THE LARGER THE CITY, THE HIGHER THE WAGES? THE EFFECTS OF AGGLOMERATION ECONOMIES ON WAGE GAPS IN SOUTHERN BRAZIL

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ÁREA 12. Questões espaciais no mercado de trabalho

ABSTRACT: This paper seeks to analyze trends in wage differences in the southern region of Brazil, taking into account the size of cities, besides the goal to verify the existence of sheepskin effect and if it modifies itself depending of the municipality position on urban hierarchy. We used OLS and Heckit method to two mincer equations to each one (two especifications about years of schooling and educational degree). Moreover, we adapted the REGIC classification of the cities in order to capture the municipality size, not only taking into account the number of inhabitans, but also the infrastructure and the influence capacity on other regions). Firstly, looking to the whole population, state of Paraná has shown the biggest returns on wage in its metropolitan region ("Big Curitiba"), regional capitals C (Ponta Grossa and Ijuí), Subregional Centers A (towns like Foz do Iguaçu, Campo Mourão, Paranaguá, Guarapuava and Toledo) and Zone Centers A (cities as Cornélio Procópio and Jandaia do Sul), while Santa Catarina just in its Suberegional Centers B (as Balneário Camboriú and Brusque), and Rio Grande do Sul have the biggest increments on salary in its Regional Capitals B (Caxias do Sul, Passo Fundo and Santa Maria) and Zone Centers B (cities like Santana do Livramento and Getúlio Vargas), when we parallel the three southern states. Secondly, analyzing the people with higher education throughout the South region, Paraná only had the highest returns on salary in its Regional Capital C (Ponta Grossa) and Zone Centers B (example of cities: Matinhos and Prudentópolis), Santa Catarina again just in its Subregional Centers B, while Rio Grande do Sul seems to endorse the sheepskin effect, showing considerable wage gaps in its Metropolitan Region (Porto Alegre), Regional Capitals B (Caxias do Sul, Santa Maria), Subregional Centers A (examples: Bagé, Bento Gonçalves, Uruguaiana) and Zone Centers A (Venâncio Aires, São Borja, Guaporé, etc). The earnings in most categories of municipalities above Local Centers are still positively influenced by the size of the city. However, it is no longer possible to see clearly that old phase of traditional urban agglomeration, in which the metropolis would offer the highest wages, and all categories below it, would proportionately offer less and less, neither for the sample of the whole population nor for the profile of graduates. Thus, the maxim "the greater the city, the higher the salary" can not absolutely be verified in any of the three southern states, although some patterns are formed between the two, three first city ranks and the last ones.

Keywords: Wage gaps; Hierarchy of the cities; Mincerian equation; Heckman model; Southern Brazil.
JEL Code: J24; J31; R23.

1. INTRODUCTION

The economic growth does not happen everywhere and at the same time. Besides, when such progress takes place, there seems to be a spatial concentration around the area where advancement begins. Inter-regional and intra-regional inequalities are generally strong phenomena in developing countries, especially in Brazil. Although its southern is the most developed between the 5 brazilian macro regions (North, Northeast, Central-West, Southeast and South)[4], it does not mean that the jobs and the opportunities are homogenously distributed throughout the region.

Therefore, the study of agglomeration economies is particularly relevant in Brazil, considering the high degree of people concentration and economic activities in few geographical spaces, a fact that may be explained by the presence of positive externalities. This suggests the tendency of a pattern of economic development, geographically diversified or focused between the different provinces of the nation, which can also aggravate regional inequalities.

A variety of countries with distinct institutional and structural arrangements also faces evidences of regional differences in average wages. Persistent earning gaps across zones could exist to offset the contrasts in amenities (like climate, pollution, poor infrastructure) or in the cost of living. They could also be the result of the concentration of human capital in some cities or regions, which generate knowledge spillovers and differential productivity (LUCAS, 1988). External economies may also occur in the presence of industrial clusters in space (MARSHALL, 1890; PORTER, 1990; ROMER, 1986). Through imitation and movement of workers between firms, ideas are quickly disseminated between neighbouring firms. Besides, people tend to migrate to areas that pay bigger salaries and offer more job opportunities. Freguglia and Menezes Filho (2011) remind us that distinct explanations for the existence of regional

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[4] South Region in Brazil is composed by 3 states: Paraná, Santa Catarina and Rio Grande do Sul, whose capitals are Curitiba, Florianópolis and Porto Alegre, respectively. This macro region is known for its european colonization, subtropical climate, urban planning (mainly in Curitiba), machinery and automobile industries, textiles, tourism, energy production (the *Itaipu* Hydroelectric Dam is the largest operational *hydroelectric energy* producer in the world and it's located in Western Paraná), information technology and others. It has the highest Human Development Index (HDI) of Brazil, 0.830 (PNUD, 2008) and the second highest per capita income of the country, behind only the Southeast Region (São Paulo, Rio de Janeiro, Minas Gerais and Espírito Santo).

gaps in wages have different implications in terms of economic policies.

In this way, many studies have decomposed the wage differentials in terms of contrasts in the market value of individual characteristics, such as education and work experience, and differences in the rates of return of those attributes. Even after adjusting for the cost of living, most studies find that regional earning gaps trend to persist over time.[5] However, few papers try to estimate the salary equation measuring the city size where the person lives/works. And thus, our main goal here is to investigate how inhabitants of southern Brazil's individual characteristics, such as: formal education, work experience, race, gender, marital status, having kids and region of housing, may have affected their income and their presence in labor force, using the Demographic Census (2010). We also aim to find out if these variables behave in the same way for people with a higher education degree, in order to test the existence of the sheepskin effect.

The next section will show a brief review of the literature on the topic. Section 3 will provide the econometric methodology and the data treatment and source. Following, we will present the data descriptive analyzes, some preliminary evidence about the inter/intra-regional wage gap in Southern Brazil, further the main econometric results. Finally, we have the last considerations and the bibliographic references.

2. LITERATURE REVIEW

A more flexible approach to investigate the earnings gap has been derived from human capital theory (MINCER, 1958, 1974; BECKER, 1964), where an individual's wage rate reflects the productivity potential based on various human capital characteristics. These seminal articles served as the basis for almost all the researches that came afterwards, putting professional experience and schooling as explanatory variables to salary (CRESPO & REIS, 2009; HECKMAN, TOBIAS & VYTLACIL, 2000; REIS & RAMOS, 2011).

The mincerian equation was gradually increased with the addition, for example, of binary variables capable of representing qualitative characteristics of the individuals regarding gender, race, marriage and quadratic terms of variables for schooling and professional experience in order to capture critical points from which the marginal effects of such variables on earnings are negative (SALVATO & SILVA, 2008; ALVARADO, 2012; JACINTO & RODEGHIERO, 2012).

These income differentials may be the result of equilibrium or compensating differentials, as the competitive model predicts, or a consequence of either temporary disequilibrium situations or external economies. Each of these situations has different implications for economic development and therefore for public policies. For example, spatial wage differentials caused by climatic differences do not require any policy intervention, whereas differentials explained by inefficiencies due to low labour mobility deserve policy measures to improve economic efficiency, according to Pereira & Galego (2007). A correct understanding about the causes of wage differentials and of their evolution is crucial to apply the appropriate policy measures.

Thereby, the estimations that disregard attributes such as city dimension and agglomeration economies may be biased and mask other factors, like compensating differentials, spillovers, the role of individual-level productivity. This, in turn, could increase wrong policy recommendations, as for example, providing subsidies to the local industry development, when in fact investments in human capital are necessary, as well as Freguglia and Menezes Filho (2011) have warned.

Since neoclassical economic theory stresses that after controlling for amenities differences, wages should be the same in distint parts of the country for workers with the same level of skills, the empirical studies should base their analysis on the estimation of human capital wage equations and on the explanation of the wage differentials in terms of different regional characteristics or on the fact that these characteristics are rewarded differently in unequal locations (BLACKABY AND MANNING, 1990; BLACKABY AND MURPHY, 1995; GARCIA AND MOLINA, 2002; DURANTON AND MONASTIRIOTIS, 2002; SIMÓN ET AL, 2006). Earnings gaps explained by differences in the both human capital and industry related aspects are compatible with the neoclassical view. On the other hand, Pereira & Galego (2007) say if the same productivity related characteristics are not reward at the same price throughout the space, we might have either a temporary situation of disequilibrium or a more complex process of agglomeration economies and cumulative disequilibrium. Typically these studies consider a static perspective of analysis and employ the Blinder-Oaxaca decomposition and/or the Heckman procedure.

From then on, we can find that the empirical evidence on regional wage differentials varies among countries. For instance, the results of Blackaby and Murphy (1995) for Great Britain show that the wage differentials between the North and the South are relatively small and the situation is not too far from the neoclassical equilibrium – the wage differential that can be explained by differences in the reward of workers with the same skills is about 2.4%, favourable to the South. For Spain, Garcia and Molina (2002) found important wage differences between Madrid and the other Spanish regions. However, they concluded that the majority of the wage differential among Spanish regions is not explained either by the employee characteristics, or by the job conditions or by the discrepant remuneration for such idiosyncratics and terms. Secondly, the highest divergences in characteristics, when compared to Madrid, correspond

[5] See, for instance, García and Molina (2002), Motellón et al (2009) and Pereira and Galego (2007). Those first two papers are about wage differentials in Spain, as the last one, Portugal.

to the Centre and the South. And at last, they saw that the variations in returns for both seniority and the use of a second language are higher than those corresponding to education. About Brazil, Sachsida, Loureiro and Mendonça (2004) noticed that the people in Southeast region earnt the highest salaries [log(monthly wage) equation] among the five regions and Southeast and Northeast had the biggest reserve wage (selection equation to Heckman Model).[6]

According to Hirschman (1958), the effects of economic progress in certain parts of the territory can be favorable (Effects of Fluency) or unfavorable (Effects of Polarization). Some of the propitious effects are increases in purchases and investments in backward regions when a complementarity relationship is established between them. On the other side, polarization effects occur when the industrial and export activities of the backward regions are adversely affected, for example when exposed to competition. It is worth saying that the more developed regions attract more skillful and dynamic workers *vis-à-vis* the less developed. The areas reported by the concentration of the industrial sector may present wage differences in relation to those with less dynamism in this sector. The cluster of this type of activity in certain cities favors the attraction of more educated and productive workers. Thus, Souza, Ribeiro and Lopes (2018) believe it is reasonable that the workers of the more industrialized centers will receive higher rents even after controlling for individual characteristics.

Wage gap is attributable to many other factors including differences in the level of education of workers, types of jobs, and industrial structure. However, Moretti (2013) reminds us that it is known that even when such factors are controlled for, workers in urban areas receive higher wages than those in rural areas, and such urban-rural differences are called the "urban wage premium". This phenomenon is closely related to demographic density.

One reason for analyzing wages from the perspective of spatial economies is to find out why spatial wage disparities occur. Higher wages in larger cities are generally interpreted as being associated with positive externalities generated by agglomeration economies. As pointed out by Marshall (1890), positive externalities stemming from stronger input-output linkages, better matching of employees and employers, and invisible but active knowledge spillovers in agglomeration economies are believed to help improve the productivity of firms located there, resulting in higher wages. Indeed, Combes et al. (2010; 2012) show that agglomeration economies help boost the total factor productivity (TFP) of firms, as does Morikawa (2011) by analyzing Japanese service industries.

Combes and Gobillon (2015) said that some old studies also generally support the finding that the larger the size of a city, the higher are the wages. Nevertheless, many of them have a more theoretical and generic approach, in addition to some of the applied papers using population density as the only one proxy to agglomeration economy.

We need to remind that theory rather predicts that the marginal returns to agglomeration should decrease with city size, for instance, because local congestion increases as the city grows. Gains from human capital externalities from the first skilled workers in a location may be rather large, but the more numerous skilled workers are, the lower the marginal gain from one additional skilled worker. A similar line of argument may hold for most technological spillovers. Economic geography models with variable markups and strategic interactions, such as the one proposed by Combes and Lafourcade (2011), do present the feature that in the short run gains from agglomeration dominate costs as long as the asymmetry between locations is not too large, but further agglomeration in the largest locations can lead to a reverse result. Local productivity is negatively affected through some channels, such as the increase of land prices with the population, whatever the city size. This kind of effect can become dominant when cities are very large. More generally, one expects gains from agglomeration to increase and be concave with a steep slope at the beginning, and costs to increase and be convex with an initial slope close to zero. In that case, the difference between the two is concave and bell shaped. The relationship between the determinants of agglomeration economies, in particular population size, and local outcomes is then expected to decrease beyond some threshold (COMBES AND GOLBILLON, 2015). In this way, it is very important to find out in this study, in which phase the Southern Brazil finds itself, if the wage gains are higher in big towns and decrease step by step, or if some medium-sized and small municipalities are capable to offer more attractive salaries.

