Borradores de ECONOMÍA

Estimating the reservation wage across city groups in Colombia: A stochastic frontier approach

By: Luz A. Florez
Ligia Alba Melo-Becerra
Carlos Esteban Posada

No. 1163
2021

BANCO DE LA REPÚBLICA
COLOMBIA

tá - Colombia - Bogotá - Colombia - Bogotá - Colombia - Bogotá - Colombia - Bogotá - Colombia - Bogotá - Colombia - Bogotá - Colombia - Bogotá - Col

Estimating the reservation wage across city groups in Colombia: A stochastic frontier approach: ♦

The opinions contained in this document are the sole responsibility of the authors and do not commit Banco de la República nor its Board of Directors

Luz A. Florez♠
lflorefl@banrep.gov.co

Ligia Alba Melo-Becerra♣
Lmelobec@banrep.gov.co

Carlos Esteban Posada ♥
cposad25@eafit.edu.co

Abstract

We use the stochastic frontier approach to estimate the reservation wage across different city groups in Colombia. We use the information of GEIH from 2008-2019 of 23 urban cities. We find empirical evidence in favour of the search theory predictions that suggest a positive relation of the reservation wage with the level of education and with the net family labour income. We also find a gender gap in the reservation wage and explore this gap controlling by the level of education and presence of children in the household. Contrary to the results found in the literature, we find that the presence of children reduces the reservation wage of women and men. Finally, we found that the reservation wage increases with the level of development and productivity of the cities, however, qualified workers in low-quality cities present higher reservation wages than median quality cities.

JEL classification: C14, J22, J64

Keywords: Reservation wage, stochastic frontier analysis, labour heterogeneity by cities.

♦ We acknowledge the excellent research assistant of Laura Camila Hernández Castillo, Jorge Leonardo Rodríguez Arenas, Johan Sebastián Coba Ayala, Ricardo Bonilla Ballén and Estefania Caldera. We also thank Luis E. Arango for his useful comments and suggestions.
♠ Grupo de Mercado Laboral, Banco de la República, Medellín, Colombia. ORCID: 0000-0001-9813-6720. (Corresponding author)
♣Unidad de Investigaciones, Banco de la República, Bogotá, Colombia. ORCID: 0000-0003-0895-9753.
♥ Departamento de Economía, Universidad EAFIT, Medellín, Colombia.

Estimación del salario de reserva por grupo de ciudades en Colombia: un enfoque de frontera estocástica[♦]

Las opiniones contenidas en el presente documento son responsabilidad exclusiva de los autores y no comprometen al Banco de la República ni a su Junta Directiva

Luz A. Florez[♠]
lflorefl@banrep.gov.co

Ligia Alba Melo-Becerra[♣]
Lmelobec@banrep.gov.co

Carlos Esteban Posada[♥]
cposad25@eafit.edu.co

Resumen

En este documento usamos el método de frontera estocástica para estimar los salarios de reserva de diferentes grupos de ciudades en Colombia. Usamos la información de la Gran Encuesta Integrada de Hogares (GEIH) para el período 2008-2019 para las 23 principales áreas urbanas. Nuestros resultados empíricos van en línea con los sugerido por los modelos de búsqueda que predicen una relación positiva entre el salario de reserva y el nivel de educación, y también con el ingreso neto laboral del hogar. Adicionalmente, evidenciamos una brecha en el salario de reserva de las mujeres comparado con el de los hombres, incluso controlando por nivel educativo y presencia de niños en el hogar. Contrario a lo encontrado en la literatura, la presencia de niños en el hogar reduce el salario de reserva tanto de los hombres como de las mujeres. Finalmente, encontramos evidencia de una relación positiva entre el nivel de productividad de las ciudades y el salario de reserva, sin embargo, individuos altamente calificados presentan salarios de reserva mayores en las ciudades de baja calidad (productividad) que en ciudades de calidad media (productividad).

Clasificación JEL: C14, J22, J64

Palabras claves: Salario de reserva, análisis de frontera estocástica, heterogeneidad laboral por ciudades.

