Real wages in Colombia: a conditional convergence analysis: 1984-2009[1]

Salarios reales en Colombia: un análisis de convergencia condicional: 1984-2009

Salários reais na Colômbia: uma análise de convergência condicional: 1984-2009

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Resumen:

Este artículo tiene como objetivo estudiar la convergencia sigma condicional empleando microdatos. Se utilizan las encuestas de hogares de 1984 a 2009 para obtener los salarios de los empleados del sector privado. Con esta información se calcula la contribución que tienen las principales ciudades del país en las desigualdades totales, empleando la descomposición del índice de Theil. Utilizando métodos de remuestreo se construyen intervalos de confianza para el componente interregional de este índice, encontrándose que dicho componente es significativo, y no se reduce a través del tiempo. Por ello, de acuerdo con los resultados del ejercicio se encuentra que no hay evidencia de convergencia sigma condicional. Posteriormente, se evalúan los determinantes micro-económicos de salarios, en un modelo minceriano. Los resultados indican que existen diferenciales significativos, al realizar control con dichos determinantes. Ello se toma como evidencia para rechazar la hipótesis de convergencia sigma condicional en los salarios de las principales ciudades del país.

Palabras clave: Mercado Laboral, Colombia, Salarios, Convergencia Sigma Condicional, Desigualdades Regionales.

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Abstract:

This study aims to study conditional sigma convergence using micro data. To this end, we use Colombian household surveys from 1984 to 2009 to calculate real wages for private sector employees. These data are used to calculate the share of total inequalities, measured by Theil index that can be attributed to interregional disparities. Bootstrapping methods are used to calculate confidence intervals for the interregional component of the Theil index. Results indicate that this component is statistically significant, and that it has not reduced through time. Thus, the findings do not support the convergence hypothesis in this respect. Results from a Mincer-type model that is used to study the microeconomic determinants of wages indicate that, after controlling for those determinants in the wage equation, significant differentials still remain. This provides evidence to reject the hypothesis of conditional sigma convergence in real wages for the main cities in the country.

Key words: Labor Market, Colombia, Wages, Conditional Sigma Convergence, Regional Inequalities.

JEL Classification: J31, R00, F20

Resumo:

Este artigo tem como objetivo estudar a convergência sigma condicional, usando microdados. Utilizam-se as enquetes de lares de 1984 a 2009 para obter os salários dos trabalhadores do setor privado. Com essa informação, calcula-se a contribuição que tem as principais cidades do país nas desigualdades totais, usando a decomposição do índice de Theil. Com os métodos de reamostragem constroem-se intervalos de confiança para o componente inter-regional deste índice, permitindo afirmar que o componente é significativo, não se reduzindo através do tempo. Segundo os dados, evidencia-se que não há convergência sigma condicional. Por outro lado, avaliam-se os determinantes microeconômicos de salários, a partir de um modelo minceriano. Os resultados indicam que existem diferencias importantes, ao se realizar controle com estes determinantes, o qual constitui uma evidência para rejeitar a hipótese de convergência sigma condicional nos salários das principais cidades do país.

Palavras-chave: Mercado de Trabalho, Colômbia, Convergência Sigma Condicional, Desigualdades Regionais

1. Introduction

Convergence matters because it is related to income distribution. From a policy perspective, having unequal income distribution becomes a more important matter of concern when there are no signs of convergence, as levels of inequality may not decrease. Inequalities and the convergence hypothesis has been studied in Colombia using GDP per capita, income, and banking deposits per capita, among others. Wages in this work are used because they are a better measure of the income in the country's

regions and they have a more direct relationship with living conditions than variables such as per capita GDP. This is because departments that are mainly dependent on mining have a per capita GDP above average, but earned income is not necessarily high due to the high participation of the capital in the inputs. Moreover, GDP is not netted out from taxes.

The questions that guided the study are the following: Are there any significant differences in regional wages? If so, how do these differences evolve over time? To answer these questions, this document uses the analysis of micro-data to calculate average wages and estimate the difference among cities. Besides, to capture the difference of wages in each city, fixed effects are included per city, taking Bogotá as a reference. This way, fixed effects represent the average conditional difference in each city in respect to Bogotá. The methodology evaluates if these differentials are maintained after controlling by other factors, which include characteristics of the workers and the sector where they are employed.

This study is different from previous focus such as those of Cárdenas et al. (1993), Bonet and Meisel (1999), Rocha and Vivas (1998) among others, which were centered in conditioned beta, β convergence, non conditional β and sigma convergence,σ, using per capita GDP. Non conditional β convergence exists when there is a negative relation between the growth rates and the initial income. When this negative relation is found once controlled for the attributes of economies, one talks about conditional β convergence. Sigma convergence, on its part, refers to the reduction of dispersion of income measured though the variation coefficient or Theil's index, among others.

The objective of this paper is to determine if the real wages are converging, expanding former works through the conditional sigma convergence, seen in time series and cross-sectional data, including controls by the sample selection bias, based in the estimation of hedonic models. Alternate definitions of conditional sigma convergence are proposed, following the distinction used by Barro and Sala-I-Martin (1991) to differentiate conditional β and non conditional convergence.

The first part of the document describes the average behavior of wages in the principal cities in the country, and proposes a conditional sigma convergence measurement evaluating the contribution that the different cities have to wage differentials. For this objective, the paper shows, in the first place, the decomposition of Theil's index, calculating the between and within inequalities using the micro-data of the household surveys. The second part of the study estimates hedonic models that allow the calculation of conditional wage differentials in the regions. It is argued that this focus allows a better understanding of the behavior of the labor market in terms of wage compensation. This section also uses the micro-data of the household surveys to analyze the differences in compensation. For the above, corrections can be implemented for selection bias with Heckman's methodology (1979, 1980), which improves the results in relation to the simple use of the average wages. Section three reviews previous literature dealing with income convergence in Colombia. Section four describes the data used. Section five presents the results of the empirical exercises. Section six concludes.

2. Theoretical and Methodological Framework

2.1 Convergence Hypothesis

Since the decade of 1980 there has been a growing interest on the hypothesis of the convergence of the level of income of poorer economies with that of the more prosperous ones (Abramovitz, 1986; Romer, 1986; Lucas, 1988; Barro and Sala-I-Martin, 1990).

Barro and Sala-I-Martin (1990) made one of the most influential contributions to the literature on growth and convergence, both from a theoretical perspective as well as from an empirical one. Convergence hypothesis can be understood as an inverse relationship between the level of capital and its rate of growth. In other words, poorer economies will grow faster than richer economies. This relationship is expressed in terms of the per capita GDP by formulating:

$$\left(\frac{1}{T}\right) log\left(\frac{Y_t}{Y_0}\right) = \alpha - log(Y_0) \cdot \left[\left(1 - e^{-\beta T}\right) \cdot \left(\frac{1}{T}\right)\right] + \varepsilon_t \qquad (1)$$

Where T is the time period, Y_0 and Y_t are, respectively, the initial GDP and the GDP at the end of the period.

In the last expression β represents the rate at which the economy approximates the steady state, that is, the speed of convergence. Absolute convergence holds if the sign of the β coefficient is positive. If the β coefficient is negative there is divergence in per-capita GDP. It must be stressed that absolute convergence makes sense when all the countries or regions in a sample are approximating to a similar steady state. When this is not the case, the analysis refers to the hypothesis of conditional convergence. This hypothesis poses that the approximation to the steady state will hold conditional on other variables that affect the growth process.