Eventhough many studies around the world have already done mincerian equations, additioning and combining some dummy variables, few of them involve urban agglomeration, human capital and wage premium. Moreover, it is more common to find papers focused on a specific area or county, but not analyzing the city classification (population size, infrastructure) and the agglomerations inside a whole region. Glaeser and Maré (2001) made one of the first studies on the subject, finding that workers in metropolitan areas in the United States earn an average of 33 percent more than other laborers.[7] In the same direction, Yankow (2006) noticed that this difference is approximately 19% for workers in USA's large urban areas. Campos and Neto (2009) obtained a similar conclusion when studying this process in Brazil, they observed that workers in the metropolitan areas earn up to 16% more than those located outside these zones. It is

[6] Heckman (1974) tests the hypothesis that the agent has an implicit reserve salary, below which he would not accept joining the labor market. By the way, Sachsida, Loureiro and Mendonça (2002) use this latent variable on the selection equation in a Heckit cross-section model to measure the returns to education in the five brazilian macro regions.

[7] One of the first studies that aim to measure the urban wage premium while controlling for individual heterogeneity was conducted by Glaeser and Maré (2001). They consider longitudinal individual data for the United States and find evidence that there is an urban premium even when observed and unobserved individual characteristics are taken into account.

worth noting that, although significant, wage differentials to compensate for the cost of living in metropolitan areas are not sufficient to justify such earning discrepancies, as suggested by Menezes Filho et al. (2007).

In the literature, there is a relative agreement on the attraction of more skilled workers in large urban centers, especially in the metropolitan areas (SILVA et al., 2016). In the national literature about wage gaps, it has been shown that cities with a higher concentration of human capital increase the productivity of workers, especially those with more education (SOARES, 2000; ROCHA et al., 2011). All of these studies reinforce our purpose of testing the hypothesis of sheepskin effect among the urban hierarchy. Moreover, some papers dealing with regional income differentials, based on data from the National Household Sample Survey (PNAD), point to urban agglomeration gains, even when controlled by the particulars of the laborers, such as age, gender, race, education, among others (ALMEIDA & BESARRIA, 2014; COELHO, VESZTEG & SOARES, 2010). Equally, in Cavalieri and Fernandes (1998), there is an evidence of discrimination only with income differentials between metropolitan regions. For the Brazilian metropolitan areas, the men's average wage is higher than the women's and the whites' is higher than the non-whites', even when controlled by variables such as age, schooling and place of residence. In addition, gender differences are homogeneous rather than race differences. Souza et al. (2015) also studied the salary difference by gender and color. Using data from the PNAD of 2013, and through the Oaxaca-Blinder decomposition, its results indicate that the wage gap is unfavorable to women, and the discrimination is positively related to the productive attributes and the type of civil union; on the other hand, it is negatively associated with the area of residence and occupation. The researchers also noted that among non-white individuals, although the wage difference was lower, gender discrimination was higher than among whites. Their main inference is that, together, both gender and color potentiate wage differentials in Brazil.

Sachsida, Mendonça and Loureiro (2008) aimed to verify the effect of the region of residence on the salary in the Distrito Federal, looking at Brasília and some satellite cities. The authors argue that individuals with more skills will possibly migrate to rich areas, and low skilled workers will live in poor areas. Such choices of residence will bias the results in favor of wage differences between areas. To prevent this bias, they performed two different econometric procedures. First, they estimated the regressions using two-stage least squares (2SLS). Secondly, they used a proxy that highly correlated with the place of the residence, but was not associated with the actual wage received by the workers. And with that, they ensured their statiscal procedure addressed the endogeneith problem, since the place of residence could be considered as endogenous. Finally, their results provide evidence in favor of *i)* a link between time spent commuting to workplace and productivity of the worker; and *ii)* statistical discrimination against workers that live in poor areas.

Furthermore, even if the same type of city classification is scoped, the results may vary in a country with continental dimensions such as Brazil. For example, Cirino and Lima (2016) demonstrated, using PNAD data for the year 2006, that the hourly earnings of individuals located in the Metropolitan Region of Belo Horizonte (capital of Minas Gerais state) were, on average, higher than those from Metropolitan Region of Salvador (capital of Bahia state). The authors emphasized that the increase in the wage rate in Belo Horizonte was due to the greater economic agglomeration and personal attributes more valued in the labor market (such as race, schooling and age of the individual). Nevertheless, this kind of result may not be unanimous.

Barros and Mendonça (1995) concluded that, despite the existence of a multifarious occupational structure among people with diverse atributes, nearly the entire salary difference should reflect only the personal profile (gender, age and race) and their endowments (schooling and experience). Disagreeing with this last point, Hoffman and Ney (2004) emphasizes the relevance of analyzing the sectors of the economy in the study of wage equations, once incomes tend to vary widely among the primary, secondary and tertiary sectors. They analysed the inequality of income distribution among people occupied in brazilian agriculture, industry and services, during the period 1992-2002. The socioeconomic level of agricultural workers, measured by average income and years of schooling, is much lower than in the other sectors, and this disparity shows no decreasing trend.

Departing from these considerations, we aim to estimate mincerian equations to people in Southern Brazil, taking into account the city classification, the sectors of the economy, in addition to personal variables, like gender, race, work experience, schooling, marriage and others. Our main goal is to discover if there is still a wage premium in big cities, metropolitan zones, or whether the medium-sized and small cities have already managed to mitigate this gap. This hypothesis is being raised due to a recent phenomenon, as disclosed by IBGE (Brazilian Institute of Geography and Statistics) that the municipalities whose populations are between 100 and 500 thousand inhabitants were those that grew more, over the period 2000 to 2015. According to IPEA (Institute of Applied Economic Research), metropoles constitute a strategic space because of their importance for national growth, but they have presented the worst productivity performance in the last 15 years.

Williamson (1965) made a seminal study on regional inequalities, indicating that in a first stage of development, the reduction of transport costs leads to increased spatial concentration, since the crowded businesses can reach wider markets. After the aggravation phase of regional differences, however, the productive activity back to disperse, because the regions are facing higher rents and the continued fall in transport costs and telecommunications makes the independent production of the territory. This phenomenon is slow and may take even more time in developing countries,

but there is already some evidence that it is happening in Brazil.[8]

There is a nuance of this phenomenon called urban sprawl. Resnik (2010) defines this as being a pattern of uncontrolled development around the periphery of a city, it is an increasingly common feature of the built environment in the United States and other industrialized nations.[9] The motivations for migrating from a metropolis to the suburbs or smaller towns usually circling: lower cost of housing and living; possibility of easy displacement, whether using public transport or private vehicles; choice or preference for a more spacious house.

On the surface, sprawling subdivisions and commercial zones are economic boons to local businesses and municipalities. The construction of dwellings, stores, and infrastructure creates employment opportunities. Home owners and commercial ventures that move into the area often provide additional revenue to local governments in the form of property taxes and sales taxes. However, such development often produces drains on local environmental resources, shifts the economic burden of development to longtime residents, increases transportation and energy costs, and diminishes overall community character (RESNIK, 2010).

The monitoring of other categories of urban center, as medium-sized and small towns, has become determinant in the current process of desconcentrating of the Brazilian economy, placing itself as an important investment alternative and also as spaces capable of receiving and fixing immigrants. Owing to this, it is even more required that we include a categorization on the structure and size of the cities where the person is located for our analysis of the labor market. Besides, we also intend to see the causalities and marginal effects between wage, presence in labor force and some explanatory variables, as individual forms and schooling.

3. METHODOLOGY

For the purpose of measuring wage differentiation and insertion into the labor market in south region of Brazil, we will first make an estimation by the Ordinary Least Squares (OLS) and after the two-step Heckman model, with two especifications each one: 1) the variable of formal education is measured by years of schooling; 2) this variable is represented by dummies with the highest level of education achieved (and completed).[10] This split is justified by the concerning in inquiring whether the diploma effect (or sheepskin-effect)[11] occurs and to discover if schooling has increasing returns in south of Brazil. Besides, we want to explore if metropolises really reward more their workers with higher scholarity.

The first step, however, is to estimate the income mincer equation (MINCER, 1974). The model for estimating wage can be expressed as

$$\ln \text{wage} = \beta_0 + \beta_1 \text{ educ} + \beta_2 \text{ exp} + \beta_3 \text{ exp}^2 + \gamma' x + \epsilon \qquad (1)$$

where: wage is the salary received by the individual; educ is the schooling; exp is the work experience; x is a vector of observable characteristics of the individual, such as race, gender, region… and ϵ is a stochastic error.

Although, one of the major concerns in estimating an OLS equation is because OLS is not able to deal with problems related to sample selection bias. As pointed out in Heckman (1974; 1979), the data used in the estimation of the mincerian equation are generally taken from individuals who obtained some income in the period, which excludes those who, despite years of study and experience, did not obtain salary income in the period. Thus, the OLS estimation coefficients of the mincerian equation will be biased. Therefore, Heckman (1974; 1979) proposes an estimation method (known as Heckit)[12] that aims to circumvent the sample selection bias and consists of a two-stage procedure that can be summarized as follows:

i) A Probit model is estimated for labor market participation for the sample with employed and unemployed workers, thus obtaining the inverse Mills ratio for each sample observation;

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[8] Problems such as lack of space and the high cost of land and rents complete the situation of "diseconomy", a name given by some experts when the investment in a particular city is no longer profitable due to structural deficiencies. It is enough to observe municipalities like Londrina (PR), Ribeirão Preto (SP), Uberlândia (MG), Natal (RN) and Teresina (PI). In the 1980s, they were medium-sized cities, but today they have climbed one step in the urban hierarchy to integrate the select group of 31 large Brazilian cities. The more companies migrate inland, the more attractive force out of the big cities. As qualified professionals will work in the companies of the interior, a new potential of consumption forms, which justifies new investments. Furthermore, huge municipalites as São Paulo and Rio de Janeiro are driving people and fundings away because of violence, high cost of living, excessive traffic, and other troubles.

[9] Urban sprawl in the United States has its origins in the migration to the suburbs that began in the 1950s. People wanted to live outside of city centers to avoid traffic, noise, crime, and other problems, and to have houses with more square footage and yard space (RESNIK, 2010).

[10] Moreover, Brazilian Census (2010) does not have the information about how many years the person has studied. So with the available data, we combined the variables "highest level of education reached" and if this level was finished or not. Then, we had near categories, based on Brazilian educational system: literacy class = 1 year of schooling; elementary education level I = 4 years; elementary education level II = 8 years; high school = 11 years; college = 15 years; masters or especialization = 17 years; PhD = 21 years (since in Brazil it is common 2 masters years + 4 doctorate years). We know the best option it would be having both informations, once we do not know exaclty if the person spent 4, 5, 6 years at a university or if he/she has already failed in school. Nevertheless, we chose this option because this new variable will reveal at least how many full years the individual has of schooling.

[11] Castro & Reis (2009) researched about sheepskin effects and the relationship between earnings and education in Brazil, indicating that a diploma or degree completion in Brazil has been loosing its value over time. At the same time, the causality between log earnings and education has become more convex. Similar trends are verified when the analysis is carried out separately by region.

[12] Following Wooldridge (2002), the procedure is sometimes called Heckit after Heckman (1976) and the tradition of putting ''it'' on the end of procedures related to probit (such as Tobit).

ii) For the sample of employed workers, the return equation (for example, the Mincer mode) is estimated by OLS, including as an additional regressor the inverse ratio of Mills obtained in the first step of the procedure. In addition, since the errors of the return equation are heteroskedastic, robust standard errors must be estimated.

For instance, Mroz (1987) applied a Heckit Model to estimate the marginal efect of education on wage. The issue here is that we observe wage only when the person is employed (in labor force, inlf=1); on the other hand, for unemployed people, inlf=0, and the wage is unobserved, denoted by missing value. However, if the population is everyone (the employed plus the unemployed), the sample consisting of only the employed is not an iid (independent and identically distributed) sample. In this case, Heckit model can be used to address the non-random sampling issue.