♦ Agradecemos la excelente asistencia de investigación de Laura Camila Hernández Castillo, Jorge Leonardo Rodríguez Arenas, Johan Sebastián Coba Ayala, Ricardo Bonilla Ballén y Estefanía Caldera. También agradecemos a Luis Eduardo Arango por sus excelentes comentarios y sugerencias.

♠ Grupo de Mercado Laboral, Banco de la República, Medellín, Colombia. ORCID: 0000-0001-9813-6720. (Autor corresponsal).

♣ Unidad de Investigaciones, Banco de la República, Bogotá, Colombia. ORCID: 0000-0003-0895-9753.

♥ Departamento de Economía, Universidad EAFIT, Medellín, Colombia.

1. Introduction

The reservation wage is known as the lowest wage at which an individual is willing to work or in other words the wage that makes workers indifferent between being unemployed or employed. It is a keystone of theoretical models of job search in understanding the worker´s unemployment experience. The reservation wage helps to explain unemployment duration and the unemployment rate (Lanchaster & Chester, 1983; Addison, Centeno & Portugal, 2004; Brown, Roberts, & Taylor, 2011). An extensive empirical and theoretical literature has found a negative relationship between reservation wages and the duration of unemployment (Addison, Centeno & Portugal, 2004; Burdett & Vishwanath, 1988; Cox & Oaxaca, 1992; Krueger & Mueller, 2016; Wright; 1987). Burdett & Vishwananth (1988) found that when unemployed workers have imperfect knowledge of the wage offer distribution, their reservation wage declines during the search period because of the selection process[1]. Therefore, when an unemployed worker receives an offer lower than expected, he revised his perception of the offer distribution, consequently his reservation wage decline. Moreover, Krueger & Mueller (2016) and Danforth (1979) found that reservation wages decline over the spell of unemployment mainly for older individuals and those with savings. Therefore, unemployed workers have positive savings at the start of the spell and reduce their reservation wage as they reduce their savings during the search process. Additionally, others have found that adverse labor market conditions are associated with lower reservation wages (Addison, Centeno & Portugal, 2004)[2].

Addison, Centeno & Portugal (2004) found that reservation wages are higher for older workers, with higher reservation wages for men than for women. In the same way, Brown, Roberts, & Taylor, (2011) found that the presence of children raises the reservation wage for both men and women, but significantly more for women. Their results suggest that children increase the

[1] Mortensen (1970) and McCall (1970) present a job search model where individual reservation wage is constant throughout the unemployment duration.

[2] A possible floor of the reservation wage in Colombia is the unemployment insurance. Law 1636 of 2013 establishes an unemployment benefit to those who lose their jobs. According to the law, those who are eligible should receive for six months: contribution to the health and pension, family subsidy payment, food subsidy (equivalent to 1.5 minimum wage divided by 6), and any additional individual saving that is done during the employment period as a severance payment.

opportunity cost of accepting work outside the home[3]. Finally, some authors also report evidence of a positive relationship between reservation wages and wealth (Bloemen & Stancanelli, 2001).

The reservation wage is not observed, so it needs to be measure indirectly. In the literature, three methodologies have been used to estimate it. The first one is a survey method that asks directly unemployed individuals about their reservation wages. The main critic of this method is the presence of response bias[4]. The second method is the approach used by Kiefer & Neumann (1979) to predict the reservation wage for unemployed persons, and the third one uses stochastic frontier models, commonly used to estimate the inefficiency measure of a production function, to predict the reservation wage for employed workers. The last two methods correspond to empirical estimations. For example, Kiefer & Neumann use the information on accepted wages after spells of unemployment, and the search theory to infer the reservation wage. This method has been used with information on countries such as the United Kingdom and Germany (Böheim, 2002; Schmidt & Winkelmann (1993); Christensen (2005); among others).

