerted by the socioeconomic and demographic characteristics on the income differentials of formal work in the Northeast region as a whole and information about the profile of commuting migrants of legal profession in the area. However, the research presents some limitations imposed by the data source itself.

For future studies, alternative databases are suggested, allowing the incorporation of other variables considered necessary for the analysis of commuting flows, as in the case of the average travel time and residence sector, among others. It is also recommended that non-commuting workers be considered in the econometric model to verify the existence of income differentials between the groups of commuters and non-commuters to complement this study.

Ethics Statement

This research article did not work with a person or groups of persons for the generation of data used in the methodology, therefore it did not require the endorsement of an Ethics Committee for its realization.

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