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# LABOR MARKET QUALITY AND INCOME INEQUALITY: AN APPROACH OF QUANTILE REGRESSION FOR PANEL DATA FOR BRAZIL (2012 – 2018)

**Abstract**

This paper aims to verify the relationship between labor market quality with income inequality for Brazilian states, from 2012 until 2018. To accomplish this objective, we created a labor market quality index (LMQI) and calculated five inequality measures (Gini, Mehran, Piesch, T-Theil, and L-Theil). We use Quantile Regression for Panel Data, a recent methodology to test the impacts of the LMQI over the inequality measures and whether these impacts change throughout the distribution among societies that are more and that are lesser equal. We found that, in the majority, the impacts are negatively bigger for the states that are more unequal and that when we consider Gini, Mehran and Piesch Indices indeed the effects are bigger in the left tail of the distribution (states that are more unequal).

Keywords: Quality of the Labor Market; Quantile Regression for Panel Data; Income Inequality

**Resumo**

Este artigo tem como objetivo verificar a relação entre qualidade do mercado de trabalho e desigualdade de renda entre os estados brasileiros, de 2012 a 2018. Para atingir esse objetivo, é criado um índice de qualidade do mercado de trabalho (LMQI) e calculado cinco medidas de desigualdade (Gini, Mehran, Piesch, T-Theil e L-Theil). Utiliza-se a regressão quantílica para dados em painel, uma metodologia recente, para testar os impactos do LMQI sobre as medidas de desigualdade e se esses impactos mudam ao longo da distribuição entre sociedades que são mais e menos iguais. Os resultados indicam que, na maioria dos casos, os impactos são negativamente maiores para os estados mais desiguais e que, quando se considera os índices de Gini, Mehran e Piesch, de fato, os efeitos são maiores na cauda esquerda da distribuição (estados que são mais desiguais).

Palavras-chave: Qualidade do Mercado de Trabalho; Regressão Quantílica para Dados em Painel; Desigualdade de Renda.

# 1. INTRODUCTION

Recent studies about labor market have focused their efforts on building indicators for better capturing the labor market dynamics and its reaction to economic shocks, considering in this case that in fact, not all jobs are the same. The look for labor market quality is quite recent and the creation of a worker-oriented, individually constructed and theoretically grounded indicator, in a way that allows a temporal country-level comparison seems promising.

On the other hand, we have a consolidated field of analysis, the one that approaches income inequality. Especially for Brazil, markedly a country that faces high levels of inequality and where this is already a structural component of the economy, several papers have discussed the most recent path of inequality declining. However, these studies have been quenching since 2012/2013. With the current changes happening inside the labor market and social security aspects, these studies seem to be in course of attention once again.

By identifying what is already consensus, that the labor market is still the main source of income inside the Brazilian economy, the main objective of this paper is to bring this new way of perceiving the labor market, considering its quality aspects, with the discussion of income inequality. In this way, we seek to answer two main questions: does the quality of the labor market affects income distribution? Do these impacts occur with the same intensity throughout the distribution of states more and lesser equals? We start with the hypothesis that the impact is negative (the higher the quality the lower the inequality) and that the impact is bigger in states that are lesser equals (the ones in the left tail of the distribution).

Testing this hypothesis may help to guide new public policies since this can be perceived as a target to equalize Brazilian states. To accomplish this objective, we propose the creation of an index capable to measure the quality inside the labor market for each Brazilian state (LMQI). In addition, we are going to calculate five inequality measures (Gini, Mehran, Piesch, T-Theil and L-Theil) and use as econometric strategy the Quantile Regression for Panel Data, following Machado and Silva (2019), with data available from Continuous PNAD, from 2012 until 2018.

This paper is divided as follows. Besides this Introduction, Section 2 is going to explore the literature about labor market quality, and income inequality. Section 3 exposes the methodology to create the LMQI, the inequality measures and the econometric strategy. Section 4 brings the main results of this research. Finally, concluding remarks, that also brings the future research agenda and the references used throughout the paper.

## 2. LABOR MARKET QUALITY AND INCOME INEQUALITY IN BRAZIL

The mere generation of jobs is not capable to homogenize opportunities, since the fact that, if this generation is linked to low-quality jobs, then it only will deepen the barriers that already exist in the labor market. This is valid because there are good and bad jobs, in such a way that quantitative aspects measured, such as employment and unemployment rates, mask other characteristics of these jobs. Thus, it is not only about having a job, but also having a good one. Mainstream theory do not see a dilemma on joining good and bad jobs in a single measurement of employment, after all, for them, the market tends to homogenize the job quality differences by paying high wages to those jobs of lower quality. Nevertheless, economic growth happens after a phenomenon of creative destruction, indicating that jobs are created and destroyed in this process mostly because of their qualitative attributes (MUÑOZ DE BUSTILLO *et al*., 2011).

The trigger that happened for the studies about quality to happen came mainly after the globalization and liberalization phenomena that, altogether with the flexibilization of the labor markets, brought changes in the wage conditions, job stability and career prospects. Thus, job quality turns as much important as traditional measures, such as employment and unemployment, since it is not enough only to have a job as long as the job itself cannot guarantee basic standards of living (BURCHELL *et al*., 2013). The concept passed through some phases. It started with the concept of quality of working life, a concept that gained importance in the 1960s/1970s. In addition, the job satisfaction concept was considered, which brought the main discussion that good jobs were directly connected to what the workers considered as valuable in them.

The definition of work-life balance, was a definition that gained more importance in the 1990s and helped to open space for the subject to achieve debate in international organizations. With this approximation of international organizations, the decent work concept was brought up by the International Labor Organization (ILO) in 1999, with the main goal the freedom, equity, security and dignity in decent and productive works, for men and women all around the world. The most recent approach for this matter is treating the quality of the labor market as a multidimensional concept. This idea brings many levels for understanding the quality itself and can be seen as a summary of all the definitions.