The stochastic frontier method has been recently used in the literature and identifies the reservation wages through the estimation of the frontier earnings function. The stochastic frontier models were introduced by Aigner et al., (1977) and Meeusen & Broech (1977)[5]. Nevertheless, his first application to estimate reservation wages was introduced by Hofler & Murphy (1994). This method has also been used with the information of countries such as Germany and the United Kingdom (Jensen et al., 2010; Cornwell and Schneider, 2000; Webb, Watson, & Hinks, 2003; Watson and Webb, 2008; among others). Hofler and Murphy (1994)[6] use information from the

[3] In 2020, after the covid-19 pandemic, given that most schools and kinder gardens were closed, there was an increase in the family responsibility among women, affecting their reservation wage. As a result, the female labour participation decrease (evidence of the reduction in women participation, especially among those with children, during the pandemic period, is reported in Labour Market Report- RML, No. 18, Bonilla, et al., 2021). This paper does not include the estimation of the reservation wage during the pandemic period due to a lack of information on worker characteristics in the collection of the household surveys.

[4] However, in section 4 we also explore the self-reported reservation wage by those who are unemployed in the GEIH during 2017-2019. Even though those self-reported estimates are bias, we find similar trends with respect to our estimates.

[5] A detailed explanation of stochastic frontier models can be found in Kumbhakar & Lovell (2003).

[6] Previous to the application of reservation wages, Hofler and Polachek (1985) use the stochastic frontier models to estimate the ignorance of the labour market defined as "the difference between the wage (price) individuals earn (pay) with full information and the wage (price) they actually receive (pay) given their limited information stocks". p.267. A similar application is used by Polachek and Yoon (1987) and Groot and Oosterbeek (1994).

US to estimate reservation wages. The authors find that a typical worker´s wage is 25% higher than his reservation wage. Moreover, their results confirm those suggested by the search theory such as reservation wages are related to age, education, and labor market density and wealth. Finally, the authors find that men have higher reservation wages than women. More recently, Leppin (2014) compares the estimation of reservation wages using the Kiefer & Neumann approach versus the stochastic frontier approach, for cross-sectional data in Germany. The author finds that the best results are achieved when using the stochastic frontier model.

In the case of Colombia, there are few estimations of the reservation wages. Villa (2006) estimates the reservation wages following the stochastic frontier approach suggested by Hofler & Murphy (1994). The author uses the information of ECH (DANE) for 2005 and found that the reservation wage is around 77% of the wage. The author finds that the reservation wage increases with the wealth and with the non-labour income; but decreases with the number of kids in the household, age, education, and being head of the household. Our approach complemented those finding by Villa (2006); however, we use the information of GEIH from 2008-2019 and explore the geographic heterogeneity of Colombia studing the reservation wage of four different labour market groups.

Our results are in favour of the search theory predictions, which suggest a positive relation of the reservation wage with the level of education and with the net family labour income. Similar results were found when analyzing the workers´ occupations. Moreover, we find medium age workers that are more attached to the labour market will set higher reservation wages than younger workers, who have not yet decided their career path (therefor they are weakly attached to the labour force). In the same way, we found that women present lower reservation wages than men. This gender gap in the reservation persists even with controlling by the level of education and presence of children in the household. Contrary to the results found in the literature (Brown, et al., 2011), we find that the presence of children reduces the reservation wage of women and men. Finally, we found that the reservation wage increases with the level of development and productivity of the cities; however, qualified workers in low-quality cities present higher reservation wages than median quality cities.

This paper is divided into five sections, aside from this introduction. In the second section, we explain the reservation wage using the job search model. The third section presents the methodology used in the estimations and describes the data used in the analysis. The fourth section presents and discusses the results. The last section concludes.

2. Job search model

According to the search theory, the reservation wage is the necessary wage to induce a worker to accept an offer of employment. However, the problem of the reservation wage is that it is unobservable, and what we observed is the wage. In this section, we introduce the definition of reservation wage according to the job search model. In this section, we present the job search model summarized by Rogerson *et al*. (2005). The model assumes that for an individual who is searching for a job, his problem is to maximize his expected discounted income:

$$E\sum_{t=0}^{\infty}\beta^t x_t \tag{1}$$

Where $\beta \in (0,1)$ is the discount factor, x_t is the income at time t, and E represents the expectation operator. The income depends on the worker's status: when a worker is employed, he gets $x = w$, and when a worker is unemployed, he gets $x = b$; being w the wage and b the unemployment insurance or the value of leisure, among others. It is assumed that an unemployed individual draws from a sample one independently and identically distributed job offer (i.i.d) each period from a known distribution $F(w)$. The worker can accept or reject the offer. If the offer is rejected, then the worker remains unemployed. If the offer is accepted, then the worker keeps the job forever. Then, the Belmman equations that represent this problem is given by:

$$W(w) = w + \beta W(w) \tag{2}$$

$$U = b + \beta\int_0^{\infty} max\{U,W(w)\}dF(w) \tag{3}$$

Where $W(w)$ represents the payoff of accepting a job offer and remaining working forever; and U represents the payoff of rejecting the wage offer and waiting for an offer in the next period. The

reservation wage (w^R) is defined as the value for which $W(w^R) = U$ is satisfied[7]. In this case, the workers are indifferent between being unemployed or employed. The decision rule implies that if $w < w^R$ the worker rejects the offer and if $w \geq w^R$ the worker accepts the offer. Substituting $U = \frac{w^R}{1-\beta}$ and subtracting βw^R from both sides of equation (2), it gives the standard reservation wage:

$$w^R = b + \frac{\beta}{1-\beta}\int_{w^R}^{\infty}(w - w^R)dF(w) \quad (4)$$

Using integration by parts,

$$w^R = b + \frac{\beta}{1-\beta}\int_{w^R}^{\infty}[1 - F(w)]dw \quad (5)$$

Then, this implies that the reservation wage depends on the value of leisure or unemployment insurance (b), the expected gain of receiving a wage offer, which depends on the distribution of job offers and the discount factor (β). However, empirically we just observed a truncated distribution of wage offers, given that rejected offers are not reported. Given this limitation, Hoffler and Murphy (1994) propose the stochastic frontier methodology to estimate the reservation wage.

3 Empirical strategy

3.1 Stochastic frontier model

The stochastic frontier models have been popular since the seminal papers of Meeusen and van den Broeck (1977) and Aigner *et al*. (1977). These models have been motivated by the theoretical concept that no economic agent (firms, or individuals) can exceed their ideal "frontier" (production or wages), and in these cases, any deviation from the ideal frontier represents an inefficiency. In general, these models have been used to estimate the inefficiency of firms under their production function, however, this methodology recently has been applied to other similar problems. Hofler and Murphy (1994), propose the estimation of the reservation wage using

[7] Given that $W(w)$ is a strictly increasing function, then there is a unique value for w_R.

stochastic frontier models with cross-section data[8]. The authors assume that the wage determination process for a particular employed individual (or stochastic wage frontier) is given by:

$$w_i = X_i\beta + \varepsilon_i \qquad (6)$$

Where X_i refers to the individual characteristics and $\varepsilon_i = \gamma_i + \delta_i$, where γ_i and δ_i are the error term specific to the individual i, from which is assumed that $E(\gamma_i) = 0$ and $var(\gamma_i) = \sigma_\gamma^2$ and $E(\delta_i) > 0$ and $var(\delta_i) = \sigma_\delta^2$. The error term γ_i is the conventional error term, while δ_i is a non-negative error term, which reflects the degree by which the worker´s observed wage exceeds the unobserved reservation wage; then $w_i - w_i^R = \delta_i$. Then as long as we can measure δ_i, we can get an estimation of the reservation wage:

$$w_i^R = w_i - \delta_i \qquad (7)$$

In a similar framework, Holfler and Polachek (1985) interpret δ_i as "ignorance", defined as the difference between the price an individual would pay with full information and the price he actually paid, considering his limited information. Polachek and Yoon (1987) interpret δ_i as the gap between the reservation wage and the wage that the firm pays.