More importantly, although the presence of β convergence is a necessary condition for the reduction in disparities in per-capita GDP, it is not a sufficient condition. It is the sigma σ, convergence that tells us if the dispersion is increasing or not. The σ coefficient is often estimated by the coefficient of variation of per-capita GDP.

In the empirical literature Barro and Sala-I-Martin's work on growth and convergence has inspired a large number of applications (Barro, 1991; Barro and Sala-I-Martin, 1991; Neven and Gouyette, 1995; Carlino and Mills, 1993, Bernard and Jones, 1996, Rey and Montouri, 1999). Different methodologies have evaluated beta convergence in the average income or the reduction of disparities by means of the sigma convergence.

The literature on integration of the labor market and convergence has pointed out the price difference between two or more markets as evidence of segmentation. Dickie and Gerking (1988) pose two possibilities for income convergence. In the first place, the strong convergence in which the non conditional mean wages or income converge among regions; weak convergence, on the other hand, corresponds to the case where the median conditional (controlling by determining attributes of differentials) converges among regions. Different studies show that strong convergence is generally not

observed; such is the case of Dickie and Gerking (1988) for Canada, Blackaby and Manning (1990) for the United Kingdom, and Montgomery (1992) for the North American economy.

"Strong" convergence is related with the concept of sigma convergence. In our case, we will refer to the unconditional sigma convergence in this respect. "Weak" convergence is approached in this study from the definition of conditional sigma convergence. With this concept we will refer to the reduction of disparities controlling by additional factors, to analyze convergence. This point follows the logic of Barro and Sala-I-Martin (1991) with the differentiation between conditional and unconditional beta convergence.

The first focus to approach conditional sigma convergence consists in calculating the participation of interregional inequalities in total inequalities. This procedure takes place with the decomposition of Theil's index in its interregional and intraregional components.

2.2 Conditional Sigma Convergence

The analysis of inequalities among regions is accomplished through the decomposition of Theil's index in its intra and interregional components, following the spatial decomposition used by Rey (2001). The decomposition of Rey's index is given by the expression of a number of groups or cities, as:

$$T = \sum_{g=1}^{G} s_g log\left(\frac{n}{n_g s_g}\right) + \sum_{g=1}^{G} s_g \sum_{i \in g} s_{i,g} log(n_g s_{i,g}) \qquad (2)$$

Where s_g is the participation of the salary in the total salary of the group or the g city; n_g is the number of observations of g city and $s_{i,g}$ is the participation of the individual $i's$ salary in g city. The first term of the equation (2) corresponds to interregional inequalities and the second one to intraregional inequalities.

The decomposition of inequalities by means of the Theil's index permits the calculation of which part of total inequalities is explained by the inequalities between the cities analyzed. This way it is possible to evaluate the importance of the regional component of inequalities.

Because distribution of the components is unknown, in order to evaluate the statistical significance of each component, the distribution of the interregional component is simulated to evaluate the significance of the localization effect of the income concentration patterns. The procedure consists in generating a random distribution of individuals among the cities considered using the bootstrapping or resampling method to obtain the distribution percentages and determine if the calculated amount is statistically significant.

Due to the fact that we are generating a distribution of randomly allocated individuals in space, they are also relocated in the simulations together with the expansion factors, and therefore we can distort the calculation of the size of the population in each city, which would add an additional source of variability in the results. To avoid

this inconvenience, we use the expanded sample in such a way that the number of individuals located in each city is not altered, but only their spatial location. In this case the result would yield what would be the income concentration if individuals were shifted randomly between cities.

The interregional component of Theil's index is calculated in every wave of the survey and it is compared with the values for the random spatial distribution of the individual. The idea of this procedure is to compare the real interregional component, with what would occur if the individuals were distributed evenly in space. This procedure is repeated 99 times and 2.5 and 97.5 percentiles are generated which serve as a point of reference to determine if Theil's real interregional component is statistically different from the one obtained by "chance" or at random.

In the above analysis, we suppose that labor is an "homogeneous asset" that may be the object of interchange among regions with no barriers for labor mobility. Relaxing this assumption to analyze labor according to the educational level, it is found that there are results that differ in the wage convergence of the principal metropolitan areas, according to the labor segment analyzed (Galvis, 2004). It is not very plausible to make this supposition, and therefore, we have to study additional factors to understand the wage differences, for example, related with the theory of human capital, which includes education, experience, among others. Other variables such as gender and marital status are also included.

2.3 Conditional Sigma Convergence Using Micro-Data

The second focus consists in evaluating the difference wage averages in every city, conditioned to the control for wage determinants suggested by the theory of human capital in a Mincer type model (Becker, 1975).

Mincer (1962) focused his work on the measurement of the magnitude and rates of return on the job training, and most importantly, its implications in the distribution of earnings. Mincer (1962) employed the net present value formula to estimate the rate of return on the average annual income in relation to the training costs, as follows:

$$\frac{d}{c} = (1 + r)\, n \qquad (3)$$

In this case, d is the increase in job earnings after training has finished and c is the amount invested (measured as annual forgone earnings during the training period); r is rate of return of the investment; and n the duration of the training period. However, given that benefits and costs are not constant, and that life span is not infinite this formulation was not really employed for empirical analysis.

Becker and Chiswick (1966) stated that the income of a person i in period j, E_{ij}, were the result of the summation of the income had the investment not existed, E_{i0} and the summation of the annual returns of past investments, $\Sigma_{j=1}^{n} r_{ij} c_{ij}$. In this formulation r_{ij} represents the rate of return for a given individual, in a given period, given the amount invested, C_{ij}:

$$E_{ij} = E_{i0} + \sum_{j=1}^{n} r_{ij} C_{ij} = E_{i0} + \sum_{j=1}^{n} r_{ij} k_{ij} E_{i,j-1} \qquad (4)$$

Taking logarithms and reorganizing previous equation it is possible to simplify it to:

$$LnE_{ij} \cong LnE_{i0} + \sum_{j=1}^{n} r_{ij} k_{ij} \qquad (5)$$

Becker y Chiswick (1966) suggest that the product rk is the "adjusted rate of return", and it is represented by r'. Now, if it is taken into account that the investment is constant, the equation (4) is simplified to:

$$LnE_{i,j} = LnE_0 + r'_i n_i + U_i \qquad (6)$$

Where U_i is the error term and measures the impact, between individuals, of the rest of the variables that affect earnings. In this paper, the authors separated formal human education from other forms of human capital, to learn more about the effect of training over earnings. To this end, it was necessary to assume that r'_{ij} is the same for all levels of education, $S_{ij,}$ differentiate r'_{ij} between levels of education, and consider explicitly the effect of work experience in earnings, yielding a new earnings equation such as:

$$LnE_{ij} = LnE_{i0} + r'_i S_{ij} + u'_i \qquad (7)$$

This equation was termed the "education-earnings function", and according to the empirical evidence, this formulation suggests a negative relation between years of education and the years invested in other forms of human capital. Moreover, their empirical results revealed rates of return lower than those obtained using Mincer's (1962) equation.

Mincer (1974) states that considering a measurement of investments performed after school in the earnings function allows the researcher to know a great detail of the income distribution. This type of formulation was called the "human capital-earnings function".