In terms of statistics, we are ultimately seeking $E(y|x)$ − here y is wage and x is educ. But, if we use the sample of the employed only, we are effectively estimating $E(y|x, inlf = 1)$. In general, the two condition means are different unless inlf is irrelevant. To fix the idea, consider a system of two models:

$$y = \beta_1 x_1 + u, E(u|x_1) = 0 \tag{2}$$

$$s = \begin{cases} 1, if\ \gamma_1 x_1 + \gamma_2 x_2 + \vartheta \geq 0 \\ 0, \quad otherwise \end{cases} \tag{3}$$

where s is a dummy variable representing the selection outcome − here, s = inlf. Wage is observed only when $\gamma_1 x_1 + \gamma_2 x_2 + \vartheta > 0$ (when a person selects to be in labor force). Notice that we need at least one variable x_2 that matters for selection but is excluded from the regression for wage.

Let ϕ and Φ denote the pdf and cdf of standard normal distribution. $\Longrightarrow E(u|v) = pv$ (4)

Thus, if u and v follow bivariate normal distribution

if v follows standard normal distribution $\Longrightarrow E(v|v > c)\dfrac{\phi(c)}{1-\phi(c)}$ (5)

$$\phi(-c) = \phi(c), 1 - \phi(-c) = \phi(c) \tag{6}$$

Given those results, it follows that

$$\begin{aligned} E(y|x_1, s = 1) &= \beta_1 x_1 + E(u|s = 1) && (7) \\ &= \beta_1 x_1 + E(u|\gamma_1 x_1 + \gamma_2 x_2 + v \geq 0) && (8) \\ &= \beta_1 x_1 + \rho E(v|v \geq -\gamma_1 x_1 - \gamma_2 x_2) && (9) \\ &= \beta_1 x_1 + \rho \left[\frac{\phi(-\gamma_1 x_1 - \gamma_2 x_2)}{1 - \phi(-\gamma_1 x_1 - \gamma_2 x_2)}\right] && (10) \\ &= \beta_1 x_1 + \rho \left[\frac{\phi(\gamma_1 x_1 + \gamma_2 x_2)}{\phi(\gamma_1 x_1 + \gamma_2 x_2)}\right] && (11) \end{aligned}$$

Where $\lambda(\gamma_1 x_1 + \gamma_2 x_2) \equiv \frac{\phi(\gamma_1 x_1 + \gamma_2 x_2)}{\phi(\gamma_1 x_1 + \gamma_2 x_2)}$ is called inverse Mills ratio (imr).

Equation (11) makes it clear that we would get biased estimate for β_1 if we ignored the inverse Mills ratio - the omitted variable in this context. Usually, the inverse Mills ratio can be well approximated by a linear function. So without x_2 there would be multicollinearity between x_1 and inverse Mills ratio. So, Heckman suggests a two-step procedure: in step one, estimate $\hat{\gamma}$ by a probit model (using both employed and unemployed persons) and compute inverse Mills ratio; in step two, run linear regression (using the employed only) that includes both x_1 and inverse Mills ratio, i.e., regression (11).

There is a command in software Stata, called "heckman" that can implement the two-step procedure automatically, and may account for the fact that a variable generated from the first-step, the inverse Mills ratio, is used in the second-step as a regressor by making adjustment to the standard error and t value. Thus, the heckman command is strongly recommended to use in practice, as Söderbom (2009) highlighted.

Beblo et. al (2003) explains that Heckman (1979) proposed two estimation techniques to overcome the self-selection problem, one consisting in maximum likelihood (ML) estimation of a selection model assuming bivariate normality of the error terms in the wage and participation equations. The other method proceeds in two steps, ML probit estimation of the participation equation, and OLS (or GLS) estimation of the wage equation using participants only and the normal hazard $\hat{\lambda}$ estimated from the first step as additional regressor. For further reference, note that this is a decreasing function of the participation probability. The authors put two main reasons to prefer two-stage estimation to the direct ML estimation of the Heckman model. First, ML relies on joint normality of the errors in the selection and level equations. Its advantages and drawbacks are twofold: if none of the equations is misspecified, simultaneous estimation yields efficiency gains. On the other hand, misspecification of one equation may contaminate the other, resulting in inconsistency. By contrast, the two-step estimator only relies on conditional moments which, although derived under joint normality, may hold for a wider class of distributions, at least approximately. Second, using OLS in the second stage has the advantage that the average of the residual is zero, which does not hold for the ML Heckman estimator.

Cameron and Trivedi (2009) also did further recomendations. For more robust identification, it is usually indicated that exclusion restrictions be imposed. This requires that the selection equation have an exogenous variable

that is excluded from the outcome equation. Moreover, the excluded variable should have a substantial (nontrivial) impact on the probability of selection. Because it is often hard to come up with an excluded variable that does not directly affect the outcome and does affect the selection, the investigator should have strong justification for imposing the exclusion restriction. Maddala (1983) and Wooldridge (2002) agree with this advice, warning that if we allow all variables in the selection equation to also appear in the wage offer equation, the Heckit estimates become very imprecise.

And therefore, we will not expose here the model without restrictions[13], only the OLS regression and the Heckit model (with restrictions), each one with two especifications about education, as it follows:

$$\ln wage = \beta_0+\beta_1 yearsofschooling+\beta_2 exp+\beta_3 exp^2+\beta_4 race+\beta_5 gender+\beta_6 urban+\beta_7 Primarysector +\beta_8 Tertiarysector+\beta_9 MetropRegion+\beta_{10} RegionalCapitalB+\beta_{11} RegionalCapitalC+\beta_{12} SubRegionalCenterA+\beta_{13} SubRegionalCenterB+\beta_{14} ZoneCenterA+\beta_{15} ZoneCenterB+ \epsilon \quad (12a)$$

$$\ln wage = \beta_0+\beta_1 ElementarySchool+\beta_2 HighSchool+\beta_3 College+\beta_4 exp+\beta_5 exp^2+\beta_6 race+\beta_7 gender+\beta_8 urban+\beta_9 Primarysector+\beta_{10} Tertiarysector+\beta_{11} MetropRegion+\beta_{12} RegionalCapitalB+\beta_{13} RegionalCapitalC+\beta_{14} SubRegionalCenterA+\beta_{15} SubRegionalCenterB+\beta_{16} ZoneCenterA+\beta_{17} ZoneCenterB+ \epsilon \quad (12b)$$

Reminding that on selection equation, the dependente variable is ilf (in Labor Force) and besides the independent variables present on especifications (a) and (b) above, the variables "Married" and "Kids" are added, since we need at least one explanatory variable that matters for selection but is excluded from the regression for wage. Moreover, we also did Bootstrap procedure when necessary, as recomended by Maddala (2003) and Oliveira et. al (2015).[14] The explanations about source and data treatment follow on the next section.

4. DATA TREATMENT AND DESCRIPTIVE ANALYSIS

The microdata come from Demographic Census 2010 (IBGE), but it does not give all the informations we need, like the sector of the economy that the person is enrolled, neither the town category where the individual lives at. However, the data give us a CNAE (National Classification of Economic Activities) code, which allow us to group branches of job activities of the citizens, and this way, we formed a traditional division into 3 major sectors of the economy: primary, secondary and tertiary.[15]

Since we would like to use a city classification on our purpose, we created an ordination, very inspired at REGIC (Influence Region of the Cities), which is a publication of IBGE (National Institute of Statistics and Geography) that aims to study the hierarchy of the Brazilian urban network, based on the flow of information, goods and services. The most recent edition was made for the year 2007.

According to REGIC (2007), the Brazilian urban network is divided into four types of centers, split according to the urban network, population and relationships (which is the number of times in the survey questionnaire the city was referred to as the destination of intercity commuting):

- Metropolis: composed by the 12 main urban centers – São Paulo, Rio de Janeiro, Brasilia, Manaus, Belém, Fortaleza, Recife, Salvador, Belo Horizonte, Curitiba, Goiânia and Porto Alegre. The main feature is the territorial extension and its direct influence.
- Regional Capitals: consisting of 70 urban centers, whose area of influence is at the regional level.
- Sub-regional Centers: composed by 138 urban centers, characterized by the presence of low complexity management activities, and whose relationships with cities outside its urban network are summarized in the 3 main metropolises. Most of the urban centers are located in the areas of greatest occupation in the Northeast and Center-South regions and in the areas of lower occupation in the North and Central-West regions.
- Zone Centers: constituted by 556 small cities, whose urban network is delimited by the neighboring cities, with basic management activities.

In addition to these, there are also the Local Centers, which are the other 4,473 Brazilian cities, with a population of less than 10 thousand inhabitants, whose importance of intra-urban activities are limited to the municipality itself, that is, they are cities that have almost no influence on others.

The central aspects considered by REGIC, for analysis of the urban network, are composed of urban and regional

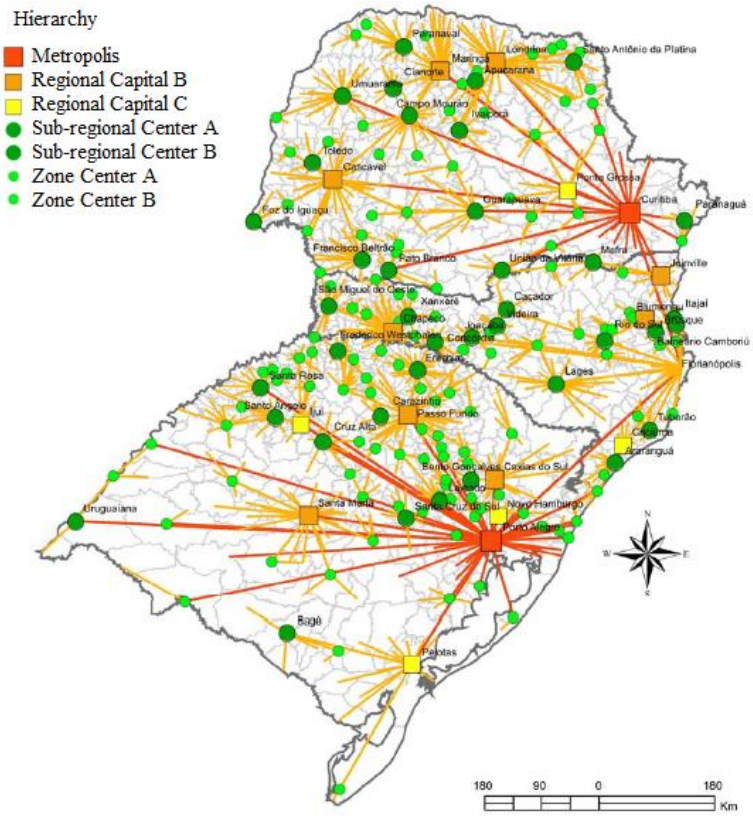
[13] We did some tests and initial equations and the Heckit model whithout restrictions was worst than the one with restrictions. The variables indicating if the person is married and if the person has any child (until july, 2010), "married" and "kids" were coherent to be only on the selection equation, once according to the statistics and the literature, those variables are very relevant in the choice (and probability) of participating in labor market, mainly between women (see Mroz [1989] and Beblo et. al [2003]).

[14] According to Maddala (2003), the Probability Ratio, Wald and Lagrangean Multiplier tests have normal or χ^2 asymptotic distributions, advising that the bootstrap methodology should be used when testing is desired. It is a technique with the following purpose: to reduce deviations and to provide more reliable standard errors. In addition, it promotes more feasible confidence intervals and approximates the sample distribution function of the population distribution function. This methodology was also applied by Oliveira et.al (2015), when they used a mincer equation to identify the links between education and experience in fixing the hourly wages of Belgian workers.

[15] CNAE has hundreds of subclasses about economy activities. Once Census (2010) use the CNAE version household 2.0, so did we to aggregate the departments into the 3 classic sectors of the economy. As an example of CNAE code, Section A: Agriculture, livestock, forestry, fisheries and aquaculture; Division 01: Agriculture, livestock and related services; Group 01.1: Production of Temporary Crops; Class 01.15-6: Soybean farming; Subclass 01.15-6 / 00: Soybean farming.

development platforms. The main platforms used are airports, shopping centers, higher education, leisure and health. The greater the total number of links and the number of connections of 1st and 2nd order, the higher the level of relationship of these cities, which may also imply in a greater dependence of the city of origin for the destination town. In addition, the REGIC also analyzes the following aspects: bus lines (number and frequency of journeys), internet access and circulation of newspapers (number of newspapers and frequency of publication). After seeing the main types of municipalities, the figure 1 ilustrates their influence areas and links, in Southern Brazil.

Figure 1 - Regions of influence of southern cities – REGIC (2007)



Source: Adapted from REGIC (2007).