In terms of literature, there is a vast range of authors that apply different approaches for understanding labor market quality. For example, Agassi (1982) understands that using job satisfaction to measure job quality is problematic. Mainly because this concept assesses the

relationship between the individual's actual job with the individual's hope of what the job could be. These expectations vary from person to person, among groups and countries and this variations distort the objective evaluation of what constitutes a good job. Thus, it turns job satisfaction measures inadequate for comparative research about it (which corroborates later with Muñoz de Bustillo and Fernández-Macías (2005)). Jencks, Perman and Rainwater (1988) combine objective characteristics (those that are expected to enhance job quality) with subjective characteristics (the ones that workers believe that enhance job quality) to understand job quality. It fails because one cannot assume that a worker always knows what is the job used as a reference.

Rubery and Grimshaw (2001) consider that the major dimensions of job quality are those that provide personal fulfillment (by using the skills involved in the job), that give an autonomy at work (or some kind of control), control and discipline coming from the fair system of management, that give freedom of association (when it comes to bargaining, principally), security (even to be able to use those skills achieved with another possible employer), and responsibilities (opportunities, satisfaction and the stress involved). Leschke and Watt (2008) perceive job quality as a composition made of different aspects: wages; non-standard forms of employment; work-life balance and working time; working conditions and job security; access to training and career advancement and collective interest representation and participation. Each one of these aspects are then joined into a European Job Quality Index, to track shifts of job quality over time and to be comparable among countries at each and every given time. Leschke, Watt and Finn (2012) updated the study considering the economic collapse after the financial crisis in 2008 as long as it affected the quality inside the labor market.

Horowitz (2016) understands that there is a connection between job quality and well-being in the USA. The author explores what constitutes job quality by identifying five dimensions, which are usually the ones considered by the most part of the literature on the subject. The first one is the monetary compensation, measured most frequently as income or wages. The second dimension is job security. This is understood as the likelihood of losing one job followed by the subjective feelings of perceived job insecurity that is connected to it. The third dimension is individual task discretion, which means the control that workers have over the tasks that are completed. The fourth is the work intensity, defined as the case when the worker is working too much or is being forced to work harder or faster. Last but not least, safe working conditions are also considered. He finds that the relationship between job quality and

well-being is positive and statistically significant, and it happens by improving social life, increasing leisure time, altering class identification, and affecting physical health.

Some other authors used the labor market quality criteria as a way to create an occupational classification for the Brazilian economy. In this field we have Monsueto, Carrijo and Autor (2017) that propose the creation of an occupational classification that, concurrent with the non-using of education level, is capable to apply some new measures related to the job quality. Labor market quality is associated with four determinants: the percentage of workers claiming to be seeking a new job, underemployment due to dissatisfaction with hours worked, presence of workers receiving less than the equivalent of a minimum wage per hour worked (considering a 40-hour workweek) and the percentage of formal workers in each occupation. They use the Pesquisa Mensal de Emprego – PME (Monthly Employment Survey) from 2002 to 2015. The authors clustered the occupations in five groups of occupations: High, Middle-High, Middle, Middle-Low and Low.

Monsueto and Autor (2019) approach the same subject creating four dimensions to understand labor market quality: opportunities; productivity; protection and stability; and internal environment. They use PNADC – Continuous PNAD and Cadastro Geral de Empregados e Desempregados – CAGED (General Register of Employees and Unemployed) for all the Metropolitan Regions (RM) and for the Integrated Management Development Region (RAID) from the first semester of 2014 until the third semester of 2018 and create an index that is capable to express the average quality of the national labor market over time. The authors show that the quality of the labor market in the regions studied has fallen drastically since the beginning of the period analyzed. Moreover, it shows that the labor market's quality of the South, Southwest and Middle West regions is bigger than the other regions.

When it comes to the studies about Brazilian income inequality, those are dated especially to the time that Brazil faced a drop in inequality. The determinants for this downfall, according to some authors, were the program of income transference realized by the government called Bolsa Família, the real wage gains and the positive evolution of the labor market (SABOIA, 2007; BIANCARELLI, 2014; HOFFMANN, 2014; SANTOS, 2015). Some authors like Neri and Souza (2012) call the decade from 2001 until 2011 as the inclusive decade; however, papers about the topic have been falling drastically since 2012/2013.

As long as we are facing several changes, mainly in the labor market and social security fields, the need for studies that brings this subject to the top again becomes fundamental.

Besides, there are no studies that connect income inequality with labor market quality and we assume that this is a key link to boost development in Brazilian states. Thus, we expect that by diminishing inequality through the increasing of the labor market quality be in vogue to be assumed by public policies as a target for socio-economic development.

## 3. METHODOLOGY

The common factors for the creation of the variables and the use of the econometric technique are the database, the level of analysis (individuals), the period and the adjustments made. We used Continuous PNAD (Pesquisa Nacional por Amostra de Domicílios Contínua - Continuous National Household Sample Survey) with data from all Brazilian states, starting in the 2012 until 2018. The adjustments were made to create a reliable, compatible and comparable analysis. In our database, we only consider the first interview, only occupied people, with declared income, aged from 18 to 65 years old. Also, we do not consider employers and the military. In the end, we got the variables and the analysis considering the 27 Brazilian states with annually information. The choice made to investigate the proposed relationship at the state level comes from the importance that heterogeneity carries in the process of socio-economic decisions and strategies developed at the national level. Continuous PNAD gives at the state level the deepest and most complete set of information and brings the advantage to construct analysis that goes beyond the "one size fits it all" type of research.

### 3.1 Labor Market Quality Index – LMQI

The variables were selected from the Continuous PNAD from the 2012 until 2018. The ones that we chose for the creation of the LMQI are in Table 1.

Table 1: Variables used to create the Brazilian Labor Market Quality Index 2012-2018, divided by dimensions.

| Variables | Code | Specification for Binaries |
|---|---|---|
| *ECONOMIC DIMENSION* | | |
| Wage-hour | VD4016/V4039c | (1) More than 2 minimum wage/hour <br> (0) Less than 2 minimum wage/hour |
| *SOCIAL PROTECTION DIMENSION* | | |
| Social Security | VD4012 | (1) Contribute to social security <br> (0) Does not contribute to social security |
| Formal | VD4009 | (1) Formal contract <br> (0) Informal contract |
| *WORK CONDITIONS DIMENSION* | | |
| Hours worked | VD4036 | (1) 40-48 hours <br> (0) Other amount of hours |
| Experience | V4040 | (1) More than 1 year <br> (0) Less than 1 year |
| Temporary Contract | V4025 | (1) Does not have a temporary contract <br> (0) Temporary contract |
| *INDIVIDUAL CONDITIONS DIMENSION* | | |
| Under occupation | V4063-V4063a | (1) Does not wish to work more <br> (0) Wish to work more |
| Double Journey | V4009 | (1) One job <br> (0) More than one job |

Source: Continuous PNAD. Wage / hours really worked×4.3. Minimum wage of the year / 172. Elaborated by the author.