Mincer (1974) in turn reformulates the "human capital-earnings function" introducing nonlinear effects to experience, T:

$$LnE_i = b_0 + b_1 S_i + b_2 T_i + b_3 T_i^2 + U_i \qquad (8)$$

In the latter expression it is expected that the returns to schooling, represented by the parameter b_1 , be positive; the parameter b_2, be positive and the parameter b_3, negative. This means that experience has positive returns but at a decreasing rate.

From the latter formulation a series of variables that explain earnings have also been included. Among these it is possible to name gender, race, union status, and so on. Moreover, economists have raised criticisms to the earnings equation as it is argued that the returns to education are biased because the equation does not include the abilities of the individuals. Another element that has had great importance is the one added to the discussion by Heckman (1979, 1980) that is related to sample selection bias. This is related to the fact that the original analysis made from the ear-

nings equation, considered only individuals who were working in the labor market. However, if more individuals with more human capital are self-selected into the labor market, the results of the analyses they are biased.

The correction for sample selection starts by formulating the equation to estimate from model of hedonic prices where the salary of the i^{th} individual in j^{th} city is modeled as:

$$lnW_{ij} = \gamma_j D_j + X_{ij}\beta_j + \varepsilon_{ij} \qquad (9)$$

In equation (9) the elements in D_j are regional dummies that identify the fixed effects in each city analyzed in the survey. It is well known in the literature of labor economics that when estimating the results with the above equation, they are biased when one does not consider the fact that the dependent variable has a truncated distribution, given that the salaries are not observed for people who are not working (Heckman, 1979). In this case, the solution proposed by Heckman (1979, 1980) is to control for the probability of participation in the job market, for which equation (8) would be reformulated as the system:

$$\begin{aligned} lnW_{ij} &= \gamma_j D_j + X_{ij}\beta_j + \varepsilon_{ij}, \\ P_{ij}^{*} &= Z_{ij}\theta_j + \mu_{ij} \end{aligned} \qquad (10)$$

In this system of equations P_{ij}^{*} is a latent variable that represents the participation probability in the labor market of each individual, or that of observing positive wages (Heckman, 1979). The error terms follow a multivariate normal distribution with mean zero, σ_μ y σ_ε , variances and ρ as the correlation coefficient which, together with the other parameters of the system, they are estimated by maximum likelihood.

Since the participation probability is modeled as a function of variables which affect salaries and the participation in the labor market, exclusion restrictions are included. These are used to identify parameters in equation (10).

An estimation alternative consists in predicting the probability of observing positive wages, and calculate with this the inverse Mills ratio, λ, as $\hat{\lambda} = \phi(Z\hat{\theta})/\Phi(Z\hat{\theta})$, where the numerator and the denominator correspond to the standard normal and the cumulative normal distribution, respectively. Mills inverse is included in equation (9) to generate a new estimation, which is known as Heckman's two-stage estimation:

$$lnW_{ij} = \gamma_j D_j + X_{ij}\beta_j + \pi_j \hat{\lambda}_{ij} + \varepsilon_{ij} \qquad (11)$$

It is recommended that the estimation be done by maximum likelihood if there are no multicollinearity problems in the model, in which case the estimation of two stages generates more robust results than the estimated by maximum likelihood (Puhani, 2000).

In wage models such as the one appearing in equation (10), the number of children less than six years old and marital status is usually used as variable added to the

Z vector as exclusion restrictions. This same procedure is used in international studies (Dolton and Makepace, 1986; Montero and Garcés, 2009). Heckman (1980) use the number of children less than 6 years home old and the hourly wages of the husband, in a study of the earnings equation of a sample of women.

The number of children and marital status are included in the present document, since we suppose that the presence of minor age children and marital status will affect the participation probability in the work force, but not necessarily the wage level that an individual receives. Dolton and Makepeace (1986) show that these variables affect the income through the term $\hat{\lambda}$, included in the wage equation.

3. Previous Work

Differences in wages can be a product of inequalities in the interior of a country and it is expected that these inequalities disappear more quickly than between countries. The reason is that because the mobility of labor can help reduce wage inequality throughout the regions, because people would move to places where higher wages may be obtained until the relative supply of labor aligns with the demand and wages are more balanced throughout the different regions. This in turn would take the country's income to higher levels of growth. The above is based in the equity objectives and growth that can be positively complemented in such a way that the greater equity can lead to greater growth as argued by Lustig et al. (2002). Moreover, this last statement is in line with research that has found a negative relation between inequalities and growth (Deininger and Squire, 1996; Alesina and Rodrick, 1994; Bertola, 1993; Engermann and Sokoloff, 2002).

Previous studies in Colombia have analyzed the economic growth and convergence, suggesting evidence both in favor and against the convergence hypothesis (see Moncayo, 2002, for a review). These research lines began with the pioneer study of Cárdenas et al. (1993), which found evidence in favor of the convergence hypothesis over the 1950-1989 period. On the contrary, later studies unanimously rejected the idea that income is converging towards one equilibrium balance. Each one used different sets of data or estimation methods rejecting the convergence hypothesis (Rocha and Vivas, 1998; Bonet and Meisel, 1999; Galvis and Meisel, 2001; Bonet and Meisel, 2006).

In the Colombian context, and making reference to the theories of labor mobility and migration, Galvis (2002) presented an empiric application through a gravitational model of spatial interaction. There he pointed out the importance and the magnitude of interregional labor mobility in Colombia. It was shown that, for the 1988-1993 period, the net interregional rate of migration in Colombia has a magnitude comparable to those of countries such as Spain, Ireland, Japan, and the United States. A fundamental conclusion of this study is the significant influence of the economic conditions in the regions of origin and destination of migratory flows with a special

emphasis on income differences, as it has been documented in previous studies where it is suggested that the mobility of labor takes place according to a set of factors, where the difference of wages plays an preponderant role (Gallup, 1997)[2].

This high mobility of labor does not appear to have contributed to the integration of the labor market or the reduction of disparities in regional income, not even among urban areas, which are the ones that attract the greatest volumes of migration flows. This is evident when analyzing the income convergence in the principal urban areas of the country (Galvis and Meisel, 2001).

Bonet and Meisel (2006) furnished additional evidence in the same sense, using a series of per capita income built by CEGA (Center for Livestock and Agricultural Studies), based in the GDP after tax deduction and transferences to local governments, going beyond the studies that only use the per capita GDP.

Real wages have been used in the studies of the Colombian labor market integration. Such is a case of Nupia (1997) who studied the regional integration of the labor market of the four principal metropolitan areas. Later, Jaramillo et al. (2001) used the urban and rural wages of unskilled workers to analyze the integration of the labor market during the period 1945-1998. Both documents present advances in the discussion of average wages in the metropolitan areas or regions of the country. Nevertheless, it can be argued that the methodology used has ignored the analysis of the important characteristics of labor and regional markets that might affect the inequality in wages, such as the skilled workers and attributes of the labor and economic sectors where employees work. One of these characteristics is the level of education which was studied by Galvis (2004) for the 1984-2000 period. His analysis of the seven principal metropolitan areas to study the integration of the labor market, included qualified and non qualified workers and differentiated them by their level of education. The findings revealed that highly qualified or educated workers are more mobile than non qualified workers and that an analysis of the integration in the labor market should include both types of workers to be able to draw conclusions on the dynamic of wages in Colombia. The study concludes that there is integration for the highly qualified workers among some pairs of cities, but the same conclusion cannot be sustained for non-qualified workers.