It is important to note that the REGIC data are already a little out of date (from 2007), and then, some regional dynamics have already changed. Thus, we mixed it with the classification of population arrangements[16] and the most updated definitions of capitals and their respective metropolitan regions in southern Brazil. The reasons for us to adapt and create a new city classification were basically three: 1) there is no official city classification to all the 5565 brazilian municipalities (in 2010), not even the REGIC; 2) neither official city classification with the metropolitan zones updated; 3) we would not want to use population size as the only threshold to the ranges. For example, a city with more than 500 thousand inhabitants is considered as a big town; one with 100 – 500 thousand people: medium-sized; and one with less than 100 thousand inhabitants, as a small town. It is assumed that population size is an insufficient factor to capture the insertion of urban centers within the different hierarchical levels of the network, which is especially important in Brazil's case. For example, due to regional heterogeneity, a city of 100 thousand inhabitants in the State of São Paulo has a distinct insertion of one with the same number of people in Roraima state.

Scherer (2018) defenses that it is feasible comparing and combining the hierarchical compositions already made. By the way, the government creates new ones, dismembers and modifies the name of the cities with a certain frequency, which justifies an updated analysis of the size classification of the municipalities.[17] In addition, the Brazilian government has been changing the regimentations of metropolitan region (for example, Florianópolis was only once again considered a metropolitan area in 2010)[18] and it also has appended more cities to the metropolitan zones in recent years. The initial configuration of the Metropolitan Region of Curitiba (RMC or "Big Curitiba"), when it was created in 1973,

[16] Population arrangements are also an IBGE classification to 2010 with 294 groups, formed by 953 municipalities, covering 55.7% of the resident brazilians, from which have been defined through population cuts, medium and large urban concentrations. It takes into account the demographic density of the spot of the urban census tracts, proportion of population in urban activities equal to or greater than 81.5%; pendular movement above 10% of the population aged 15 years or over who work or study, besides the population size.

[17] From 1940 to 2007, Brazil created 3990 new municipalities, according to IBGE. In 2000, Brazil had 5,507 municipalities. In 2010, there were 5565 - 58 new municipalities in ten years. In 2012, 5570 cities at all.

[18] The Metropolitan Area of Florianópolis (SC) was created for the first time in 1998, with the law LCE (state complementary law) 162/1998, it was abolished by the supplementary state law number 381 of 2007 and reinstituted by the LCE 495/2010. Through REGIC classification, Florianópolis appears like a Regional Capital A, but we know it is important to regard it as a metropolis, as well as we should not let the other eight cities which form the metropolitan zone of Florianópolis (also called by "Big Florianópolis") without classification or like a local center.

comprised 14 municipalities. Some dismemberments and aggregations occurred, and the last change happened in 2011, with the addition of 3 cities, totaling since then, 29 municipalities (according to city hall of Curitiba). It is the second largest metropolitan region of the country in geographical size, with more than 16.5 thousand km² of area. It represents 40% of the Gross Domestic Product (GDP) of Paraná (IBGE, 2010).The "Big Porto Alegre" was also founded in 1973 and the latter modifications occurred in 2010 and 2011, with the sum of one more municipality in each year, containing thenceforward, 34 cities. According to the 2010 IBGE census, it was the fourth most populous in Brazil - surpassed only by the metropolitan regions of São Paulo, Rio de Janeiro and Belo Horizonte, respectively and the Big Porto Alegre owns the fourth largest GDP in Brazil too.

Thereby, to the cities without classification, we follow the REGIC criteria and we saw they were very small, entering into the range of local center. The classification of population arrangements was superimposed by the incidence of state capitals and their respective metropolitan areas (being the own capitals their headquarters).[19] Since a significant part of the population live in a city and study/work in another and come back everyday into home, and this phenomena is very clear in Southern Brazil,[20] mainly in the capitals and surroundings, we should not analyze the state capital apart from the neighbor cities which form the metropolitan zone. Moreover, our ranking also intends to capture whether there is any wage premium within metropolitan areas or whether other kind of regions are already becoming more attractive. Hence, the making of the city assortment will be more detailed below (table 1), together with the description of the other variables needed for the present work. [21]

Table 1 – Data Description and Treatment

Variables	Meaning	Construction
Ln (wage)	Log of monthly wage[22]	Neperian log of monthly Salary from work (currency: brazilian reais of 2010)
InLaborForce (ilf)	Be in the labor force	Dummy =1 if the person has at least one job
YearsScho	Years of Schooling	Number of years of schooling (completed)
NoInstruction	Without formal education	Dummy =1 if the individual has never been to school or if the individual hasn't finished the elementary school
Elementary School	The level of Elementary school is completed	Dummy =1 if the highest level of education the person reached is the primary school and if it's completed
HighSchool	The level of High school is done	Dummy =1 if the highest level of schooling the person reached is the High school and if it's completed
College	The level of College is completed	Dummy =1 if the person has a college degree
Work Exper	Work experience (in years, we used individual age like a proxy to work experience)	Number of years (age)
race	Race (black, brown, indigenous, asian, white)	Dummy =1 if the person is white
gender	Gender (male, female)	Dummy =1 if the person is male
urban	Place of housing (urban, rural)	Dummy =1 if the dwelling-place is on an urban area
Married	Marital status (married, divorced, separated, widow, single)	Dummy =1 if the person is married
Kids	Having kids	Dummy =1 if the person had at least one child until July 2010
Primary Sector	Primary sector of the economy (includes agriculture, livestock, mining, forestry, grazing, hunting and gathering, fishing, quarrying)	Dummy =1 if the person works in the primary sector
Secondary Sector	Secondary sector of the economy (manufacturing, processing, construction, metalworking and smelting, energy utilities)	Dummy =1 if the person works in the secondary sector
Tertiary	Tertiary sector of the economy (retail and wholesale sales,	Dummy =1 if the person works in the tertiary

[19] In spite of some classifications put another towns but the capital as metropolis with a lot of municipalities inside their metropolitan zones, some of them are not officials and/or include very small towns, for instance with 1 thousand people. As in Southern region, the capitals (including all the metropolitan zone) are the biggest cities, we chose classyfing only the state capitals with their metropolitan areas (the latters defined by government) as Metropolitan Regions (the first level of hierarchy in our classification to Southern cities).

[20] In Paraná, approximately 60% of the people who move to work and/or study seek the three largest urban centers: Curitiba, Londrina and Maringá, but 43% of the movement converge to the capital. Much of this daily migration happened in the state in 1980, involved some municipality of the RMC, however, almost all of this flow was intrametropolitan. In 2000, three out of four people who performed an intra-state pendulum movement had a metropolitan municipality as their destination. It can be seen in the three RMs (Curitiba, Florianópolis and Porto Alegre) a very similar dynamic in which the polo municipality (the capital) stands out as the space of opportunities. To know more about this fact, check Ribeiro (2005).

[21] We also did a table that shows all the city names for each category. However, it was suppressed here because of the limited space.

[22] We chose the monthly wage instead of wage per hour/per week as dependent variable, because Census question only asks how many hours the person worked in the survey week and in the main job, not capturing people that are employed but are distant during that week and people with two or more occupations. The Brazilian Census gives us the earnings from all jobs per month and we preferred to use this information.

Sector	transportation and distribution, restaurants, clerical services, media, tourism, insurance, banking, health care, law, education)	sector
Metrop Region	Metropolitan region (the state capital and its metropolitan area according to the brazilian government)	Dummy =1 if the individual lives in a state capital or its metropolitan zone
RegionalCapital B	Regional Capital B (there are 20 cities in Brazil in this range by REGIC (2007), with an average population of 435 thousands of inhabitants and 406 relationships of intercity movements. For example, Londrina (PR), Maringá (PR), Chapecó (SC), Santa Maria (RS)	Dummy =1 if the person lives in a regional capital level B
RegionalCapital C	Regional Capital C (it is composed of 39 municipalities in Brazil (REGIC, 2007), with 250 thousand people and 162 relationships of intercity movements, on average. For instance, Ponta Grossa (PR), Criciúma (SC), Novo Hamburgo (RS), Pelotas (RS)	Dummy =1 if the person lives in a regional capital level C
SubRegional Center A	Sub Regional Center A (there are 85 cities in Brazil in this category, with an average population of 95000 inhabitants and 112 relationships (REGIC, 2007). Examples: Foz do Iguaçu (PR), Paranaguá (PR), Caçador (SC), Bagé (RS)	Dummy =1 if the dwelling-place is on a sub regional center A
SubRegional Center B	Sub Regional Center B (composed of 79 cities, with 71 thousand inhabitants and 71 relationships, on average, such as: União da Vitória (PR), Balneário Camboriú (SC), Cruz Alta (RS))	Dummy =1 if the person lives in a sub regional center level B
Zone Center A	Zone Center A (there are 192 cities, with 45000 people and 49 relationships, on average. Examples: Assis Chateaubriand (PR), Jacarezinho (SC), Torres (RS))	Dummy =1 if the person lives in a zone center level A
Zone Center B	Zone Center B (364 cities in Brazil, with average population of 23 thousand inhabitants and 16 relationships, for example: Quedas do Iguaçu (PR), Sombrio (SC), Garibaldi (RS))	Dummy =1 if the person lives in a zone center level B
Local Center	Local Center (it encompasses the other more than 4500 thousand cities in Brazil, usually with less than 10000 inhabitants), such as: Boa Esperança (PR), Arvoredo (SC), Chuí (RS))	Dummy =1 if the person lives in a local center

Source: The authors.

It is necessary to indicate that we used a filter in order to exclude only the people with less than 10 years old, as recommended by many authors, such as Queiroz and César (2016) and the PNAD (National Household Sample Survey) methodology, which does not include these individuals in the PEA (Economically Active Population).[23] Beyond that, the estimations and statistics were made using the software Stata 14.0, and the sample weights of the individuals available in the microdata of the Census 2010. After we found the descriptive statistics for each state (Paraná, Santa Catarina and Rio Grande do Sul), here we have a short comparison with their numbers of observations and means (table 2).

Table 2 – Summary statistics to Paraná, Santa Catarina and Rio Grande do Sul (2010)

State	**Paraná**		**Santa Catarina**		**Rio Grande do Sul**	
Variable	**Obs**	**Mean**	**Obs**	**Mean**	**Obs**	**Mean**
Wage from work (R$)	649,022	1322	479,481	1355	740,552	1292
YearsScho	913,098	5.599	599,693	6.049	959,402	5.794
NoInstruction	1.107e+06	0.487	753,677	0.455	1.213e+06	0.482
ElementarySchool	1.107e+06	0.181	753,677	0.195	1.213e+06	0.190
HighSchool	1.107e+06	0.229	753,677	0.248	1.213e+06	0.237
College	1.107e+06	0.0971	753,677	0.0970	1.213e+06	0.0866
WorkExper (age)	1.107e+06	36.95	753,677	36.76	1.213e+06	38.76
race	1.107e+06	0.698	753,677	0.840	1.213e+06	0.835
gender	1.107e+06	0.488	753,677	0.494	1.213e+06	0.483
urban	1.107e+06	0.854	753,677	0.841	1.213e+06	0.850
Married	1.107e+06	0.412	753,677	0.403	1.213e+06	0.362
Kids	1.107e+06	0.331	753,677	0.325	1.213e+06	0.331
InLaborForce	1.107e+06	0.577	753,677	0.614	1.213e+06	0.573
PrimarySector	1.075e+06	0.0926	730,417	0.0896	1.182e+06	0.102
SecondarySector	1.107e+06	0.136	753,677	0.182	1.213e+06	0.136
TertiarySector	1.107e+06	0.740	753,677	0.700	1.213e+06	0.736
MetropRegion	1.107e+06	0.306	753,677	0.142	1.213e+06	0.357
RegionalCapitalB	1.107e+06	0.112	753,677	0.162	1.213e+06	0.0826
RegionalCapitalC	1.107e+06	0.0294	753,677	0.0310	1.213e+06	0.0384

[23] By the way, the concept of Active Age Population (PIA) corresponds to a population of 10 years or older that is able to perform some type of work.

SubRegionalCenterA	1.107e+06	0.117	753,677	0.0952	1.213e+06	0.0729
SubRegionalCenterB	1.107e+06	0.0189	753,677	0.0845	1.213e+06	0.0141
ZoneCenterA	1.107e+06	0.0623	753,677	0.0548	1.213e+06	0.0984
ZoneCenterB	1.107e+06	0.0500	753,677	0.0639	1.213e+06	0.0722
LocalCenter	1.107e+06	0.305	753,677	0.366	1.213e+06	0.264

Source: Elaborathed by the authors.

We can have already some preliminary findings through the table 2. It shows that Santa Catarina had the highest means to monthly wage, years of schooling, participation in labor force and white people between the three states in Southern Brazil. This macro region seems to be homogeneous comparing with the rest of the country, with high HDIs, good educational indicators, incomes above the national mean, a strong presence of european descendants, but when you take a look inside the region, you will see that it is not totally uniform. Paraná and Rio Grande do Sul have a larger share of the dwellers concentrated in the metropolitan zones, while in Santa Catarina there is a larger fraction in the smaller towns, with a little less of urbanization. These two states also have their workforce more aggregated in the tertiary sector.