We designed and adjusted them to a binary format, this mainly because it would be easier to calculate the percentages of our interest, that is when the binary is assigned with value 1. When it is equal to 1, we understand it as the positive perspective of the measure, which means that a good quality labor market is the one with a high percentage of jobs that pays more than 2 minimum wages per hour, with a high percentage of workers that contribute to social security and that is legally secured by a formal contract. Also, that has a high percentage of workers having a traditional weekly workday, experience, and that is not only temporary workers. In terms of personal choices, it is preferred when the highest percentages are connected to workers that do not wish to work more than already work and that have just one job, not being overloaded. All of the variables are quarterly measures for each Brazilian state in the period considered.

We decided to organize the selection of variables in dimensions, in an attempt to bring balance to all possible aspects that can interfere in the quality of the labor market. It is known

that the individual level of job quality is influenced by the socio-economic characteristics of the worker, but also by the characteristics of the firm where the worker is employed. Even though this is an aggregated analysis, at the Brazilian state level, the premise of the study is valid at the individual level at first. In this sense, we considered eight measures (wage; social security; jobs with formal contracts; hours worked; experience; temporary job; under-occupation and double journey) divided into four dimensions (Economic Perspective; Social Protection; Working Conditions and Individual Conditions) to compose our LMQI.

The index is created following the Principal Component Analysis (PCA) methodology and it is designed to be a worker-oriented, individually-constructed and theoretically-grounded indicator. This analysis, following Nardo *et. al* (2005), is used when we want to explain the variance of the observed data through some linear combinations of the original one. Thus, even if there are Q variables, $x_1, x_2, ..., x_Q$, the variation of this data can be explained by a small number of variables (Z), the principal components. These are some linear relations of the master data and are uncorrelated, as well. In fact, there are Q principal components, but we are looking for the first ones ($C < Q$) that preserve a high amount of the cumulative variance in the original data.

As mentioned before, the most useful property of the principal components is that they are uncorrelated, which implies that each one represents a different statistical dimension of the data. Thus, if the objective is to present the original data set by using a few variables, this dimension reduction is possible through the application of PCA. If the original variables are uncorrelated, then the analysis does not add anything, but if they are highly correlated then a significant reduction can be achieved.

We assume that the first principal component is the latent factor that measures the labor market quality. Thus, it will be used as the LMQI. The evidence for this is that the variables selected point towards the labor market quality and their respective elements associated with the principal component eigenvector are all positive. In other words, the variables are positively correlated with the first principal component, which is the index of quality itself[1].

## 3.2 Inequality measures

There are several ways of measuring income inequality. We propose to use five important and well accepted methods: the Gini Index (G), the Mehran Index (M), the Piesch

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[1] The details about the eigenvectors and analysis of variance can be requested at any moment. The quality tests and results also are available under request.

Index (P) and the entropy inequality measures of Theil (T and L), following Hoffmann (1998), Hoffmann (2004) and Mehran (1976). We calculated all the indices using the Continuous PNAD from 2012 until 2018, with income from the principal job in real values of 2019.

The Gini Index (G), the Mehran Index (M), and the Piesch Index (P) are linear measures of inequality that are based on the Lorenz Curve. This curve shows the points in an orthogonal Cartesian system that were defined by the cumulative proportion of population (p) and the cumulative proportion of the total income distribution ($\Phi$). Thus, the main idea of this curve is to show how the total income proportion rises as a function of the proportion of the population. Let N be the size of our sample (or population, if available), if all people have the same income, then the cumulative income proportion will be equal to the cumulative proportion of population ($\Phi = p$), producing the line of perfect equality (line OB in Figure 1). On the other hand, if all the income is concentrated in the hands of one person, and the rest ($n - 1$) received nothing, then the Lorenz Curve would be over the X axis until $= 1 - \frac{1}{n}$, jumping to the point B. At the count for a large n, the Lorenz Curve is given by with the polygonal, OCB, which represents the line of perfect inequality.

Figure 1: Lorenz Curve in the orthogonal Cartesian system.
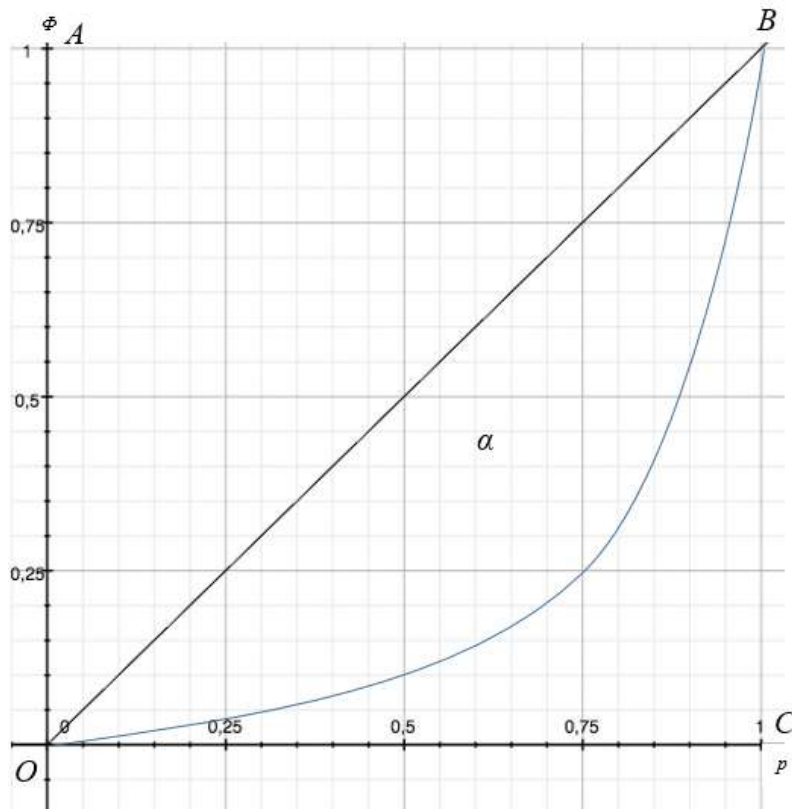


Source: Elaborated by the author.