Other types of work that move away from the perspective of the time series are those based on more micro-econometric foundations such as Mesa et al. (2008) and Ortiz et al. (2009), who study the labor market of the seven principal metropolitan areas during the period of 2001-2005. In Mesa's et al. work (2008), the distribution of wages is analyzed discriminating them by city and economic sector. The work uses non parametric proofs to compare distributions and verify if differences do exist. Moreover, Mincer type equations have been estimated to figure out the fixed effects per city and sector and compare the differences that are not attributed to the productivity of individuals.

2 Martínez (2006: 323), even though reporting a high rate of migration in Colombia in relation with other countries, suggests that interdepartmental migration seems to respond very little to economic stimuli and that it responds more to the difference in life conditions such as safety.

These significant set effects constitute evidence of the labor market segmentation.

Ortiz et al. (2009), on their part, study the labor market segmentation during the 2001-2006 period, analyzing the formal and informal sectors to see if the differences in wages of both sectors still persist. They analyzed the different versions of a Mincer equation slowly including variables of the size of the companies, regional dummies for thirteen metropolitan areas, interactions of the dummies with education, and spline variables of education. In all the cases, the dummy variables that identify small or informal companies show negative and significant coefficients, which imply that there are remunerations that are consistently under those paid by large and formal companies, or that, in other words, there is segmentation in the labor market.

In the international literature only recently there has been an attempt to study convergence at the micro-level, employing a hierarchical model. The importance of this type of work lies on the fact that traditionally growth convergence has been studied from a macroeconomic standpoint, and the "macro dynamics result from the underlying microeconomic activity" (Fazio and Piacentino, 2011).

This paper is different from previous research in several aspects. In the first place, the analysis uses real wages to study the convergence hypothesis, rather than the GDP and other variables that have been used in former studies. In the second place, to control for the difference of attributes of labor, we use conditional average wages. In the third place, we consider the sample selection bias—for non observed wages—because not including them leads to biased calculations that result in minor differences of the average conditional wage. Therefore, it is centered in the relation between wages in the regions using the National Household Survey, NHS, the Continuous Household Survey, CHS, and the Great Household Integrated Survey, GHIS, which take place in the principal cities and metropolitan areas in the country. This way, we exploit the greater statistical power that is derived from the use of large micro datasets. Even though this focus limits the reach of our conclusions for the urban market instead of doing it in the national labor market, it has the advantage that it considers the selection bias and analyzes both qualified and non qualified workers.

The purpose of this analysis is to evaluate the convergence hypothesis in real wages and obtain conclusions from a perspective of time series and cross-sectional data. To do so in a precise way, it is argued that to evaluate the convergence hypotheses, the analysis of the simple average wage is not enough in itself, because variation between different labor markets may arise. These variations may have origin in the attributes of sectors that, in each metropolitan area is specialized in work attributes or those of the worker. We also consider the characteristics of labor which are not homogeneous in all the labor market (Galvis, 2004; Mesa *et al.*, 2008). Furthermore, we analyze a larger and more recent period and we consider the differences in economic activity in regions as to key matters such as the economic sector in which the employees are working because, given the industrial composition of each region, there may be differences associated with specialization.

4. Data

The National Home Survey (NHS) is used in the first part of the work for the period 1984-2000 with a quarterly frequency. Later, the data is linked with those of the Continuous Household Survey (HCS) from 2001 to 2006 and the Great Household Integrated Survey (GHIS) from 2006 to 2009. Since the methodology of the household surveys changes between the types of surveys to make the analysis more consistent, a fraction of the work force was used representing the employees of the private sector who work at least 40 hours per week. This allows us to analyze a more homogeneous group of workers for which there should be less inflexibility in the salaries and we would expect more fluctuations in them, which might eventually lead to a convergence of salaries.

Some groups of workers that are excluded from the sample are, for example, the self-employed, for which there is no salary per se, but an income, which is associated with the fluctuations of the work in the informal market. To this respect, García-Suaza et al. (2009) report differentiated results for employees and the self-employed workers, justifying the treatment of both groups in a separate way in the wage models. Another group that was excluded from the analysis is the public employees, whose salaries are adjusted according to institutional factors that may impose inflexibility that may complicate the analysis of convergence. A similar work strategy is found in Bratsberg and Turunen (1996) and in Arango et al. (2010).

To make the analysis more manageable, we only took data for the second quarter in each year.

To consolidate a series with a large coverage in the temporal dimension, we only included the seven principal metropolitan areas in the analysis when the NHS was used. Beginning 2001, a separate analysis was made for the seven and thirteen cities available.[3]

Real wages were calculated with nominal salaries, deflated by the consumer price index base 2008. Since it is possible that there are some differences in the cost of living in cities that affect the wage compensation (Roback 1982, 1988), price indexes were used for each metropolitan area.[4] To capture the importance of the industrial composition on salary differences, fixed effects have been included for each one of the economic sectors, since we expect that a part of these salary differences is explained by the economic sector where the employees are working.

5. Results

The first focus used to characterize the behavior of urban wages is based on analyzing trends through time and exploring the patterns suggested by the dispersion

3 The cities were Barranquilla, Bogotá, Bucaramanga, Manizales, Medellín, Cali, Pasto, Cartagena, Montería, Villavicencio, Cúcuta, Pereira, and Ibagué.

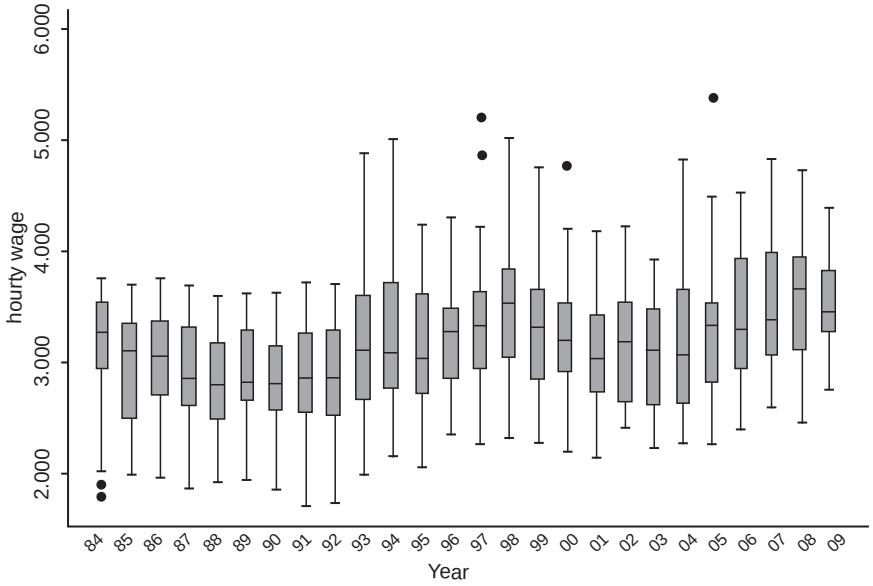
4 Except during the period 1984-1987, for which price indexes at a national level where used for each one of the cities.

of data. The main question to be solved is if there exists unconditioned sigma convergence, examining the wage variation coefficient. The second part of this section seeks, by controlling the difference inside the cities, to verify the contribution of wage dispersion that the studied cities have in the frame of conditional sigma convergence. Finally, we use the analysis of micro data for the study of the conditional sigma convergence, controlling the factors that influence over wage differentials in hedonic models.