5. MAIN RESULTS AND DISCUSSION

And finally, here we have the estimations results to the OLS and Heckit models, with specifications using years of schooling (1a and 2a) and degree of instruction (1b and 2b). Firstly, we have the estimations for wage equation to Paraná, Santa Catarina and Rio Grande do Sul.[24]

5.1 Estimations for Paraná

Table 3 - Results of the model estimations for Paraná (2010) with OLS and Heckit methods

Ln wage (dependent variable)	OLS Model		Heckit Model	
	(1a)	(1b)	(2a)	(2b)
main				
Years of Schooling	0.0529***		0.0490***	
	(0.0003)		(0.0003)	
Work Experience	0.0573***	0.0610***	0.0486***	0.0519***
	(0.0007)	(0.0005)	(0.0006)	(0.0006)
WorkExper2	-0.0006***	-0.0006***	-0.0005***	-0.0005***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
race	0.1949***	0.1288***	0.1850***	0.1326***
	(0.0026)	(0.0022)	(0.0023)	(0.0020)
gender	0.4158***	0.4639***	0.3951***	0.4414***
	(0.0027)	(0.0023)	(0.0025)	(0.0023)
urban	0.2228***	0.1735***	0.1646***	0.1304***
	(0.0039)	(0.0033)	(0.0035)	(0.0029)
Primary Sector	-0.0848***	-0.1191***	-0.1092***	-0.1293***
	(0.0048)	(0.0039)	(0.0039)	(0.0032)
Tertiary Sector	0.1030***	0.0092***	0.1511***	0.0674***
	(0.0029)	(0.0025)	(0.0048)	(0.0044)
Metropolitan Region	0.3234***	0.2823***	0.2825***	0.2621***
	(0.0032)	(0.0027)	(0.0029)	(0.0025)
Regional Capital B	0.2561***	0.2178***	0.2765***	0.2427***
	(0.0043)	(0.0037)	(0.0040)	(0.0036)
Regional Capital C	0.1461***	0.1311***	0.1726***	0.1604***
	(0.0074)	(0.0061)	(0.0071)	(0.0062)
Subregional Center A	0.1530***	0.1356***	0.1742***	0.1576***
	(0.0038)	(0.0033)	(0.0037)	(0.0032)
Subregional Center B	0.0659***	0.0578***	0.0871***	0.0766***
	(0.0080)	(0.0069)	(0.0084)	(0.0072)
Zone Center A	0.0877***	0.0795***	0.1107***	0.1015***
	(0.0049)	(0.0042)	(0.0048)	(0.0042)
Zone Center B	-0.0032	-0.0132***	0.0086*	0.0012
	(0.0055)	(0.0047)	(0.0050)	(0.0042)
Elementary School		0.2509***		0.2390***
		(0.0029)		(0.0028)
HighSchool		0.4830***		0.4466***
		(0.0027)		(0.0030)
College		1.1885***		1.1087***
		(0.0041)		(0.0043)

[24] The whole estimations, explicitly including the selection equation in Heckman correction, were made to each state. However, due to the space limitation, we just exposed here the first part of each equation.

Constant	4.4120***	4.4397***	4.6666***	4.6781***
	(0.0120)	(0.0104)	(0.0146)	(0.0130)
Mills (imr)				
lambda			-0.0935***	-0.1096***
			(0.0065)	(0.0057)
R2 adj	0.3230	0.3955		
Number of obs	467064	577787	886476	1074822
F	8258.2979	11392.3662		
Prob>F	0.0000	0.0000	0.0000	0.0000
Wald Chi2			164484.2696	261754.0234
Prob>Chi2	0.0000	0.0000	0.0000	0.0000

Notes: Heteroskedasticity robust standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01. Source: Elaborathed by the authors.

It is usual in the econometric literature to present the OLS and Heckit estimates in the same table. Thus, the table 3 does it with the mincer equations to Paraná state. Initially, two results are of note. First, the estimated coefficient of the Inverse Mills ratio (imr) is statistically significant, implying that there is a selection bias present in the least squares results (for both specifications, as shown through 2a and 2b). It should be noted that as in the estimation step of the income formation equation the presence of heteroscedasticity was detected, both by the White test and the Breusch-Pagan test, robust standard errors were used for heteroscedasticity, and the estimations were balanced with their data weights (provided by the Census 2010). [25]

It is convenient to use the logarithm of wage, since it allows estimating semi-elasticities and results that are more tangible. We can observe that each additional year of study brings 4.9% to individual earnings, on average, in Heckman model, revealing that the OLS method inflated the return to schooling. The years of experience appeared with a positive sign and this same variable raised to the square (both significant for all equations), with negative signal, what corroborates with the hypothesis that additional years of age (experience) exhibit decreasing wage returns.[26]

In relation to the race, white people tend to earn 18.5% more than the non-white, in specification 2a. For the version with degrees of education (2b), the wage differentiation because of the person's color is lower (13.26%). The wage gaps through gender was were very high, and once again, the OLS model was overestimating the increase in the salary for being a man. Living in an urban area brings a growth of 16,46% (2a). Comparing with the secondary sector, beying employed in the primary can decrease the wage in 12.93% (2b) and participating of the tertiary may rise the earning in 15.11% (2a), but only in 6.74% (2b) when the levels of instruction are present on the equation. This possibly is related with much of tertiary sector (such as education, health, business, public administration, information technology) requiring skilled labor, and formations with sheepskin, which do not cause much effects if the person studied a few years, but did not obtain the diploma.

Equating now with a citizen who lives in a very small town in Paraná (less than 10 thousand inhabitants, classified here as local center), the salary that belongs to a person who lives in Curitiba and Metropolitan Area considerably increases, *ceteris paribus*. Therefore, it reveals a substantial wage premium (about 28.25% on version 2a) for living/working in the metropolitan zone. Meantime, whoever inhabits a city with one degree below in the urban hierarchy (Regional Capital B), gains a wage increase almost equal to the one of the metropolitans: 27.65% in specification 2a. It means that municipalities like Londrina and Maringá are paying wages roughly equal to the capital. Rocha & Campos (2007) found a big gap between the Metropolitan Region of Curitiba (a wage increment of 31.91%), Londrina (17.47%) and Maringá (7.73%) using the Heckman equation to men in Paraná with Census 2000 data. This difference with our results may be justified because of our equations have more covariables, including the sectors of the economy[27] and also because the accentuated outgrowth of these two cities in the last years. Deschamps et. al (2008) put Londrina and Maringá as the second and third polo in the state looking to the people and trade flows. Moreover, the GDP in Maringá grew more than 17% in 2011 (IPARDES, 2011).

Refering to the Regional Capital C, it presents a wage increasing of 17.26% in relation to a local center, which is very close to the increment brought by the Subregional Center A (one degree above the Regional Capital C in the scale), about 17.42% (version 2a). Eventhough there is a gap when they are compared with metropolitan region or with the Regional Capital B, there is no such difference looking at the salary gains promoted by Regional Capital C (for instance, Ponta Grossa) and Subregional Center A (towns like Campo Mourão and Pato Branco).

A considerable distinction comes when we compare the categories above with the Subregional Centers B, which

[25] The correct standard errors which do account for the first stage probit estimation were obtained using Stata's heckman command.

[26] These numbers confirm the human capital theory, which argues that a negative sign of the experience variable attests to decreasing (though positive) wage yields for each extra year of laborer experience (Rocha & Campos. 2007).

[27] Rocha & Campos (2007) found that the workers of Curitiba have the highest return because they are in the capital, followed by those of Londrina and Maringá respectively, although Maringá is ahead of Londrina in the income equation of the women. Regional determinants have a smaller impact on the equation of blacks and browns, and more significant in the equation for whites. However, these results should be interpreted with caveats, since in the estimation of wage equations the industrial affiliations of the employed individuals were not controlled. Evidently, the differences obtained could be more tenuous if they were controlled by disparities in the productive structure and the particularities of the industrial organization of each municipality, according to Fontes, Simões and Oliveira (2006).

bring an accrual wage equivalent to half of those from Subregional Center A (8.72% in 2a about the local centers, on average). Surprisingly, the next degree on city hierarchy, Zone Center A, presents higher wage returns (11.07% in specification 2a or 10.75% in 2b) than Subregional Center B. This means that cities like Marechal Cândido Rondon, Cornélio Procópio can offer better salaries than towns a bit larger in Paraná, such as União da Vitória. And finally, we have the Zone Center B, which brings a tiny increase in salary (0.86%), compared to the local centers. This variable, although with a small impact, was only significant and positive in version 2a. In OLS modeling, it brought negative returns to the salary (but also small). Thus, we can infer that living in a city whose size is Zone Center B does not guarantee a higher wage than in a tiny town (with less than 10 thousand people).

Before the estimations, we expected the impact of city hierarchy on wage gains to fall proportionately as the analysis turned to medium and smaller cities. However, the observed was not a decrease in cadence, but rather a fall, followed by some relative constancy.

Regarding education levels, the conclusion of each stage of scholarity adds value in the individual salary, being that the comparative is an individual who has never attended school or who did not finish elementary school. Therefore, for those who completed the basic education cycle, the salary is 23.90% higher, for those who complete high school, a 44.66% increase, and for those who hold a higher education diploma, a considerable 110.87% bonus (all in 2b). This fact further reinforces the hypothesis that sheepskin effect occurs in Brazil. In addiction, these results are quite smaller from those of Kaizt and Nakabashi (2007), who found as returnings to schooling: 43.99% to elementary school, 71.64% to high school, 168.37% to college, in relation to a person without instruction to Paraná in 2005.[28]

To the selection equation , the most effects of the variables were similar to those found on wage equation (positive and significant), with some exceptions: both primary and tertiary sector had negative coefficients, which can reflect a big presence of non-formal labor and underemployment in tertiary sector, in parallel with the manufacturing industry. In addiction, the variables that there are present in selection equation but not directly in wage equation, married and kids, have respectively, a small positive impact on work decision (which is not a consense in literature) and a huge negative coefficient to participate in labor force. We have already expected that people with children had a lower probability of being active in the labor market, but not that big. The literature presents it as common, mainly between women.[29]

And finally, the relevant imr (inverse Mills ratio or λ) was significative and negative, which indicates that there was sample selectivity bias. And more, Heckit procedure removed from the negative bias provoked by sampe selection of the income formation model from the individual characteristics of the laborer (WOOLDRIDGE, 2006).

5.2 Estimations for Santa Catarina

Table 4 - Results of the model estimations for Santa Catarina (2010) with OLS and Heckit methods

Ln wage (dependent variable)	OLS Model		Heckit Model	
	(1a)	(1b)	(2a)	(2b)
main				
Years of Schooling	0.0429***		0.0391***	
	(0.0003)		(0.0003)	
Work Experience	0.0590***	0.0616***	0.0484***	0.0525***
	(0.0007)	(0.0006)	(0.0007)	(0.0006)
WorkExper2	-0.0006***	-0.0006***	-0.0005***	-0.0005***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
race	0.1996***	0.1471***	0.2031***	0.1657***
	(0.0033)	(0.0028)	(0.0034)	(0.0028)
gender	0.3723***	0.4116***	0.3476***	0.3838***
	(0.0026)	(0.0022)	(0.0026)	(0.0023)
urban	0.1269***	0.0800***	0.1006***	0.0629***
	(0.0040)	(0.0034)	(0.0037)	(0.0031)
Primary Sector	-0.1587***	-0.1820***	-0.1300***	-0.1538***
	(0.0053)	(0.0043)	(0.0046)	(0.0038)
Tertiary Sector	0.0693***	-0.0246***	0.1261***	0.0301***
	(0.0028)	(0.0024)	(0.0050)	(0.0047)
Metropolitan Region	0.1991***	0.1550***	0.2104***	0.1754***
	(0.0043)	(0.0036)	(0.0039)	(0.0035)
Regional Capital B	0.1588***	0.1294***	0.1837***	0.1577***
	(0.0037)	(0.0032)	(0.0038)	(0.0033)
Regional Capital C	0.0851***	0.0479***	0.1100***	0.0762***
	(0.0085)	(0.0074)	(0.0078)	(0.0069)

[28] Although Kaizt and Nakabashi (2007) also used Heckman procedure, their data were from PNAD (2005), which shows some different informations about schooling, and they had less than 2 thousand observations, while our sample has more than 1.2 million to Paraná. Moreover, they used less control variables than we did. It also can reveal an expansion on educational cover in the state.