In this way, the further the curve is from the line of perfect equality (OB), the higher the degree of inequality in the distribution. The area between the line of perfect equality and the Lorenz Curve (the area $\alpha$) is called the area of inequality.

Following Hoffmann (2004), three measures of inequality that are associated with the area between the Lorenz Curve and the line of perfect equality (when $\Phi = p$) are the Gini Index (G), the Mehran Index (M) and the Piesch Index (P) which are defined as follows:

$$G = \frac{2}{n} \sum_{i=1}^{n-1} (p_i - \Phi_i) \tag{1}$$

with $0 \leq G \leq 1 - \frac{1}{n}$.

$$M = \frac{6}{n} \sum_{i=1}^{n-1} (1 - p_i)(p_i - \Phi_i) \tag{2}$$

with $0 \leq M \leq 1 - \frac{1}{n^2}$.

$$P = \frac{3}{n} \sum_{i=1}^{n-1} p_i (p_i - \Phi_i) \tag{3}$$

with $0 \leq P \leq \left(1 - \frac{1}{n}\right)\left(1 - \frac{1}{2n}\right)$.

In the Mehran Index, the difference between the ordinate of the line of perfect equality and the ordinate of the Lorenz Curve is weighted by $1 - p_i$, which makes this index relatively more sensitive to changes in the left tail of the distribution (the poorest ones), if compared to the Gini Index. On the other hand, the Piesch Index has as weighting factor $p_i$, making it relatively more sensitive to changes in the right tail of the distribution (the richest ones).

The entropy inequality measures of Theil (T and L) are based on the concepts of the information theory. Specifically, the entropy concept is borrowed from the thermodynamics and measures the degree of equality inside a distribution. Although the concept is the same, the way it manifests inside Physics and Economics is different. In Physics, the higher the entropy, the higher the disorder in the system. But in Economics, we cannot associate higher equality in the distribution with higher economic disorder. At this point, Theil (1967) argumented that is more interesting to use inequality measures, other than equality, by deducting the entropy of its own maximum value.

Considering a population of size n where each one receives one fraction of the total income, $y_i$ (non-negative), then formally we have:

$$\sum_{i=1}^{n} y_i = 1 \tag{4}$$

The values of $y_i$ have the same properties of the probabilities associated with an event[2]. Then, the entropy $H(y)$ of the income distribution is:

$$H(y) = \sum_{i=1}^{n} y_i \log \frac{1}{y_1} \tag{5}$$

where $0 \leq H(y) \leq \log n$.

Based on this entropy measure, the perfect equality would happen when $y_i = \frac{1}{n}$, so $H(y) = \log n$. The case for perfect inequality would be when $y_i = 1$, then $H(y) = 0$. To consider this as a measure for inequality, like stated before, Theil (1967) deduced from the maximum value ($\log n$) the entropy measure. Thus, the first measure of Theil is

$$T = \log n - H(y) = \sum_{i=1}^{n} \log n \cdot y_i \tag{6}$$

where $0 \leq T \leq \log n$.

Then:

$$T = \sum_{i=1}^{n} y_i \log \frac{y_i}{\frac{1}{n}} \tag{7}$$

This measure corresponds to the expectation of the informative value of an uncertain message, which transforms fractions of population in fraction of income. In addition, it is more sensitive to the right tail of the distribution (the richest ones); even more than the Piesch Index. However, if we are looking for the expectation of the informative value of an uncertain message, which transforms fractions of income in fractions of population, then we have the measure L.

$$L = \sum_{i=1}^{n} \frac{1}{n} \log \frac{\frac{1}{n}}{y_i} = \frac{1}{n} \sum_{i=1}^{n} \log \frac{1}{ny_i} \tag{8}$$

where $0 \leq L \leq \infty$.

## 3.3 Econometric Strategy

The strategy to identify and measure the relationship between income inequality and labor market quality is possible with panel data analysis. This approach is already wide spread; it minimizes difficulties arising from endogeneity and allows the use of standard econometric techniques to obtain parameter estimation. Furthermore, it can also control heterogeneity by allowing individuals-specific variables, provide more informative data, variability, efficiency, degrees of freedom, and less collinearity between variables (BALTAGI, 2008). Although this

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[2] To understand how the entropy is calculated in thermodynamics, see Hoffmann (1998).

technique would already be enough to test the relationship itself, our hypothesis brings an extra question, which is not only if the relationship is valid statistically speaking, but also if the quality of the labor market affects in the same way those regions that are more or less equal, right and left side of the distribution, respectively. We expect that the higher the quality the higher it is the negative effect on regions that are lesser equal. Thus, increasing the quality of the labor market should be a target to converge societies that are lesser equal to those that are equal by the decrease of the inequality.

Considering this hypothesis brings the necessity of using another methodology, an expansion of the traditional panel data. Quantile regression for Panel Data allow the researcher to consider the unobserved heterogeneity and effects of heterogeneous covariates, while the panel data allow the inclusion of fixed effects to control unobserved covariates. The strategy here consists in using the estimator MM-QR (Method of Moments – Quantile Regression), developed by Machado and Silva (2019). This method can be seen as an additional tool, as long as it turns possible to estimate regression quantiles in specific settings of data where it would be impossible otherwise.

This estimator is different from the traditional estimator of quantile regression developed by Koenker and Bassett (1978), mainly because, as long as MM-QR is based on conditional means, the robustness properties are not shared, but Machado and Silva (2019) state that under the appropriate conditions, their estimator identifies the same conditional quantiles, the optimal predictors under the usual asymmetric loss function, and these are intrinsically robust[3].