The problem we have when using the traditional OLS estimation is to be able to decompose the two terms γ_i and δ_i. The stochastic frontier models allow us to distinguish between these two terms, where the parameter δ_i is constrained from below, $E(\delta_i) > 0$, given the decision rule of accepting an offer. The most common distributions are the half-normal truncated at zero; the half-normal truncated at a non-zero point; and the exponential (Jondrow; 1982; Battese and Coelli,

[8] Stochastic frontier models can also be estimated with panel data. Battese and Coelli (1988; 1992), Cornwell et al. (1990), Lee and Schmidt (1993), Kumbhakar (1990) assume the parameters α_i to be the same across individuals, while Greene (2005 a, b) propose a methodology assuming that the parameter is different across individuals, followed also by Polachek and Yoon (1996), Kumhhakar and Wang (2005), and more recently Chen et al. (2014), Wang and Ho (2010) and Belotti and Llardi (2012). These authors solve the incidental parameter problem and propose different transformations to remove individual effects. The estimation of the stochastic frontier production function in a panel is given by: $w_{it} = \alpha_i + X_{it}\beta + \varepsilon_{it}$, where $\varepsilon_{it} = \gamma_{it} - \delta_{it}$ and $\delta_{it} \geq 0$. α_i refers to the individual fixed effect, and γ_{it} are i.d.d. $N(0, \sigma_\gamma^2)$ and δ_{it} are $N^+(0, \sigma_\gamma^2)$ or half-normal. δ_{it} reflects the degree by which the worker´s observed wage exceeds the unobserved reservation wage; then $w_{it} - w_{it}^R = \delta_{it}$, which can change across time. Additionally, once we have δ_{it}, we can get the estimation of the reservation wage as $w_{it}^R = w_{it} - \delta_{it} = \alpha_i + X_{it}\beta + \gamma_{it}$.

1988). These distributions allow us to separate the two components of the error term and estimate the degree actual wage exceeds the reservation wage for each individual. The half-normal model assumes that δ_i is i. i. d. $N(0, \sigma_\delta^2)$ and truncated at zero from below. The mean of the conditional distribution is given by:

$$E[(\delta_i|\varepsilon_i)] = (\sigma\lambda/1+\lambda^2)\left[\left(\phi(\varepsilon_i\lambda/\sigma)\right)/\left(1-\Phi(-\varepsilon_i\lambda/\sigma)\right)-(\varepsilon_i\lambda/\sigma)\right] \qquad (8)$$

Where φ and Φ are the density and the distribution functions of the standard normal distribution, $\lambda = \sigma_\delta/\sigma_\gamma$ and σ is the standard deviation of the composed error term. In the truncated normal model, δ_i is i.d.d. $N(\mu, \sigma_\delta^2)$ where $\mu \neq 0$ and the distribution is truncated at zero from below. Thus, this distribution contains an additional parameter μ to be estimated. To obtain the mean of the conditional distribution, the expression $\varepsilon_i\lambda/\sigma$ is now $\mu^* = \varepsilon_i\lambda/\sigma + \mu/\sigma\lambda$. In the exponential model, the mean of the conditional distribution is given by:

$$E[(\delta_i|\varepsilon_i)] = \left(\varepsilon_i - \theta\sigma_\gamma^2\right) + \left[\left(\sigma_\gamma\phi\left(\varepsilon_i - \theta\sigma_\gamma^2\right)/\sigma_\gamma\right)/\left(\Phi\left(\varepsilon_i - \theta\sigma_\gamma^2/\sigma_\gamma\right)\right)\right] \qquad (9)$$

Although efficiency measures obtained by different distributional assumptions can have variations, the empirical literature has found that efficiency rankings of production units are similar, particular at the top and the bottom of the distribution (See, for example, Kumbhakar and Lovell, 2003). We use the half-normal distribution and assume that δ_i, the gap between the worker´s observed wage and the unobserved reservation wage $(w_i - w_i^R = \delta_i)$, is a function of labour market conditions that are not controlled by the individuals, but which affect their reservation wage.

3.2 Data

In this paper, we use the information on salaried employed individuals in the period 2008-2019, from the Great Household Integrated Survey (GEIH), provided by the National Administrative Department of Statistics (DANE). This information is representative of all 23 main cities and their

metropolitan areas in Colombia[9]. Estimations were carried out using the pool of individuals who answered the survey during the analyzed period and reported to be occupied as salaried during the survey week. The dependent variable used in the stochastic frontier estimations is the natural logarithm of the worker's hourly wage[10]. Following the search model, we use individual workers´ characteristics to measure the reservation wage such as: age, education, gender, and occupations. We also control by geographic regions and economic sectors.