[29] By the way, when we were testing in the beginning, when the variable "kids" were also put in the wage equation, colinearity appeared with the gender variable. In addiction, many studies analyze the presence of kids in the decision of working, one of the them was Mroz (1987).

Subregional Center A	0.0701***	0.0470***	0.0980***	0.0782***
	(0.0049)	(0.0041)	(0.0048)	(0.0042)
Subregional Center B	0.1070***	0.0879***	0.1304***	0.1144***
	(0.0051)	(0.0044)	(0.0049)	(0.0043)
Zone Center A	-0.0294***	-0.0533***	0.0023	-0.0197***
	(0.0061)	(0.0052)	(0.0060)	(0.0052)
Zone Center B	0.0215***	0.0207***	0.0412***	0.0419***
	(0.0050)	(0.0044)	(0.0048)	(0.0041)
Elementary School		0.1976***		0.1859***
		(0.0030)		(0.0030)
HighSchool		0.3981***		0.3621***
		(0.0029)		(0.0032)
College		1.0417***		0.9650***
		(0.0043)		(0.0045)
Constant	4.7899***	4.8255***	5.0299***	5.0155***
	(0.0126)	(0.0109)	(0.0154)	(0.0136)
mills				
lambda			-0.1183***	-0.1078***
			(0.0072)	(0.0065)
R2 adj	0.2770	0.3449		
Number of obs	337929	427720	581317	730417
F	5630.0097	8073.9814		
Prob>F	0.0000	0.0000	0.0000	0.0000
Wald Chi2			98160.6906	160081.4541
Prob>Chi2	0.0000	0.0000	0.0000	0.0000

Notes: Heteroskedasticity robust standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01. Source: Elaborathed by the authors.

We can infer in Santa Catarina that almost all variables had their coefficients and signals coeherents as expected in the literature. The return to years of schooling was a little slightly lower than in Paraná (an increasing of 3.91% on wage for each year of study). Individuals working on farms and other primary activities tend to earn 13% less than a worker on secondary sector. Nevertheless, in relaction to this second, a person enrolled in tertiary activities, must gain 12.61% more (specification 2a). Once again, the heckit version seems to adjust the overestimations from OLS. The city hierarchy apparently reveals that the metropolitan region causes a raise on wage, however not of the same magnitude that happens in Metropolitan Region of Curitiba (which is responsible for a wage premium nearly 30%). In Big Florianópolis, this value is over 21% (version 2a). It may be related to many factors: the formal and governmental support to establish the "Florianópolis Metropolitan Region" is recent and relatively unstable; in addition to that, Florianópolis is an island and that further advances are needed in the local infrastructure to foment this conurbation with great potential. Following, we come across the Regional Capital B (relevant towns, such as Blumenau, Chapecó and Joinville), with wage addition not far from the Big Florianópolis: 18.37% in 2a.

Looking now to the next step on city scale, we can note a slight fall in the salary premium brought by living in Regional Capital Cs (11% in 2a), very similar to those derived from Subregional Center As (9.8%). Surprisingly, the wage premium given by the next category does not appear in a downward trajectory. Subregional Center B has a return of more than 13% on salary, when compared with small towns (usually less than 10 thousand people). To illustrate, it is enough to think that municipalities like Balneário Camboriú and Brusque (Subregional Center Bs) tend to offer, on average, higher wages than Criciúma (Regional Capital C) and Caçador (Subregional Center A), ceteris paribus.

While all other variables were presented as significant, the Zone Center A was the one that appeared not so in Heckit specification a. It was significant only in the specification with schooling levels (version b), but with a small and negative value. This may indicate that there are no large wage disparities between those living in a city with 45,000 inhabitants on average and size equivalent to Zone Center A (for instance, São Bento do Sul) and those who inhabit a small municipality with less than 10,000 people.

The category of city that lies between Zone Center A and the very small cities (the local centers, used here as our criterion of comparison) was not shown as irrelevant or with negative feedback, as one might imagine given the last result observed. The Zone Center B generates a salary increase of 4.12%, including cities like Ibirama and Ituporanga.

Finally, the returns to schooling degree (version 2b) on salary were: 18.59% to elementary school, 36.21% to high school and 96.50% to college.These values were a little lower than those from Paraná, but still are coherent according to the literature.[30]

Through the lambda (λ) variable, which is the estimate of the inverse Mills ratio obtained in the first stage of the Heckit, we observe the statistical significance, indicating that the Heckman method was effective in removing the

[30] Suliano and Cerqueira (2012) found that in the period 2001-2006, the return to schooling fell in the three states of Southern Brazil, being more severe the reduction in the state of Santa Catarina. This fall in the return to schooling on wage may be the result of a greater supply of skilled workers throughout the region studied.

sample selectivity bias. Moreover, in selection equation we can see some similar results comparing to Paraná, as "having kids" with a negative impact on the probability of being employed and the completed degrees of schooling exercising considerable influence over labor force participation. On the other hand, we can note some disparities: Capital Regional C had no significance in both of specifications and Zone Center A had a small and negative contribution on being on labor market, comparing with a very small city. Also with this same comparison, the variable Zone Center B, in turn, had a positive and even greater influence than some city grades above it in the urban hierarchy.

5.3 Estimations to Rio Grande do Sul

And lastly, we have the analysis for the state in the extreme south of Brazil.

Table 5 - Results of the model estimations for Rio Grande do Sul (2010) with OLS and Heckit methods

Ln wage (dependent variable)	OLS Model		Heckit Model	
	(1a)	(1b)	(2a)	(2b)
main				
Years of Schooling	0.0509***		0.0456***	
	(0.0003)		(0.0003)	
Work Experience	0.0514***	0.0544***	0.0430***	0.0519***
	(0.0006)	(0.0005)	(0.0007)	(0.0003)
WorkExper2	-0.0005***	-0.0005***	-0.0004***	-0.0005***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
race	0.2643***	0.1776***	0.2600***	0.2000***
	(0.0032)	(0.0026)	(0.0030)	(0.0026)
gender	0.3749***	0.4255***	0.3583***	0.3918***
	(0.0026)	(0.0021)	(0.0025)	(0.0020)
urban	0.1390***	0.0837***	0.0967***	0.0490***
	(0.0041)	(0.0034)	(0.0035)	(0.0030)
Primary Sector	-0.0725***	-0.0960***	-0.0808***	-0.0732***
	(0.0050)	(0.0040)	(0.0042)	(0.0036)
Tertiary Sector	0.0978***	-0.0106***	0.1349***	0.1251***
	(0.0028)	(0.0023)	(0.0050)	(0.0052)
Metropolitan Region	0.2374***	0.2078***	0.2086***	0.1961***
	(0.0032)	(0.0027)	(0.0029)	(0.0025)
Regional Capital B	0.2850***	0.2339***	0.3039***	0.2558***
	(0.0044)	(0.0037)	(0.0043)	(0.0039)
Regional Capital C	0.0490***	0.0237***	0.0736***	0.0476***
	(0.0069)	(0.0058)	(0.0065)	(0.0057)
Subregional Center A	0.1343***	0.1170***	0.1505***	0.1308***
	(0.0046)	(0.0039)	(0.0046)	(0.0040)
Subregional Center B	0.0552***	0.0286***	0.0788***	0.0461***
	(0.0101)	(0.0086)	(0.0100)	(0.0088)
Zone Center A	0.0413***	0.0444***	0.0615***	0.0602***
	(0.0042)	(0.0036)	(0.0041)	(0.0035)
Zone Center B	0.0276***	0.0379***	0.0485***	0.0511***
	(0.0043)	(0.0036)	(0.0040)	(0.0034)
Elementary School		0.2326***		0.1946***
		(0.0027)		(0.0028)
HighSchool		0.5266***		0.4286***
		(0.0026)		(0.0035)
College		1.2775***		1.0759***
		(0.0043)		(0.0050)
Constant	4.5702***	4.6243***	4.8308***	4.7746***
	(0.0113)	(0.0098)	(0.0151)	(0.0083)
mills				
lambda			-0.0918***	-0.1837***
			(0.0069)	(0.0056)
R2 adj	0.2674	0.3633		
Number of obs	506347	646735	934650	1181663
F	7137.1373	11379.2329		
Prob>F	0.0000	0.0000	0.0000	0.0000
Wald Chi2			131140.7580	248075.4204
Prob>Chi2	0.0000	0.0000	0.0000	0.0000

Notes: Heteroskedasticity robust standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01. Source: Elaborated by the authors.

Most of the variables behaved as expected and also similarly to the other southern states. Each year of schooling brings an increasing of 4.56% on wage, on average. On primary sector, people tend to have a salary 8.08% lower than a worker in the manufacturing industry, while a person employed on tertiary sector lean to receive 13.49% more

compared with the last one (specification 2a).

For the first time, the Metropolitan Region was not the one that brought the greatest increase in absolute values in the hierarchy of cities. Although in the states of Paraná and Santa Catarina, the salary difference between the metropolis and the Regional Capital B was tiny, the metropolitan region was still the one that better paid its workers, on average. In Rio Grande do Sul, besides the Regional Capital B (cities as Caxias do Sul, Passo Fundo and Santa Maria) it is the one that provides the state's highest wages, ceteris paribus, the wage gap between them and the metropolitan region of Porto Alegre is substantial (30.39% and 20.86% of raise on salary, respectively). As for the Regional Capital C, a large drop in wage increase, adding only 7.36% in value (version 2a). Another counter-result was the one obtained in Subregional Center A (15.05% in 2a), with the wage premium higher than that brought by municipalities with size in a grade above. People in cities like Pelotas and Novo Hamburgo probably earn less than those in Bagé, Bento Gonçalves and Uruguaiana, for instance. Even Subregional Center B brings an increment in income slightly higher than in Regional Capital C (7.88% in 2a). The gains promoted by both Zone Center A and Zone Center B (6.15% and 4.85%) were positive and proportionally smaller, as expected, in comparison with little cities (Local Centers).

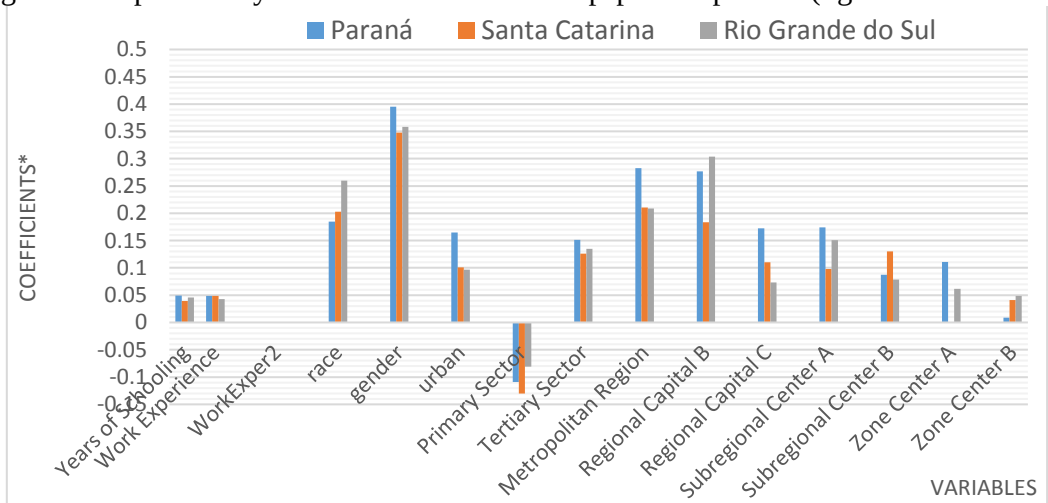
Through version 2b, we may note that the levels of schooling aggregate much on salary, more than doubling at each stage completed, also endorsing the hypothesis of the diploma effect. Finally, the lambda or inverse Mills ratio was significative and negative, which indicates that there was sample selectivity bias, and by the way, Heckit procedure vanished the negative bias caused by sample selection.

Of all the three states in analysis, Rio Grande do Sul was the one that presented the smallest influences of the categorization of the cities in the probability of the person having an occupation. The other variables presented similar results to those observed in the other two southern states, with a great strength of the levels of schooling completed for the definition of the selection equation, mainly to tertiary education.

5.4 Summary of the results and a brief comparison between the southern states

In this section, as we were already doing, we will compare the results between the three states and sumary the outcomes, through a table and a graphic. We chose the Heckit model with version 2.a to do this review.

Figure 2 - Graphical analysis about the results to whole population per state (significant coefficients)



Notes: Only the significant coefficients (at least at 10%) were displayed on the graph. The constants were significant, but they would disturb the visualization. Source: Elaborated by the author.