Figure 1 shows the behavior of wage dispersion in the metropolitan areas of the study using variation coefficients. The graph makes evident that in general, the series for the majority of the cities shows a decreasing trend in its dispersion towards the end of the nineties. Nevertheless, during the following years dispersion enlarges again and with it, the wage gaps increase once again. Nevertheless, note that if one observes the mean behavior (the line drawn inside the bar), it does not vary significantly, compared with the distribution extremes, thus other distribution percentiles would be the ones explaining the variations in salary dispersion.

Finally, to the question of the reduction in wage differentials, according to Figure 1, we have to respond negatively. The variability of wages among metropolitan areas shows cycles where there are increases in dispersions and in others, reductions. Nevertheless, if one examines all the series for the analysis period, a general reduction is not observed in the disparities of regional average wages. In other words, the non-conditional sigma convergence is not observed; that is, there is not "strong" convergence.

Figure No. 1: *Dispersion of real wages 1984:1-2009:2*



Source: The author's calculations based on DANE.

5.1 Interregional Disparities in Wages

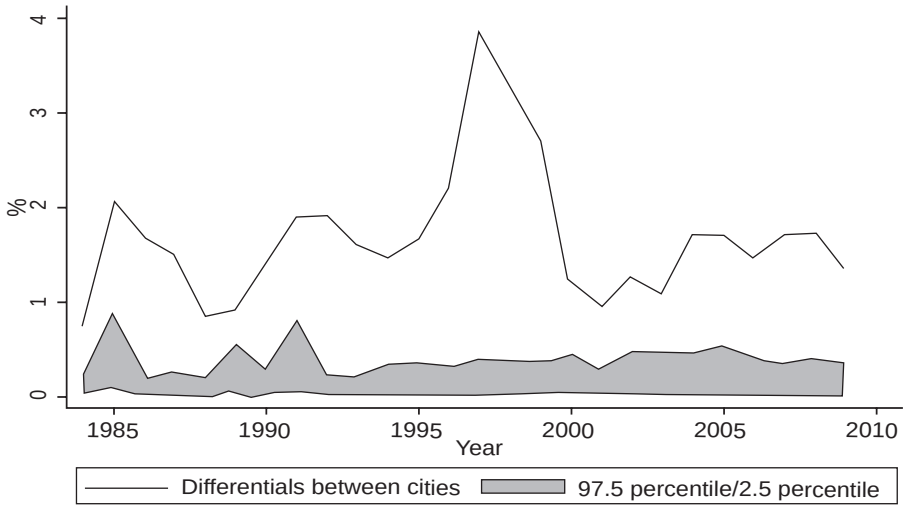
When comparing the variation coefficients though the different periods of study, we find great variability in these (Figure 1). The first analysis calculates the wage differentials, explained by the location of individuals in some of the cities considered. That is, because there are wage disparities at the regional level, what one wants is to investigate is the contribution of the regional component of Theil's index to total inequalities in the frame of conditional sigma convergence.

Conditional sigma convergence would not be refuted if, according to this methodology, there had been reductions in the interregional component of wage disparities. Figure 2 shows the participation calculations of interregional inequalities in the total inequality. The area between 2.5 and 97.5 percentile of the calculated indexes from the relocation of observations is also calculated. It is represented by the shadow strip.

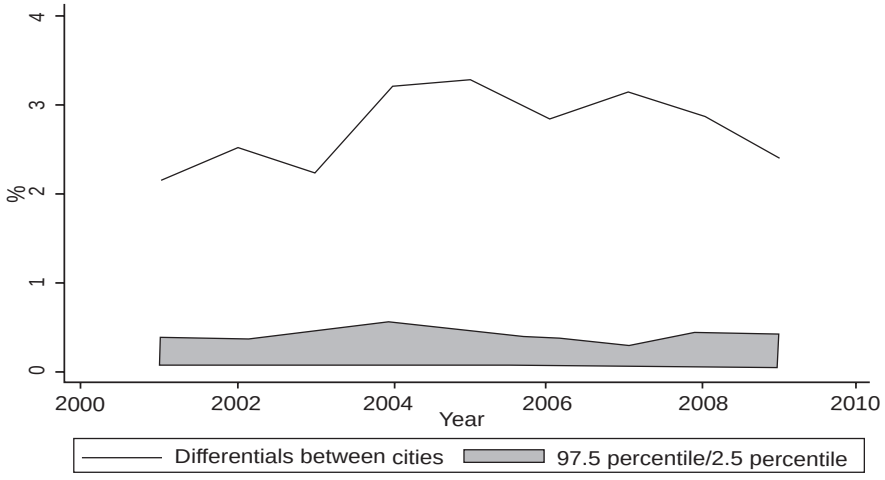
It cannot be said that there was a generalized increase in interregional disparities, nor can it be concluded that these were reduced during all the analyzed period. Moreover, one can identify two differentiated periods. The first one until 1997, where a trend in the increase of regional wage disparities can be observed, followed by an abrupt drop in these differentials. Analyzing the data more carefully, it is noted that the dispersion of wages is significantly reduced when precisely Bogotá moves away from other metropolitan areas around 1998. After that year there is a reduction in wages in Bogotá, which is followed by the rest of metropolitan areas, leading to the reduction of the spreads. The second one starting the year 2000 where one can observe once again an increased tendency in the observed differentials. Nevertheless, note that in the second period the average of those differentials is much less than the levels reached at the end of the first period.

Figure No. 2: *Contribution of cities to wage differentials, 1984:2-2009:2*

A) Using seven cities



B) Employing thirteen cities



Source: The author's calculations based on DANE.

An element that deserves attention is the percentage, from the total disparities, that represents the regional component. It would certainly seem that this percentage does not have greater relevance. Nevertheless, when comparing the figures with the values that would have been obtained if the population would be distributed randomly

in the space (localized between percentiles 2.5 and 97.5), one can find that the calculated values are significantly different from those hypothetic figures. This means that, controlling for disparities within the cities, the differences among cities contributes a significant percentage of the total wage disparities among cities. In other words, space does matter in the explanation of wage differentials.

5.2 Estimation of Wage Equations

In this section, additional control variables are used to explore the regional differences of real wages in the main metropolitan cities in Colombia. Wage equations are estimated for several stages of household surveys to cover not only recent tendencies in the labor market, but also the former behaviors that are important for our analysis.

In Mincer-type wage models, variables used regularly to study the factors determining wages were included, such as the level of education, age, marital status and characteristics of the gender and work, according to the theory of human capital (Becker, 1975). Additional control variables included in this analysis show results coherent with the results traditionally obtained for this type of estimations, particularly those in respect to the coefficient signs of wage determinants. For example, results point to wage earnings lower for women in general, while age, as a proxy of experience, shows a positive effect over wages, but with increases at decreasing rates.

The principal object of this analysis is the identification of city effects, which identify individuals living in Barranquilla, Bucaramanga, Cali, Manizales, Medellín and Pasto, in the case of the seven cities. When analyzing thirteen cities, we additionally included Cartagena, Monteria, Villavicencio, Cúcuta, Pereira and Ibagué. In both cases the base group of comparison is Bogotá.