We apply this technique to each one of the inequality measures created, as we understand that each index brings different information about the inequality inside the states: Gini (G), Mehran (M), Piesch (P), T-Theil (T) and L-Theil (L).

$$G_{it} = \beta_0 + \beta_1 LMQI_{it} + \epsilon_{it}$$
$$M_{it} = \alpha_0 + \alpha_1 LMQI_{it} + \epsilon_{it}$$
$$P_{it} = \gamma_0 + \gamma_1 LMQI_{it} + \epsilon_{it} \qquad (9)$$
$$T_{it} = \theta_0 + \theta_1 LMQI_{it} + \epsilon_{it}$$
$$L_{it} = \zeta_0 + \zeta_1 LMQI_{it} + \epsilon_{it}$$

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[3] To understand the logic behind the construction of the estimator, check Machado and Silva (2019).

where $G_{it}$ is the Gini Index for for state $i$ at time $t$, $M_{it}$ is the Mehran Index for state $i$ at time $t$, $P_{it}$ is the Piesch Index for state $i$ at time $t$, $T_{it}$ is the T of Theil Index for state $i$ at time $t$, $L_{it}$ is the L of Theil Index for state $i$ at time $t$ and $LMQT_{it}$ is the Labor Market Quality Index for state $i$ at time $t$. As a first approximation for the study of the relationship, we opted to keep a simple model, giving more attention to the relationship itself and to the different impacts over the indices distribution. Also, we use the bootstrap procedure to test if the coefficients in the distribution on quantiles are statistically different one of each other

## 4. RESULTS AND DISCUSSION

The evolution of the Labor Market Quality Index (LMQI) from 2012 until 2018 is a reflection of the variables chosen, the period covered and the socio-economic and political environment. With this stated, it is important to understand that there were some events that directly or indirectly influenced the quality of the labor market associated to each Brazilian state.

Considering a macroeconomic and political context, we have two important points to highlight to start this analysis. From 2011 to 2016, the government was led by the left party, with Dilma Rousseff as president, who had her second government interrupted in 2016 with the impeachment process. Michel Temer assumed from 2016 until 2018, when new elections took place and Jair Bolsonaro was elected. Our data covers 2012 until 2018, which means that our indicators are also reflexes from two governments. Although the goal of this research does not have a political bias, it is important to state that, since the set of policies changes when a new government rises, the actions taken have pervasive characteristics inside the labor market and the way that a country, state, region structurally develops. This interferes not only in the way one perceives society, but also the studies made and to be made about it. We plotted the LMQI for 2012 and 2018 in Figure 2 below.

Figure 2: Distribution of the LMQI throughout Brazilian states (2012 and 2018).
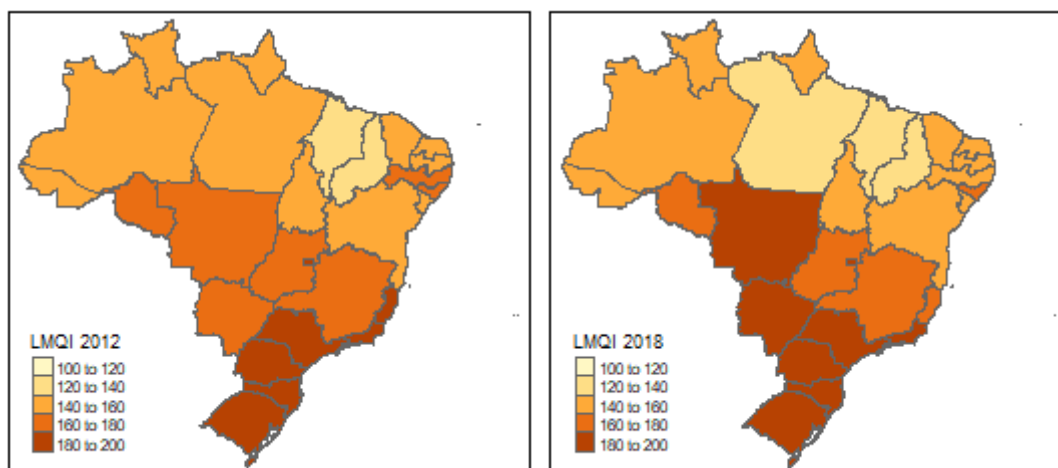


Source: Elaborated by the author.

The majority of the states had a positive evolution in the quality, when we consider the beginning and the end of the period analyzed. However, this can happen for different reasons as long as it is a combination of all the variables chosen to compose the index, being the opposite also valid. It is important to notice that Brazil is markedly divided, beyond the regions' division, which means that is possible to visualize how the North and Northeast regions are separated from the South, Southeast and Middle West of Brazil in terms of the quality inside their labor markets. Considering the evolution, even that it is markedly positive, it is also ambiguous. It is stable among the states, so the division remains, but intensifies throughout time.

The variation from 2012 to 2018 in the LMQI was highly negative in Distrito Federal, decreasing 4.38% whereas the highest increase was in Paraiba, where the index raised by 4.99%. In absolute terms, this results need to be accompanied by a decomposition of which variables contributed the most for the increase/decrease of it. For example, considering the Economic Dimension, most Brazilian states presented a decrease in the percentage of workers that earn more than 2 minimum wages per hour worked, with special attention for North and Northeast states, such as Roraima, Amazonas, Pará, Tocantins, Pernambuco, Maranhão, Ceará, Paraíba and Alagoas. In average, these states had a decrease of 13.11%.

The Social Protection Dimension, which considers the Social Security and Formal variables, show that, in average, the change in the contribution for social security is 0.75% and in the percentage of formal workers, a decrease of 6.99% (Distrito Federal leads the decrease, 15.57%). This is specially concerning considering that there is an increase of workers connected with informal types of contract, meaning less protection and higher job insecurity.

We may connect this to the high level of unemployment that Brazil is facing since 2017, which brings people to alternatives of employment that can surpass the initial condition. Social security contribution is almost steady from 2012 until 2018, but with prospects of a diminishing rate, because of Social Security Reform.