Through figure 2, we can observe that the most of results were according to the expected, like positive coefficients to years of schooling, work experience, race (white), gender (male), urban, tertiary sector (comparison to secondary sector) and all the urban hierarchy categories (in relation to local centers); and negative coefficients to work experience squared, primary sector (comparing with transformation industry). However, we imagined before the estimations, that this graph, from Metropolitan Region until Zone Center B would appear in a ladder format, from the highest step until the smallest in the three southern states (indicating a "traditional" urban hierarchy). Or the first step smaller, the second (or third) higher, and then the others progressively smaller (representing a certain urban sprawl). Even this shape can be seen in a certain way, the "steps" don't go down proportionally. Paraná presents the biggest returns on wage in its metropolitan region ("Big Curitiba"), regional capitals C (Ponta Grossa and Ijuí), subregional centers A (towns like Foz do Iguaçu, Campo Mourão, Paranaguá, Guarapuava and Toledo) and zone centers A (cities as Cornélio Procópio and Jandaia do Sul), while Santa Catarina in its suberegional centers B (as Balneário Camboriú and Brusque), and Rio Grande do Sul have the biggest increments on salary in its regional capitals B (Caxias do Sul, Passo Fundo and Santa Maria) and Zone Centers B (cities like Santana do Livramento and Getúlio Vargas), in comparison with the other southern states.

Analyzing the whole population we also had some outcomes less representative. Living in a Zone Center A inside the Santa Catarina Federative unit, it does not seem to affect the salary gains at all and housing some Zone Center B inside Paraná, it does not differ too much the labor earnings from Local Centers.

There is not yet a similar paper with hierarchical classification for the southern region of Brazil so that we can draw many comparisons, only some studies looking at certain states of the Northeast and Southeast regions, but they usually put only one dummy variable about the house place to belong or not to the metropolitan area. Cirino and Dalberto (2015) made one of these studies and our results go some way towards theirs. These authors point out that the magnitude generated by the locational question regarding the personal attributes of wage differentiation is the basis for studies on the spatial inequality of income. This is insofar as the analysis of the relationship between the place of residence (Metropolitan Region of Aracaju and other municipalities in Sergipe) and the characteristics of the individuals (gender, race, education, age and labor market situation) provide indicators that allow the measurement of magnitude. As main evidence, it is worth noting that the decomposition revealed that the place is the main attribute that implies greater effect on the individual income. In this regard, Cirino and Lima (2016) found that the hourly earnings of individuals located in the Metropolitan Region of Belo Horizonte (capital of Minas Gerais state) were, on average, higher than those from Metropolitan Region of Salvador (capital of Bahia state). They focused on the importance of a region with economic dynamism marked by the development of industrial activities, the service sector with the largest concentration of formal jobs with a considerable salary level, followed by better job opportunities compared to regions with little productive and economic dynamism. The largest clusters of enterprises connected to the service and industrial sectors are in the Metropolitan Region of Aracaju, endorsing the effects of attraction of skilled labor (as approached by the theory of human capital).

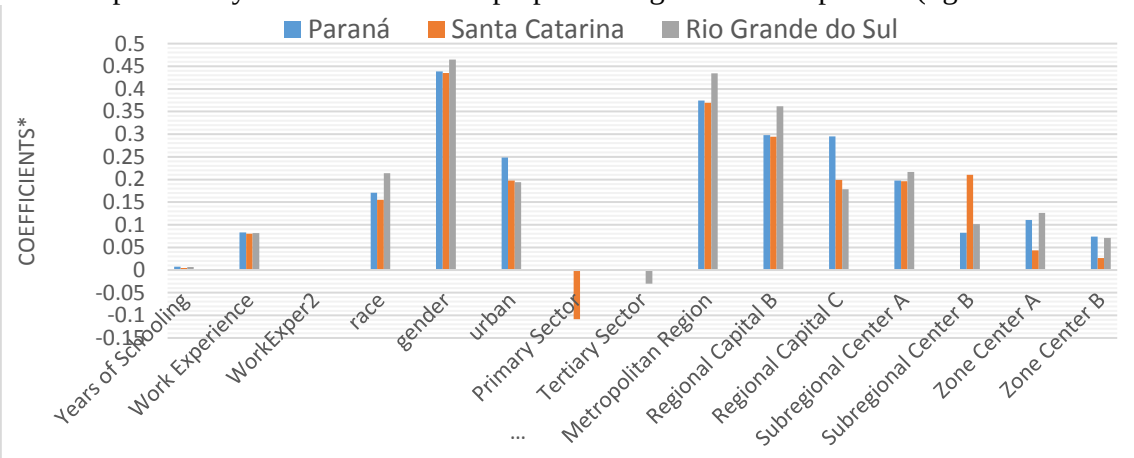
We observe that in southern region, we have certain concentration of industries and tertiary sector activities in the 3 metropolitan areas, but we also have many medium-sized cities competing with the state capitals, in addition to other classes of towns that are representative, exerting influence in the surroundings and that spread investment, employment and income throughout the southern region.

On the other hand, we wonder if our results would be the same if we look at some parts of society, as splitting by educational level. This way, we want to check if people with full college would be more impacted by the level of the city in which they live, since we do not expect their salary gains to behave in the same way as an individual of low schooling, who tends to have a lower cost of opporunity and a lower reserve salary as well. Therefore, this last assay will deal with the population group who has a sheepskin.

5.5 Analysis of sheepskin effect for the three southern states

To investigate whether people with higher education levels tend to be better rewarded in larger cities, or if the returns brought by the city category are the same as those shown for the entire population, we considered only the people with a diploma. Thus, we applied the mincerian model here exposed in the OLS method, once in all the three states, the lambda (imr) was not significant with heckit procedure.

Figure 3 - Graphical analysis about the results to people with higher education per state (significant coefficients)



Notes: Only the significant coefficients (at least at 10%) were exhibed on the graphic. The constants were significant, but they would disturb the visualization. Source: Elaborated by the author.

Now with figure 3, regarding the values coming from the population with at least 15 years of schooling (and bachelor degree), it is possible to verify that most of the variables presented behaviors as previously expected. The marginal gain from each additional year was tiny when compared to that one from the analysis with the population of all types of schooling. The confrontation between the sectors of the economy was not very significant on this parsing, while the divisions in city hierarchy seem to bring stronger wage gaps to all southern states. Looking at the marginal effects in Paraná, each additional year of schooling to a bachelor leads to a small salary increase of 0.7%. The Metropolitan Region of Curitiba may raise the salary in more than 37%, Regional Capitals B and C also may cause a considerable increment, nearly to 30%. From the Subregional Center A to the Zone Center B, wage returns are decreasing proportionally (but the Zone Center A presents a slightly raise), all of which remain positive and significant. This reinforces the idea about the sheepskin effect and also when the person has a high level of scholarity, he will try to capture the highest salary as possible, probably migrating to a bigger town (if it is necessary, or working in a neighbour

city, usually inside the metropolitan region). In some city categories, we saw in section 5.1 that sometimes, the wage gap between them is small or even non-existent (like between Regional Capital C and Subregional Center A in Paraná, for instance) when we are analyzing the whole sample (all the people over ten years). However, when we research about the people with tertiary education, we found that the wage differences caused by the size of the city are more dissimilar and generally higher in absolute values. So, probably, the worker without or with lower schooling is less affected by the town in which he lives, having a lower opportunity cost, than a holder of a sheepskin.

The two other federal units had similar results, including the Rio Grande do Sul, where the "Big Porto Alegre" reached a surprisingly return of 43.47% on wage, contrary to what we found in section 5.c, when this metropolitan region had lower earnings than those provided by the category below, Regional Capital B. Not only in the metropolis, but also in Regional Capitals B (like Caxias do Sul and Santa Maria), Subregional Centers A (Bagé, Bento Gonçalves) and Zone Centers A (Guaporé, Monte Negro, etc) in Rio Grande do Sul are prone to offer better salaries to graduates than in the equivalent cities of the other two southern states. In Santa Catarina, the Florianópolis Metropolitan Region, where sometime aggregated the wage increase by 21.04% (version 2.a or 17.54% in 2.b), now contributes almost 37%. Also in Santa Catarina, the Subregional Centers B (municipalities as Videira, Mafra, Balneário Camboriú and Brusque) tend to compensate its graduated workers with a wage reward of around 21% more than the Local Centers (*ceteris paribus*), even slightly surpassing the salary differentials found in the two categories above in the city hierarchy (Regional Capital C and Subregional Center A).

This kind of anlysis may guide private and public policies to observe where people with higher education are more remunerated and investigate the reasons why it happens, whether it means a high demand for skilled labor and low supply of this type of worker. There may be indications that there are few universities in these localities and/or that this type of city needs to offer a very high salary to attract a higher qualifying individual, thereby providing a kind of salary bonus to compensate for moving to that location and even to keep him there.

Wherefore, we can conclude that the sheepskin effect is verified in southern Brazil when we observe the differential that it brings to each type of town, showing that it is not enough only the years of study, but also the educational title to capture greater effects on income.

6. FINAL CONSIDERATIONS

The Brazilian economy, as we know, is extremely unequal both at the individual and regional level. This study sought to verify the magnitude of the variability wage can be attributed to individual characteristics and can be assigned to the type of region the person is living. The first conclusion arrives at that much of the wage variability found in the South Brazilian economy can be related to the city sizes and categories, looking at population, infraestructure and influence network.

Agglomeration economies are defined as external economies of scale, representing productivity gains generated by the concentration of economic agents in space. In this context, Glaeser and Gottlieb (2009) associate them to the reduction of transportation costs of goods (greater proximity between intermediate goods supply and demand), people (labor markets are more efficient in urban areas and service providers have greater access to their clients), and ideas (stronger knowledge exchange between people and firms).

Thus, aiming to investigate how the agglomeration affect people's wage, we did OLS and Heckit method to two mincer equations to each one (two especifications about years of schooling and educational degree). Moreover, we adapted the REGIC classification of the cities in order to capture the municipality size, not only taking into the number of inhabitans.

Firstly, looking to the whole population, Paraná shown the biggest returns on wage in its metropolitan region ("Big Curitiba"), regional capitals C (Ponta Grossa and Ijuí), subregional centers A (towns like Foz do Iguaçu, Campo Mourão, Paranaguá, Guarapuava and Toledo) and zone centers A (cities as Cornélio Procópio and Jandaia do Sul), while Santa Catarina just in its suberegional centers B (as Balneário Camboriú and Brusque), and Rio Grande do Sul have the biggest increments on salary in its regional capitals B (Caxias do Sul, Passo Fundo and Santa Maria) and Zone Centers B (cities like Santana do Livramento and Getúlio Vargas), when we parallel the three southern states.

Secondly, analyzing the people with higher education throughout the southregion, Paraná only had the highest returns on salary in its Regional Capital C (Ponta Grossa) and Zone Centers B (example of cities: Matinhos and Prudentópolis), Santa Catina again just in its Subregional Centers B, while Rio Grande do Sul seems to endorse the sheepskin effect, showing considerable wage gaps in its Metropolitan Region (Porto Alegre), Regional Capitals B (Caxias do Sul, Santa Maria), Subregional Centers A (examples: Bagé, Bento Gonçalves, Uruguaiana) and Zone Centers A (Venâncio Aires, São Borja, Guaporé, etc).

In general, we did not find a perfect ladder on the results to regional wage premium from the highest "step" (Metropolis) until the last step (Zone Center B) in the model with whole population on the three southern states. When we look only to people with higher education, we can observe somehow a ladder format, besides the wage gaps among the types of cities are bigger. The towns do not want to lose qualified human capital, offering higher salaries to remain the already residents and to attract the new ones. The oppotunity cost of a person who spent many years in formal education, achieved at least a college degree and lives in a tiny city, such as local centers in Southern Brazil is very high,

much more than a person who has never been to school or not completed the basic education. Accordingly, the city size where the citizen dwells/works matters more the more educated the person is.

Although most categories of municipalities above Local Centers still positively influence personal salaries, neither for the sample of the whole population nor for the profile of graduates, it is possible to see that old phase of traditional urban agglomeration, in which the metropolis would offer the highest wages, and all categories below it, would proportionately offer less and less. Thus, the maxim "the greater the city, the higher the salary" can not be absolutly verified in any of the three southern states, although some patterns are formed between the two, three first city ranks and the last.

People have no borders and urban evolution has demonstrated the practical need for integrated regional planning. This is the case with the southern cities in Brazil. We hope this paper may help private and public policies to concern about which sectors and which regions need more investiments, ocasionating spillovers and contributing to the development of southern Brazil. Besides, the sheepskin effect reveal that there is still space to invest in higher education institutions.