According to the results, with rare exceptions, all the fixed effects are statistically significant in all considered surveys.[5] This would show that there are significant differential impacts, due to the location of the individual, explaining the wage disparities in the analyzed cities. These disparities are evaluated in relation to Bogotá, which, as it was stated before, is taken as a reference group.

In this part of the methodology, regressions were obtained with Heckman's methodology using maximum likelihood estimation. The second quarter of each year from 1984 to 2009 was used for seven metropolitan areas, and for the period of 2001–2009 for the thirteen principal metropolitan areas. The effects of each city are analyzed, representing the differentials of the conditional wage media, after controlling other factors which affect wages. [6]

Taking the second semester of the year 2009 as an example, Table 1 shows that conditioning on the other factors that affect wages, in Barranquilla, on average, it is

5 For simplicity only the fixed effects with their respective standard error were included (see ANNEX A). Calculations report the robust standard errors in order to be consistent with the presence of heteroskedasticity in this type of estimations.

6 Because the results represent a vast extension of information, all the estimated models are not included in the tables, but the summary of the coefficients of interest.

observed that wages are 21.2% under those in Bogotá.[7] On the other hand, the city of Pasto will have a wage average which is 32.4% under the one observed in the capital. Notice that the main cities, such as Cali, Medellín and even Bucaramanga, present wages very near in average, since their differences vary between 5 and 8% below those of Bogotá. This amount represents one fourth of the differential of Pasto, and less than half of the differential in respect to Barranquilla, Manizales, Cartagena, Montería and Ibagué.

Table No. 1: *Fixed effects by cities in the wage model in 2009:2.*

Dependent Variable: Log(hourly wage)	Coefficient	Standard Error	p-value	95% Confidence interval	
Fixed effects:				Lower limit	Upper limit
Barranquilla	-0.2392	0.0202	0.000	-0.2787	-0.1996
Bucaramanga	-0.0714	0.0211	0.001	-0.11 28	-0.0301
Manizales	-0.2271	0.0322	0.000	-0.2902	-0.1640
Medellín	-0.0527	0.0117	0.000	-0.0756	-0.0297
Cali	-0.0868	0.0150	0.000	-0.1162	-0.0574
Pasto	-0.3924	0.0426	0.000	-0.4759	-0.3089
Cartagena	-0.2243	0.0285	0.000	-0.2801	-0.1685
Montería	-0.25 38	0.0436	0.000	-0.3393	-0.1683
Villavicencio	-0.1333	0.0356	0.000	-0.2031	-0.0635
Cúcuta	-0.1343	0.0259	0.000	-0.1851	-0.0835
Pereira	-0.1164	0.0266	0.000	-0.1684	-0.0643
Ibagué	-0.2287	0.0306	0.000	-0.2886	-0.1688

Note: The table continues with the rest of the variables of the Mincer type model and the corrections of sample selection bias, but to simplify only the coefficients used in the analysis of the convergence graphs are shown.

Source: Authors calculations based on DANE.

The question that we want to answer with the estimation of the fixed effects is if those wage differentials -conditioning on personal and industry attributes- increase are reduced or maintain themselves through time. To accomplish this, a time series has been constructed with the estimation of the wage models, and its trend through times has been evaluated.

Figure 3 presents fixed effects for the seven principal metropolitan areas from 1984 to 2009 and Figure 4 shows the results including the thirteen principal cities from 2001 to 2009. In general, it is observed that these differentials through time do not show a tendency to decline. Exceptional cases are Manizales and Pasto. The first city

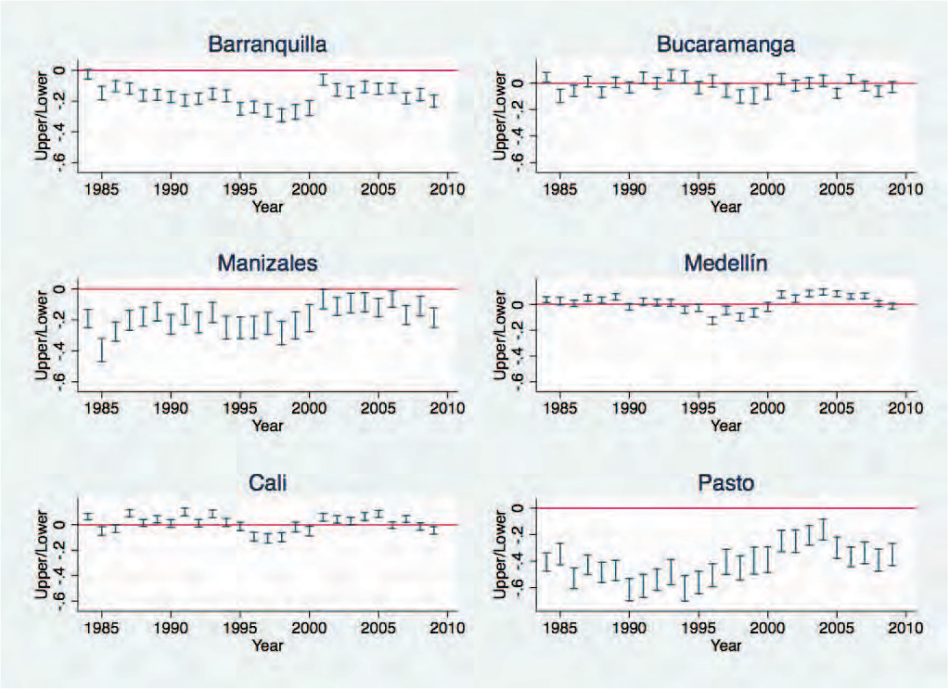
7 The percentage differential calculus of wages among metropolitan areas takes place with the equation, $\Delta W_{rt} = \left(e^{\beta_{rt}} - 1\right) * 100$, where β_{rt} is the coefficient of the fixed effects for each metropolitan area or region *r*, and *t* indicates the period of time.

showed differentials in the 20% average order during the 1990s and towards the end of the period they were reduced to half. For its part, Pasto also reduced its differential to half, but the differences with the other metropolitan areas are still very large because in the 1990s, the differential of salaries in cities in respect to Bogotá was 50% on average and it shifted to a differential of 25% towards the 2000-2009 period.

The analysis repeatedly points Cali, Bucaramanga and Medellín as the nucleus of the economic activity (center) where wages are closer to those in Bogotá, the highest wages in the country in relation with the other metropolitan areas (periphery).

It must be stressed that, in general, the results of the analysis presented up to now clearly show the notion of a persistent pattern in the regional wage differences among metropolitan areas, because the dispersion of the unconditional measure of salaries is not reduced in time. With this result in mind, one cannot speak of strong convergence in Dickie and Gerking's (1988) sense.