The Work Conditions Dimension brings information about Hours Worked, Experience and Temporary Contract. The worker's journey became more regular, increasing the percentage of workers working between 40 to 48 hours per week (Amapá leads the increase, 31.16%). Experience had a slight increase in average throughout the country, increasing in 1.18%. The percentage of workers not attached to temporary jobs, in average, had increased in 1.42%. However, special attention goes to Sergipe, Rio Grande do Norte and Paraíba which had an increase of 12.73%, 11.62% and 10.56, respectively. Recognizing the effects of the Labor Reform, implemented in 2018, is yet not possible. These results can change in the near future, as long as the reform regulates the temporary job.

Finally yet importantly, the Individual Conditions Dimension considers the Underoccupation and the Double Journey. The results account an increase, in average, of the underoccupation of workers in 0.74%. The double journey has decreased in 0.04%. This shows an overall stability in workers individual conditions, thus, this dimension contributed little for the variation of the LMQI. Summarizing, the contribution for the variation of the LMQI was negatively from the Economic and Social Protection Dimensions, but positively, in almost the same measure, from the Work Conditions Dimension, culminating in a scant positive average variation of the LMQI in 0.44%. That is why, once again, by assuming that there are heterogeneities in the results across states, it urges for a regional-based analysis on the subject. The hypothesis in this research is that there is a relationship between the LMQI and the inequality among the states in Brazil, but also we state the hypotheses that this impact is negative (the higher the quality the lesser the inequality) and with different measures in the distribution of the inequality. We can give a first look at the results of inequality in Brazilian states, considering all the five measures in 2012 and 2018.

Figure 3: Evolution of the inequality in Brazilian states in order of appearance – Gini, Mehran, Piesch, T-Theil and L-Theil (2012 and 2018).
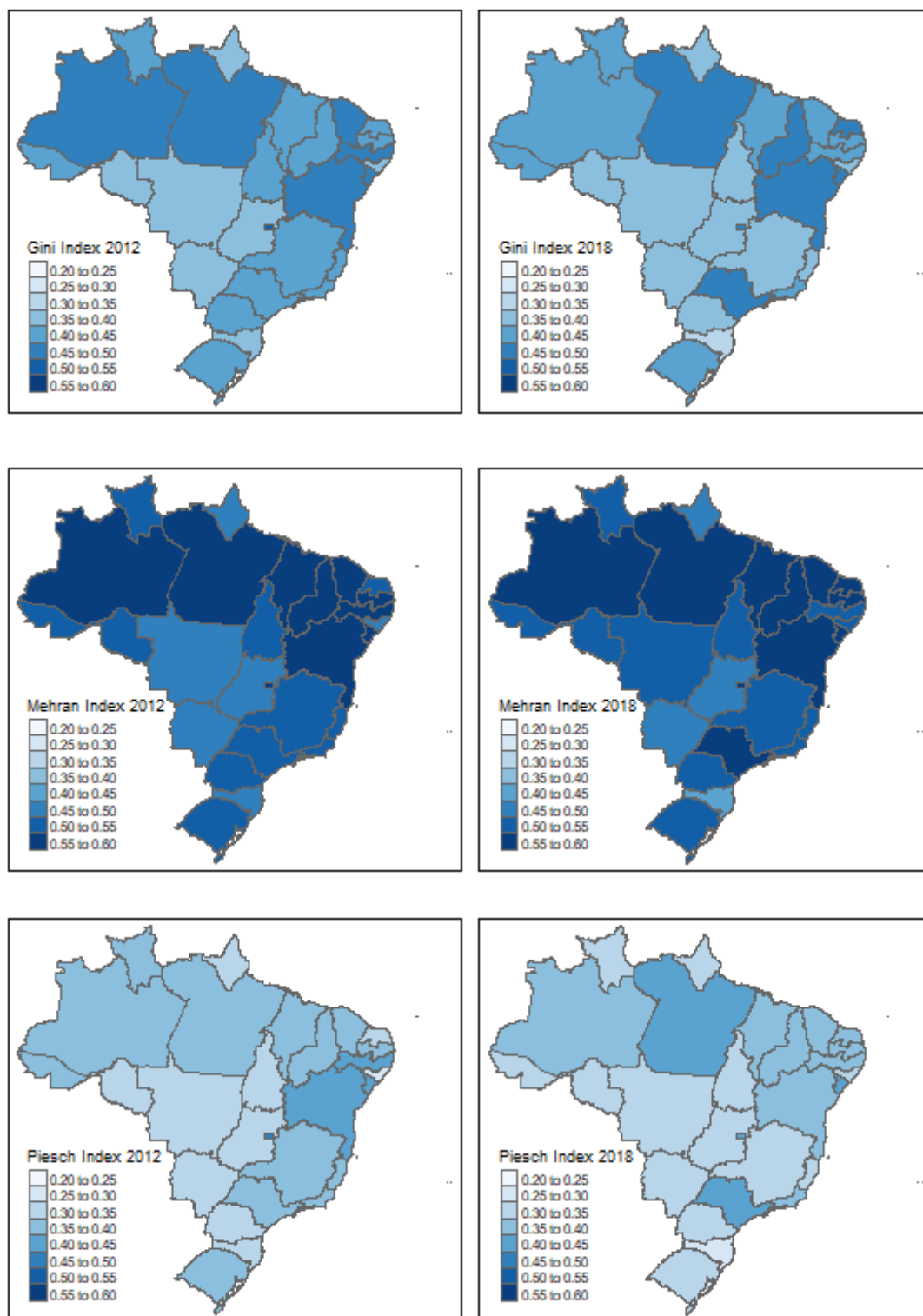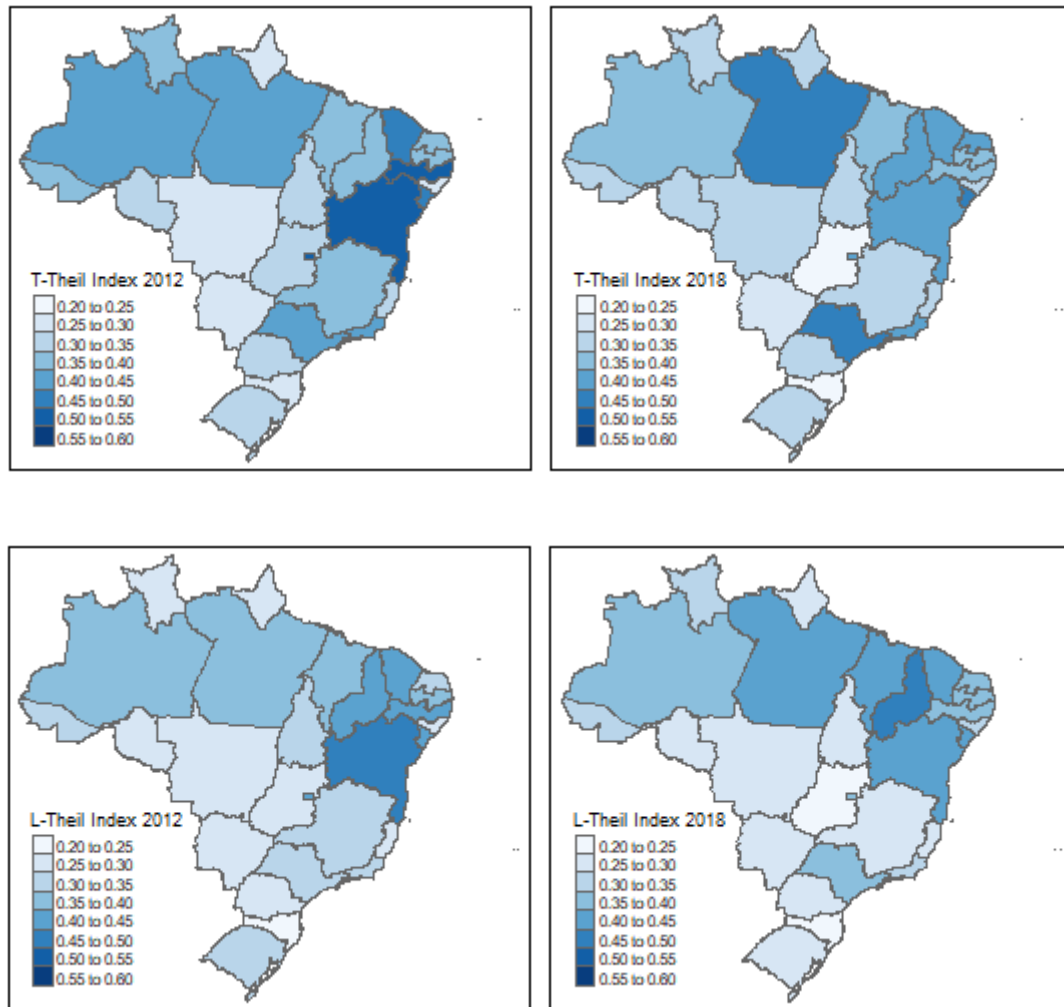
The results show that, despite the measure adopted, inequality has dropped in Brazil in average. Although, there is the same marked division in Brazilian regions with North and Northeast regions with the most unequal states. It is important to notice the difference that occurs when we compare measure with measure. The Gini Index does not give any special ponderation to any part of the income and population distribution. It shows that the level of national inequality has dropped, in average, 1.45%. However, among the states, there are some exceptions. Rio Grande do Norte, Alagoas, São Paulo, Pará, Piauí, Maranhão, Rio de Janeiro and Mato Grosso faced a positive evolution of the inequality, being Rio Grande do Norte and Alagoas the leaders (11.32% and 11.22%, respectively).