Considering the heterogeneity of the labor market across cities of the country, results assess differences of actual and reservation wages across four different groups of cities, which are grouping base on the competitive ranking of cities in 2020 build by the Private Competitivity Council (CPC by acronym in Spanish). To build this index, the CPC considers four groups of indicators including enabling conditions of living, human capital, market efficiency and innovative ecosystem, using in total around 103 different indicators. Using the CPC indicator by city, we group cities from the most competitive to the less competitive: the first group includes individuals who work in Bogotá, the capital of the country; the second group include individuals who work in Medellín, Manizales, Bucaramanga, Tunja, Cali, Pereira and Barranquilla; the third group those who work in Popayán, Armenia, Cartagena, Neiva, Pasto, Ibagué, Cúcuta and Santa Marta; finally, the fourth group includes the individuals who work in Villavicencio, Montería, Sincelejo, Valledupar, Florencia, Quibdó and Riohacha.

Table 1 summarizes the descriptive statistics of the variables used in the estimation for the total sample and by groups of the cities. For the period 2008-2019, in the whole sample the salaried worker received a median wage per hour of $3.543 (constant prices of 2018), the median age is 31 years old and 47.9% of workers are male. In terms of occupations, 24% are managers and professionals, while more than 50% are workers dedicated to services, technical, sales work etc. These occupations are highly related to the level of education where more than 52% have secondary education, 21.6% have a technical education and 16% have a higher education.

[9] The main 23 cities are: Armenia, Barranquilla, Bogotá, Bucaramanga, Cali, Cartagena, Cúcuta, Florencia, Ibagué, Manizales, Medellín, Montería, Neiva, Pasto, Pereira, Popayán, Quibdó, Riohacha, Santa Marta, Sincelejo, Tunja, Valledupar, Villavicencio.

[10] The data are transformed in such a way that the arithmetic mean of the sample of the variables in logarithm is 0, which is equivalent to setting the geometric mean of the original variable (without logarithms) equal to 1. This is done by dividing each series by its geometric mean (Coelli, Estache, Perelman and Trujillo 2003).

Table 1. Descriptive statistics: 2008-2019

	Total sample	Group 1	Group 2	Group 3	Group 4
Worker's hourly wage ($, 2018=100)	3,543	3,956	3,569	3,476	3,441
Household income excluding worker´s wage ($, 2018=100)	6,798	8,379	7,066	6,301	6,500
Age	31	30	31	32	31
Years present employer	2	2	2	3	3
Children under 14 years	1	1	1	1	1
Sex (male=1) (%)	47.9	49.0	49.1	47.6	45.5
Head household (yes=1) (%)	29.0	29.1	28.3	29.5	29.6
Marital status (married=1) (%)	54.7	51.7	52.4	56.2	57.7
Occupation					
Manager or professional (%)	24.0	25.7	22.2	24.2	26.3
Service, tech, sales w. (%)	52.1	50.6	51.4	53.7	52.4
Craft, operative w. (%)	14.5	15.1	18.1	12.4	9.8
Unskilled (%)	9.5	8.5	8.3	9.7	11.5
Education					
Secondary education (%)	52.5	54.3	54.2	50.8	50.5
Technical education (%)	21.6	20.7	22.9	22.0	19.4
College education (%)	16.3	15.0	14.3	17.1	19.3
Graduate level education (%)	7.3	7.4	6.3	7.9	8.3
Economic sector					
Agricultural sector (%)	0.9	0.4	0.9	0.9	0.5
Mining sector (%)	0.6	0.5	0.2	0.7	1.1
Manufacturing sector (%)	13.2	16.5	19.2	9.8	5.9
Electricity, gas, water (%)	1.4	0.6	1.2	1.7	1.7
Construction sector (%)	3.7	3.2	3.9	3.4	3.7
Commerce, hotel, rest. (%)	26.6	23.2	25.5	28.2	27.8
Transport, storage, communic. (%)	6.7	9.0	6.9	6.9	5.3
Financial intermediation (%)	3.5	5.6	3.5	3.3	3.2
Real estate activities (%)	8.0	15.1	9.8	6.2	4.7
Public services (%)	35.3	25.8	28.9	38.8	46.1

Source: Author's calculations based on Great Household Integrated Survey (GEIH).