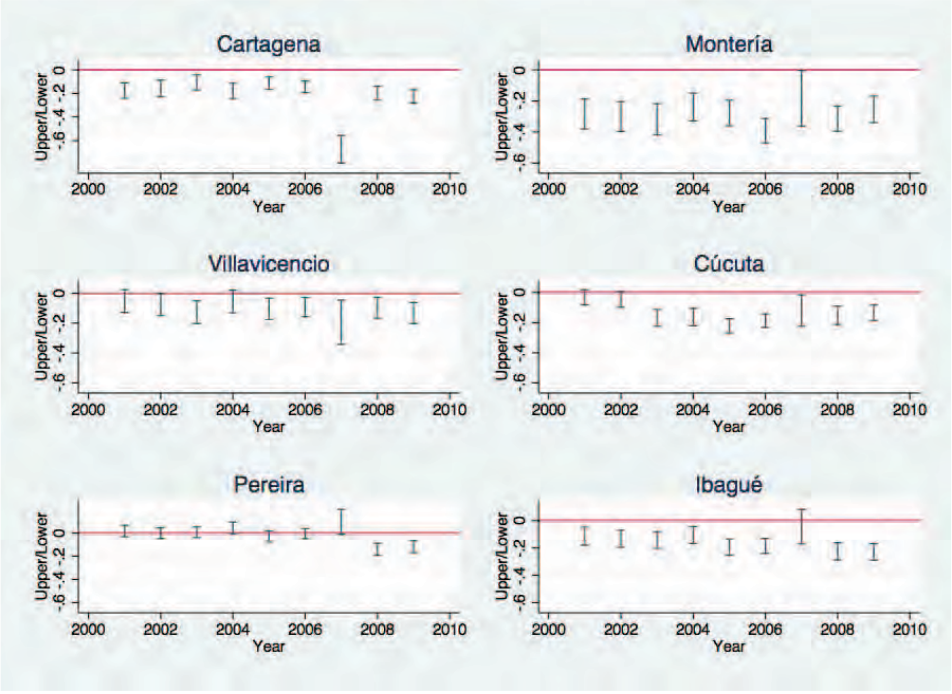
Figure No. 3: *Comparison of fixed effects in the principal metropolitan areas in respect to Bogotá, 1984-2009*



Note: The graph shows the coefficient of the set effect in each city, and the confidence interval. The figures represent the percentage of the average wage differential in respect to Bogotá.

Source: Author's calculations based on DANE, NHS, HCS, GHIS

Figure No. 4: *Comparison to the fixed effects in the main small metropolitan areas in respect to Bogotá. 2001-2009*



Note: The graph shows the coefficient of the set effect in each city, and the confidence interval. The figures represent the percentage of the average wage differential in respect to Bogotá.

Source: Author's calculations based on DANE, NHS, CHS, GHIS

After controlling the determining of wages in an hedonic model, the remaining differences are interpreted as the existing inequalities among wage remuneration in the country's principal cities. These inequalities of the labor compensation in the center, compared to the country's periphery, play an important role in the non convergence of wages, which lead to the fact that there is no "weak convergence", or sigma convergence conditioned on the attributes considered in a Mincer-type model for wages.

For future work, it is important to consider specific information on cities to compare the differences in the salaries given the attributes of the cities and develop an analysis in an aggregate level to explore the possible explanation for the existence of wage differences and their persistence, something that has been already advanced in Arango's et al. work (2010) in relation to unemployment.

Finally, a note of caution in relation with the fact that, due to the lack of information in household surveys, variables such as race, union affiliation and experience, among others, are not included and which would probably be important to analyze the sources of wage differences.

6. Concluding Remarks

In the search for understanding the dynamics of wages among Colombian metropolitan areas, this study is differentiated from previous studies to analyze the convergence hypotheses among the principal cities of the country, by using the household survey data for the period 1984-2009. In contrast with previous studies on the topic, an alternate convergence of income is developed in this study which spins around two principal points: the use of a series that shows the behavior of real wages in several periods of time and the use of cross-sections for the microeconomic analysis of the determinants of wage differentials.

The results indicate that there is no evidence that supports the unconditional convergence hypothesis of wages in the principal cities of Colombia. Conditional sigma convergence was analyzed through the participation of the inequalities of salaries among the main cities, finding that those wage differences were not reduced though time, that is, that there is no evidence of conditional convergence.

On the other hand, the results of the cross sectional analysis show that, even those employing the series of real wages and controlling the attributes which regularly explain the wage differences, there are persistent differences in urban wages among the Colombian metropolitan areas. This finding is particularly critical for the case of Pasto, Cartagena, Montería, Villavicencio, Cúcuta and Ibagué, cities found in the country's economic periphery.

As a result of this analysis, it can be suggested to revise the current policies to reduce income inequalities among regions, allowing a convergence process in the distribution of income. This is fundamental if one considers that in several studies have documented that greater inequalities can lead to lesser economic growth.

It is important to identify the specific attributes for future works to determine the wage difference in them. For example, it would be interesting to control for the cost of living, the amenities of the cities and their influence over the wages, and also the industry mix in every metropolitan area. At the same time, it must be recognized that, due to the structure and design of the data of household surveys, it was not possible to include in the model control other variables that can be important in the analysis of the wage differences, such as race, union affiliation and experience, because these variables are not available in the surveys.

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Annex A. Wage equations results.

Table A.1: *Fixed effects for the main seven metropolitan areas, 1984-2009.*

Dependent Variable: Log(hourly wage)	1984	1985	1986	1987	1988	1989	1990	1991	1992
Barranquilla	-0.025	-0.148***	-0.103***	-0.118***	-0.164***	-0.160***	-0.174***	-0.195***	-0.185***
	[-0.02]	[-0.02]	[-0.02]	[-0.02]	[-0.02]	[-0.02]	[-0.02]	[-0.02]	[-0.02]
Bucaramanga	0.044*	-0.099***	-0.059**	0.012	-0.069***	0.005	-0.034	0.039	-0.002
	[-0.02]	[-0.03]	[-0.02]	[-0.02]	[-0.02]	[-0.02]	[-0.02]	[-0.02]	[-0.02]
Manizales	-0.192***	-0.395***	-0.276***	-0.203***	-0.178***	-0.148***	-0.229***	-0.165***	-0.218***
	[-0.03]	[-0.04]	[-0.03]	[-0.03]	[-0.03]	[-0.03]	[-0.03]	[-0.03]	[-0.03]
Medellín	0.037***	0.026	0.009	0.049***	0.033**	0.059***	-0.019	0.023	0.014
	[-0.01]	[-0.01]	[-0.01]	[-0.01]	[-0.01]	[-0.01]	[-0.01]	[-0.01]	[-0.01]
Cali	0.063***	-0.050**	-0.032*	0.090***	0.013	0.042**	0.008	0.099***	0.011
	[-0.01]	[-0.02]	[-0.02]	[-0.01]	[-0.01]	[-0.01]	[-0.02]	[-0.02]	[-0.02]
Pasto	-0.407***	-0.347***	-0.530***	-0.428***	-0.486***	-0.471***	-0.616***	-0.588***	-0.540***
	[-0.04]	[-0.04]	[-0.04]	[-0.04]	[-0.04]	[-0.04]	[-0.04]	[-0.04]	[-0.04]

* p<0.05, ** p<0.01, *** p<0.001

Source: Authors calculations based on DANE.