However, when we consider the measures that give attention to a specific part of the distribution (Mehran and Piesch), we realize that the Gini Index seem to overestimate/ underestimate the inequality in some states. For example, the Mehran Index is relatively more sensitive to changes in the left tail of the distribution (the poorest ones), if compared to the Gini

Index. Then, it seems that the inequality in the states were overestimated by the Gini Index, showing that, principally Northeast states have a high quantity of poor people with a high inequality among them. The national average evolution is a decrease of 0.22% in the inequality, however, states like Rio Grande do Norte and Alagoas faced a positive evolution (10.43% and 9.42%, respectively).

On the other hand, we have the Piesch Index which is relatively more sensitive to changes in the right tail of the distribution (the richest ones) when compared to the Gini Index. It seems that the Gini Index underestimate the measure and that the Brazilian states that are more unequal among the poorest ones are the most unequal when we weight by the richest ones. The national average is a decrease of 2.33%. Rio Grande do Norte and Alagoas lead the positive evolution of the inequality (12.63% and 12%, respectively). Summarizing, despite the use of these three inequality measures that rely on the Lorenz Curve the results are coherent among them, which means that inequality is a real phenomenon and it is more intense in the Northeast states.

When we consider the entropy measures, T-Theil and L-Theil, the scenario does not change much. The national average is positive for L-Theil in 0.14% and a decrease in 3.25% of T-Theil. The states from Northeast are still the most unequal ones, considering the fractions of income or fraction of population. The average for the evolution is led by Rio Grande do Norte and Alagoas (22.45% and 20.38%, respectively). Besides that, in the majority of states the evolution goes towards equality, indicating a decrease of the inequality in Brazilian states. Once again, no matter the measure, the inequality decreased in Brazil, which corroborates with the studies on the subject. The next step is to test the relationship and our hypothesis.

We use Quantile Regression for Panel Data, as was mentioned in the previous section to open the impact of the LMQI over the distribution of inequality, measured by the five indices exposed before. We consider the $10^{th}$, $50^{th}$ and $90^{th}$ quantiles. We may compare societies that are more unequal (that belong to the $10^{th}$ quantile) with societies that are more equal (that belong to the $90^{th}$ quantile), starting with the hypothesis that the impact is not the same and is bigger in the $10^{th}$ quantile of the distribution. The results of the models proposed for all five measures of inequality are in Table 2.