To future papers, we suggest the analysis with Oaxaca-Blinder decompositions and also some spatial econometric models to binary choice, which are relatively new, such as spatial probit and spatial logit.

7. REFERENCES

ALMEIDA, W. S.; BESARRIA, C. N. Diferenciais de rendimento por gênero e raça no mercado de trabalho nordestino: uma análise via regressões quantílicas e decomposição de Oaxaca-Blinder (1973). In: *Anais* do X Encontro de Economia Baiana, Salvador, Bahia, 2014.

ALVARADO, Rafael. **Wages differentials in Ecuador:** A regional approach with sample selection of Heckman and Oaxaca-Blinder decomposition. Munich Personal RePEc Archive (MPRA) paper No. 37470, posted 20. March 2012.

AZZONI, C. R. Economic growth and regional income inequality in Brazil. The Annals of Regional Science, 35 (1): 133 – 152, 2001.

BECKER, G. (1964), Human Capital - A Theoretical and Empirical Analysis with Special Reference to Education, Columbia University Press, Chicago.

BEBLO, M., BENINGER, D., HEINZE, A., & LAISNEY, F. Measuring selectivity-corrected gender wage gaps in the EU. No. 03-74. ZEW Discussion Papers, 2003.

BLACKABY, D. AND MANNING, D. (1990) The north-south divide: questions of existence and stability? *The Economic Journal, n.*100, 510-527.

BLACKABY ,D. AND MURPHY, P. (1995) Earnings, unemployment and Britain's north-south divide: real or imaginary? *Oxford Bulletin of Economics and Statistics, n.* 57, 4, 487-512.

BRASIL. Instituto Brasileiro de Geografia Estatística. **Regiões de Influência das Cidades (REGIC)**. Rio de Janeiro, 2007.

CAMERON, A. C.; TRIVEDI, P. K. **Microeconometrics using stata.** [S. l.]: Stata Press, 2009. 691p.

CAMPOS, F. M.; NETO, R. M. A importância da dimensão do mercado de trabalho para os diferenciais de participação e salários entre gêneros: uma análise empírica para os centros urbanos brasileiros. In: *Anais* do XXXVII Encontro Nacional de Economia - ANPEC, Foz do Iguaçu, Paraná, 2009.

CAVALIERI, C. H.; FERNANDES, R. Diferenciais de salários por gênero e por cor: uma comparação entre regiões metropolitanas brasileiras. *Revista de Economia Política*, v. 18, n. 1, p. 158-175, 1998.

CIRINO, J. F.; DALBERTO, C. R. Trabalhadores formais versus informais: diferenças de rendimento para a região metropolitana de Belo Horizonte. *Perspectiva Econômica*, v. 11, n. 2, p. 81-94, 2015.

CIRINO, J. F.; LIMA, J. E. Diferenças de rendimento entre as regiões metropolitanas de Belo Horizonte e Salvador: uma discussão a partir da decomposição de Oaxaca-Blinder. *Revista Econômica do Nordeste*, v. 43, n. 2, p. 371-389, 2016.

CITY HALL OF CURITIBA (PREFEITURA DE CURITIBA). Região metropolina de Curitiba – RMC. Available on: www.curitiba.pr.gov.br/conteudo/titulo-regiao-metropolitana-de-curitiba/2666. Acessed in May 27, 2018.

COELHO, D.; VESZTEG, R.; SOARES, F. V. Regressão Quantílica com correção para a seletividade amostral: estimativas dos retornos educacionais e diferenciais raciais na distribuição de salários das mulheres no Brasil. Instituto de Pesquisa Econômica Aplicada, Brasília: IPEA, 2010. (Texto para Discussão, n. 1.483).

COMBES, Pierre-Philippe; GOBILLON, Laurent. The empirics of agglomeration economies. In: **Handbook of regional and urban economics**. Elsevier, 2015. p. 247-348.

CRESPO, A.; REIS, M. C. Sheepskin effects and the relationship between earnings and education: analyzing their evolution over time in Brazil. **Revista Brasileira de Economia**, Rio de Janeiro, v. 63, n. 3, p. 209-2031, Julho-Setembro 2009.

DESCHAMPS, M., CINTRA, A., DELGADO, P., & MOURA, R. (2008). Quantificação e mapeamento dos movimentos pendulares dos municípios do Estado do Paraná-2000. *Curitiba: IPARDES.*

FREGUGLIA, R. S.; MENEZES-FILHO, N. A. Inter-regional wage differentials with individual heterogeneity: evidence from Brazil. *The Annals of Regional Science*, v. 49, n. 1, p.17-34, 2012. ISSN 1432-0592.

FONTES, G. G.; SIMÕES, R. F.; OLIVEIRA, A. M. H. C. de. **Diferenciais regionais de salário no Brasil, 1991 e 2000:** uma aplicação dos modelos hierárquicos. Anais do XXXIV Encontro Nacional de Economia, ANPEC, v. 34, 2006.

GARCÍA I, MOLINA J. A. (2002) Inter-regional wage differentials in Spain, Applied Economics Letters, 9: 209-215.

GLAESER, E.L.; GOTTLIEB, J.D. The wealth of cities: agglomeration economies and spatial equilibrium in the United States. *NBER Working Paper* 14806, 2009.

GLAESER, E. L.; MARÉ, D. C. Cities and skills. *Journal of Labor Economics*, v. l9, n. 2, p. 316- 342, 2001.

HECKMAN, J. J. Sample selection bias as a specification error (with an application to the estimation of labour supply

functions). *Econometrica*, v. 47, n. 1, p.153-161, 1979.
HECKMAN, J., TOBIAS, J. L., & VYTLACIL, E. Simple estimators for treatment parameters in a latent variable framework with an application to estimating the returns to schooling. **NBER Working Paper**, 7950., 2000.
HIRSCHMAN, A. O. *The strategy of economic development*. New Haven: Yale University Press, 1958.
HOFFMANN, Rodolfo; NEY, M. G. Desigualdade, escolaridade e rendimentos na agricultura, indústria e serviços, de 1992 a 2002. ***Economia e Sociedade***, Campinas, v. 13, n. 2, p. 51-79, 2004.
JACINTO, P. de A.; RODEGHIERO, L. B. Retorno em escolaridade: um estudo para a região metropolitana de Porto Alegre. **Revista Brasileira de Estudos Regionais e Urbanos**, v. 6, n. 1, p. 37-56, 2012.
LUCAS, R. E. On the mechanics of economic development, Journal of Monetary Economics, 22(1): 3-42, 1988.
MADDALA, G.S. (1983) Limited-Dependent and Qualitative Variables in Econometrics. Cambridge University Press.
_____. Introdução à Econometria.3ª. ed., Editora LTC: Rio de Janeiro, p. 318, 2003.
MARSHALL, A. (1890) Principles of Economics. Macmillan.
MENEZES-FILHO, N. A.; FERNANDES, R.; PICCHETTI, P. Educação e queda recente da desigualdade no Brasil. In: BARROS, R. P.; FOGUEL, M. N.; ULYSSEA, G. (Org.). *Desigualdade de renda no Brasil*: uma análise da queda recente. Brasília: IPEA, 2007.
MINCER, J. (1958), Investment in Human Capital and Personal Income Distribution, Journal of Political Economy, 66(4), 281-302.
MINCER, J. (1974) Schooling, experience and earnings, New York: National Bureau for Economic Research.
MORETTI, Enrico (2013) "Real Wage Inequality," *American Economic Journal: Applied Economics* 5(1), pp. 65-103.
MOTELLÓN E, LÓPEZ-BAZO E, EL-ATTAR M (2009). Regional heterogeneity in wage distributions: Evidence from Spain. Research Institute of Applied Economics Working Paper 2009/03.
MROZ, Thomas A. The sensitivity of an empirical model of married women's hours of work to economic and statistical assumptions. **Econometrica: Journal of the Econometric Society**, p. 765-799, 1987.
NEAL, D. The measured black-white wage gap among women is too small. **Journal of Political Economy**, 112(1): S1-S28, 2004.
OLIVEIRA, F. R., CASAGRANDE, D. L., STUDART, G., DA SILVA, I. B., & GUIMARÃES, P. H. M. (2015). Salário, educação e experiência: Uma abordagem econométrica. *Revista Nexos Econômicos*, *9*(2), 7-20.
PEREIRA J, GALEGO A (2007) Regional wage differentials: static and dynamic approaches. Cefage. UE – Working paper 2007/07
PORTER M. (1990) The Competitive Advantage of Nations, Free Press, New York.
QUEIROZ, Bernardo Lanza; CÉSAR, Cibele Comini. Dinâmica econômica, mercado de trabalho e diferenciais de salários nos estados brasileiros. Anais ABEP, p. 1-28, 2016.
RIBEIRO, L. C. de Q. **Observatório das Metrópoles**: território, coesão social e governança democrática. IPPUR/UFRJ, 2005.
REIS, M. C.; RAMOS, L. Escolaridade dos pais, desempenho no mercado de trabalho e desigualdade de rendimentos. **Revista Brasileira de Economia**, Rio de Janeiro, v. 65, n. 2, p. 177-205, Abril/Junho 2011.
RESNIK, D. B. (2010). Urban Sprawl, Smart Growth, and Deliberative Democracy. *American Journal of Public Health*, *100*(10), 1852–1856. http://doi.org/10.2105/AJPH.2009.182501
ROCHA, M. A.A.; DE SOUZA CAMPOS, M. de F.. Desigualdades salariais no mercado de trabalho urbano no Paraná: uma aplicação da metodologia de Heckman. **Revista Paranaense de Desenvolvimento-RPD**, n. 112, p. 47-71, 2011.
SACHSIDA, A.; LOUREIRO, P. R. A.; MENDONÇA, M. J. Um Estudo Sobre Retorno em Escolaridade no Brasil. **Revista Brasileira de Economia**, Rio de Janeiro, v. 58, n. 2, p. 249- 265, Abril/Junho 2004.
SACHSIDA, A.; MENDONÇA, M. J. C.; LOUREIRO, P. R. A. Wage punishment and place of residence. **Econ. aplic**., São Paulo, v. 12, n. 3, p. 443-461, JULHO-SETEMBRO 2008.
SALVATO, Márcio Antônio; SILVA, Denis Gomes. O impacto da educação nos rendimentos do trabalhador: uma análise para região metropolitana de belo horizonte. SEMINÁRIO SOBRE A ECONOMIA MINEIRA, XIII, Anais, 2008.
SALVATO, M. A.; FERREIRA, P. C. G.; DUARTE, A. J. M. O impacto da escolaridade sobre a distribição de renda. *Estudos Econômicos*, v. 40, n. 4, p. 753-791, 2010.
SCHERER, C. E. M. **Polarização e centralidade:** uma análise para a rede de cidades brasileira com foco nas cidades médias (2000-2010). Tese de da Faculdade de Ciências Econômicas da Universidade Federal de Minas Gerais, CEDEPLAR/UFMG, Belo Horizonte – MG, março de 2018.
SILVA, D. L. G.; SANTOS, G. F.; FREGUGLIA, R. S. Distribuição espacial dos efeitos de aglomeração sobre os retornos à educação no Brasil entre 1995 e 2008. *Pesquisa e Planejamento Econômico*, v. 46, n. 2, p. 7-46, 2016.
SÖDERBOM, Mâns. ERSA Training Workshop Lecture 5: Estimation of Binary Choice Models with Panel Data, 2009.
SOUZA, L. R. S.; RIBEIRO, L. C. de S.; LOPES, T. H. C. R. DIFERENCIAÇÃO SALARIAL NO ESTADO DE SERGIPE: UMA ANÁLISE ENTRE A REGIÃO METROPOLITANA DE ARACAJU E OS DEMAIS MUNICÍPIOS. **Revista Brasileira de Estudos Regionais e Urbanos**, v. 12, n. 1, p. 1-16, 2018.
SULIANO, D.C.; SIQUEIRA, M.L. (2012) Retornos à educação no Brasil em âmbito regional considerando um ambiente de menor desigualdade. **Economia Aplicada**, v.16, n.1.
WILLIAMSON, J. G. (1965). Regional inequality and the process of national development: a description of patterns, Economic Development and Cultural Change, 13, 1 – 84.
WOOLDRIDGE, Jeffrey. M.(2002) Econometric Analysis of Cross Section and Panel Data. **The MIT Press 0**, v. 5, n. 1.
YANKOW, J. J. Why do cities pay more? An empirical examination of some competing theories of the urban wage premium. *Journal of Urban Economics*, v. 60, n. 2, p. 139-161, 2006.