Table A.1: *Fixed effects for the main seven metropolitan areas, 1984-2009. (Continued)*

Dependent Variable: Log(hourly wage)	1993	1994	1995	1996	1997	1998	1999	2000	2001
Barranquilla	-0.153***	-0.166***	-0.252***	-0.238***	-0.261***	-0.292***	-0.270***	-0.246***	-0.061***
	[-0.02]	[-0.02]	[-0.02]	[-0.02]	[-0.02]	[-0.02]	[-0.02]	[-0.02]	[-0.02]
Bucaramanga	0.060**	0.046	-0.034	0.015	-0.057*	-0.101***	-0.096**	-0.066*	0.03
	[-0.02]	[-0.02]	[-0.02]	[-0.02]	[-0.03]	[-0.03]	[-0.03]	[-0.03]	[-0.02]
Manizales	-0.153***	-0.250***	-0.251***	-0.248***	-0.223***	-0.285***	-0.236* **	-0.189***	-0.067*
	[-0.03]	[-0.04]	[-0.04]	[-0.04]	[-0.04]	[-0.04]	[-0.04]	[-0.04]	[-0.03]
Medellín	0.012	-0.041**	-0.026	-0.125***	-0.046**	-0.097***	-0.064***	-0.019	0.078***
	[-0.01]	[-0.01]	[-0.01]	[-0.01]	[-0.02]	[-0.02]	[-0.02]	[-0.02]	[-0.01]
Cali	0.084***	0.017	-0.014	-0.094***	-0.106***	-0.099***	-0.019	-0.051**	0.058***
	[-0.02]	[-0.02]	[-0.02]	[-0.02]	[-0.02]	[-0.02]	[-0.02]	[-0.02]	[-0.02]
Pasto	-0.483***	-0.606***	-0.562***	-0.507***	-0.406***	-0.451***	-0.396***	-0.389***	-0.249***
	[-0.05]	[-0.05]	[-0.04]	[-0.04]	[-0.05]	[-0.05]	[-0.05]	[-0.05]	[-0.04]

* p<0.05, ** p<0.01, *** p<0.001

Source: Authors calculations based on DANE.

Table A.1: Fixed effects for the main seven metropolitan areas, 1984-2009. (Continued)

Dependent Variable : Log(hourly wage)	2002	2003	2004	2005	2006	2007	2008	2009
Barranquilla	-0.126***	-0.142***	-0.107***	-0.120***	-0.117***	-0.182***	-0.158***	-0.200***
	[-0.02]	[-0.02]	[-0.02]	[-0.02]	[-0.02]	[-0.02]	[-0.02]	[-0.02]
Bucaramanga	-0.021	0	0.018	-0.078***	0.029	-0.023	-0.063**	-0.03
	[-0.02]	[-0.02]	[-0.02]	[-0.02]	[-0.02]	[-0.02]	[-0.02]	[-0.02]
Manizales	-0.114***	-0.092**	-0.087**	-0.121***	-0.066*	-0.169***	-0.111***	-0.186***
	[-0.03]	[-0.03]	[-0.03]	[-0.03]	[-0.03]	[-0.03]	[-0.03]	[-0.03]
Medellin	0.044**	0.085***	0.097***	0.083***	0.062***	0.066***	0.006	-0.012
	[-0.01]	[-0.01]	[-0.01]	[-0.01]	[-0.01]	[-0.01]	[-0.01]	[-0.01]
Cali	0.042**	0.028	0.063***	0.084***	-0.005	0.045**	-0.014	-0.046**
	[-0.01]	[-0.01]	[-0.02]	[-0.01]	[-0.01]	[-0.01]	[-0.01]	[-0.01]
Pasto	-0.249***	-0.206***	-0.162***	-0.299***	-0.368***	-0.338***	-0.392***	-0.350***
	[-0.04]	[-0.04]	[-0.04]	[-0.04]	[-0.04]	[-0.04]	[-0.04]	[-0.04]

* p<0.05, ** p<0.01, *** p<0.001

Source: Authors calculations based on DANE

Table A.2: Fixed effects for the main thirteen metropolitan areas, 2001-2009.

Dependent Variable: Log(hourly wage)	2001	2002	2003	2004	2005	2006	2007	2008	2009
Barranquilla	-0.083***	-0.151***	-0.175***	-0.136***	-0.161***	-0.157***	-0.276***	-0.200***	-0.239***
	[-0.02]	[-0.02]	[-0.02]	[-0.02]	[-0.02]	[-0.02]	[-0.04]	[-0.02]	[-0.02]
Bucaramanga	0.006	-0.047*	-0.034	-0.012	-0.120***	-0.013	0.079	-0.108***	-0.071***
	[-0.02]	[-0.02]	[-0.02]	[-0.02]	[-0.02]	[-0.02]	[-0.04]	[-0.02]	[-0.02]
Manizales	-0.090**	-0.141***	-0.126***	-0.117***	-0.164***	-0.107***	-0.048	-0.156***	-0.227***
	[-0.03]	[-0.03]	[-0.03]	[-0.03]	[-0.03]	[-0.03]	[-0.07]	[-0.03]	[-0.03]
Medellín	0.056***	0.02	0.053***	0.069***	0.042***	0.021	0.095***	-0.037**	-0.053***
	[-0.01]	[-0.01]	[-0.01]	[-0.01]	[-0.01]	[-0.01]	[-0.03]	[-0.01]	[-0.01]
Cali	0.035*	0.016	-0.005	0.034*	0.043**	-0.046***	-0.091**	-0.058***	-0.087***
	[-0.02]	[-0.02]	[-0.02]	[-0.02]	[-0.01]	[-0.01]	[-0.03]	[-0.01]	[-0.02]
Pasto	-0.272***	-0.275***	-0.241***	-0.192***	-0.345***	-0.411***	-0.464***	-0.437***	-0.392***
	[-0.04]	[-0.04]	[-0.04]	[-0.04]	[-0.04]	[-0.04]	[-0.08]	[-0.04]	[-0.04]
Cartagena	-0.176***	-0.156***	-0.106**	-0.178***	-0.113***	-0.143***	-0.674***	-0.197***	-0.224***
	[-0.03]	[-0.04]	[-0.03]	[-0.03]	[-0.03]	[-0.02]	[-0.06]	[-0.03]	[-0.03]
Montería	-0.284***	-0.301***	-0.317***	-0.239***	-0.277***	-0.392***	-0.183*	-0.315***	-0.254***
	[-0.05]	[-0.05]	[-0.05]	[-0.05]	[-0.04]	[-0.04]	[-0.09]	[-0.04]	[-0.04]
Villavicencio	-0.053	-0.077*	-0.128**	-0.056	-0.105**	-0.093**	-0.194*	-0.098**	-0.133***
	[-0.04]	[-0.04]	[-0.04]	[-0.04]	[-0.04]	[-0.03]	[-0.08]	[-0.04]	[-0.04]
Cúcuta	-0.032	-0.046	-0.168***	-0.163***	-0.221***	-0.187***	-0.120*	-0.151***	-0.134***
	[-0.03]	[-0.03]	[-0.03]	[-0.03]	[-0.02]	[-0.02]	[-0.05]	[-0.03]	[-0.03]
Pereira	0.019	0.001	0.008	0.046	-0.028	-0.004	0.098	-0.138***	-0.116***
	[-0.03]	[-0.02]	[-0.02]	[-0.03]	[-0.02]	[-0.02]	[-0.05]	[-0.03]	[-0.03]
Ibagué	-0.113***	-0.132***	-0.141***	-0.105***	-0.193***	-0.184***	-0.044	-0.224***	-0.229***
	[-0.03]	[-0.03]	[-0.03]	[-0.03]	[-0.03]	[-0.03]	[-0.06]	[-0.03]	[-0.03]

* p<0.05, ** p<0.01, *** p<0.001

Source: Authors calculations based on DANE.