Table 2: Regression results for all five measures of inequality.

| | (1)<br>Gini | (2)<br>Mehran | (3)<br>Piesch | (4)<br>T-Theil | (5)<br>L-Theil |
|---|---|---|---|---|---|
| 10$^{th}$ Quantile | | | | | |
| LMQI | -0.080** | -0.133* | -0.054** | -0.128** | -0.215 |
| | (0.03) | (0.03) | (0.03) | (0.05) | (0.13) |
| Constant | 0.510* | 0.711* | 0.408* | 0.499* | 0.622* |
| | (0.06) | (0.06) | (0.05) | (0.08) | (0.16) |
| 50$^{th}$ Quantile | | | | | |
| LMQI | -0.065*** | -0.115* | -0.042 | -0.099*** | -0.191* |
| | (0.04) | (0.03) | (0.03) | (0.05) | (0.05) |
| Constant | 0.521* | 0.722* | 0.425* | 0.516* | 0.638* |
| | (0.06) | (0.06) | (0.04) | (0.08) | (0.08) |
| 90$^{th}$ Quantile | | | | | |
| LMQI | -0.028 | -0.078** | -0.008 | -0.038 | -0.152* |
| | (0.03) | (0.04) | (0.03) | (0.08) | (0.06) |
| Constant | 0.509* | 0.715* | 0.418* | 0.525* | 0.661* |
| | (0.05) | (0.05) | (0.05) | (0.19) | (0.17) |
| Number of observations | 189 | 189 | 189 | 189 | 189 |

Standard errors in parenthesis. *** $p<0.10$, ** $p<0.05$, * $p<0.01$.
Source: Research results.

In this way, it is possible to diagnose that, in majority of the cases, the higher the quality of the labor market, the lower the inequality in Brazilian states. For the Gini Index, the negative effect over inequality is bigger in the 10$^{th}$ quantile, and in the 90$^{th}$ the effect is not significant. This means that the impact of increasing the quality of the labor market is bigger in societies that are more unequal. The Mehran Index shows that the effects happen throughout the inequality distribution, but is also bigger in societies that are more unequal. Considering the Piesch Index, there is relevant and significant effect in the 10$^{th}$ quantile; however, the impact over the 90$^{th}$ quantile is not significant. T-Theil Index corroborates our hypothesis that the effects over the distribution is different and bigger for societies that are more unequal. The L-Theil Index shows no relevant and significant impact in the 10$^{th}$ quantile, but the LMQI also influences less the 90$^{th}$ quantile when compared to the 50$^{th}$.

In terms of quantile regression, despite being applied in cross-section data or longitudinal one, it is important to test whether the effects are different throughout the distribution and if they are statistically different one of another. Bootstrapping technique can be used in this case. We can test if there are indeed significant differences between the 10$^{th}$ and 90$^{th}$ quantiles by bootstrapping standard errors and confidence intervals. Moreover, this technique can be used to replicate the model to obtain a description of the sampling properties of empirical estimators by using the data itself (BALTAGI, 2003). The results of this bootstrapping technique to verify the differences are on Table 3 below.

Table 3: Difference between the 10th and 90th quantiles by bootstrapping standard errors and confidence intervals.

| Difference between 10th and 90th Quantiles | Observed Coefficient | Bootstrap Standard Errors | z | p-value | Normal-based [95% Confidence Interval] | |
|---|---|---|---|---|---|---|
| Gini | 0.05 | 0.01 | 4.05 | 0.00* | 0.03 | 0.08 |
| Mehran | 0.05 | 0.01 | 5.91 | 0.00* | 0.04 | 0.07 |
| Piesch | 0.05 | 0.01 | 3.92 | 0.00* | 0.02 | 0.07 |
| T-Theil | 0.09 | 0.16 | 0.57 | 0.57 | -0.22 | 0.40 |
| L-Theil | 0.06 | 0.07 | 0.84 | 0.40 | -0.08 | 0.21 |

*** p<0.10, ** p<0.05, * p<0.01.
Source: Research results.

The impacts are statistically different for the Gini, Mehran and Piesch Indices. Indeed, there is a bigger impact over the 10th quantile, which means, the societies that are more unequal. By assuming these results, it is viable to consider that one public policy target to equalize Brazilian societies should pass in aiming to increase the quality inside their labor markets. Considering the construction of our index and the weights that some variables have on it, the structure of this objective should involve better working conditions, starting with the earnings and prospects of a lifetime. Still, there is lots to be said about the reforms proposed for Brazil (Labor Reform and Social Security Reform, mainly), but the real outcomes of them are not yet available in official data. These reforms have ambiguous interests and may not be a positive factor in Brazilian labor markets and in income distribution. Papers about income inequality probably are going to gain space in the debate again, since the drop in inequality seems to be quenching.

In addition, two points need attention. First, the measurement of income by Continuous PNAD is not very clear, as long as it is self-reported, thus the highest incomes are underestimated. Therefore, this is a concern especially in the right tail of the income distribution. Second, we are still facing the small data issue. Continuous PNAD came in substitution of the annually PNAD, however even with quarterly data available, we only have it since 2012, which sometimes can be not sufficient for long-run impacts.

## 5. CONCLUDING REMARKS

The objective of this paper was two answer two main questions. Does the quality of the labor market affects income distribution? Do these impacts occur with the same intensity throughout the distribution of states more and lesser equals? We assumed that the impact was

negative (the higher the quality the lower the inequality) and that the impact was bigger in states that were lesser equals (the ones in the left tail of the distribution).

In fact, our results corroborate our hypothesis. We observed that, with exception of L-Theil, the LMQI influenced negatively more the $10^{th}$ quantile of the distribution, which means that the impact of increasing the quality of the labor market is bigger in societies that are more unequal. When tested the differences between the $10^{th}$ and $90^{th}$ quantiles, we found that the impacts were statistically different for the Gini, Mehran and Piesch Indices. Indeed, there was a bigger impact over the $10^{th}$ quantile, which means, the societies that are more unequal, when considered these measures.

These results indicate that the quality of the labor market can and should be considered in public policies for socio-economic development of the Brazilian states. It may be understood as a tool to equalize societies towards equality. Still, there are some important statements to be said about the reforms proposed for Brazil (Labor Reform and Social Security Reform, mainly), but the real outcomes of them are not yet available in official data. We understand that these reforms have ambiguous interests and may not be a positive factor in Brazilian labor markets and in income distribution.

The research agenda covers some other points that deserve attention, such as the relationship between labor market quality and the productive structure of Brazilian states. In addition, by assuming this relationship, understand how it can affect the income inequality for these states is the next step of study.

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