Finally, regarding sectors, the majority of salaried workers are operating in the manufacturing sector (13.2%), commerce, hotel and restaurants (26.5%) and the public services sector (35.3%). Moreover, by groups of cities, we find important differences, for example, group 1 presents a median wage per hour higher than the whole sample ($3,956), followed by group 2 which presents a median wage per hour of $3,569, group 3 with $3,476 and group 4 with $3,441. The lowest median wage per hour in group 4 is not surprising when we consider that this group has received the lowest classification of the competitive index, and the highest levels of inequality

as reported by other authors[11] (Arango, Flórez & Delgado, 2019; and Otero, Herrera, & Monroy, 2019). Another interesting difference across groups is the distribution of economic sectors; while group 1 and 2 have a higher proportion of workers in the manufacturing sector (compared to the whole sample), group 4 presents a higher proportion of workers in the mining sector[12], and a low proportion in the manufacturing sector. Moreover, while the proportion of workers in the public sector for groups 1 and 2 is very similar; for groups 3 and 4 this proportion is relatively high (around 40%)[13]. This composition also indicates different levels of development between these groups of cities.

4. Results

4.1. Stochastic wage frontier

The estimation of the stochastic wage frontier is carried out using the half-normal distribution for the pool of individuals who responded to the GEIH during the 2008-2019 period and who reported being a salaried worker. Table 2 present the results of the estimated wage function (equation 6). As in the traditional wage function estimations, the coefficients of age and age squared indicate that earnings increase with age but at a decreasing rate (similar results with experience working with the current employer). Moreover, characteristics such as being male, head of the household, or married increase the wage earnings. In terms of occupations, we find the earnings increase with the level of skill, then the higher the occupation skill the higher the wage-earning. For example, individuals whose occupation is manager or professional received a wage 39.6% higher than those unskilled workers. Similar results are found when comparing the level of education. Individuals with secondary education received wage earnings 11.6% higher than those with primary education. As it is also reported by the literature, there is a positive and significant relationship between actual wage and income of the worker's household net of the worker's own income.

[11] Recent studies have analyzed the relation between the coal price and the labour market dynamic in Valledupar (Arango, Flórez & Delgado, 2019), and the increase of the levels of inequality in Valledupar (Otero, Herrera, & Monroy, 2019).

[12] We estimate all results excluding the mining sector. The results were very similar to the ones presented in the main estimations. Results are available upon request.

[13] The public sector includes workers in the public administration and defense, education, health, and other social services.

Table 2. Estimated parameters of the wage function from stochastic frontier estimation
Dependent variable: ln actual hourly wage

Variables	Parameters
Income of the worker's household net of the worker's own income	0.1188***
	(0.000)
Age	0.0284***
	(0.000)
Square of age	-0.0003***
	(0.000)
Years working with the present employer	0.0032***
	(0.000)
Square of the number of years with the present employer	-0.0000***
	(0.000)
Head of the household (yes=1)	0.1171***
	(0.000)
Marital status (married=1)	0.0752***
	(0.000)
Manager or professional (yes=1)	0.3960***
	(0.000)
Service, technical, sales workers (yes=1)	0.1885***
	(0.000)
Craft or operative worker (yes=1)	0.0680***
	(0.000)
Number of children under 14 years of age	-0.0165***
	(0.000)
Sex (male=1)	0.0969***
	(0.000)
Secondary education (yes=1)	0.1167***
	(0.000)
Technical education (yes=1)	0.2717***
	(0.000)
College education (yes=1)	0.6956***
	(0.000)
Graduate level education (yes=1)	1.1767***
	(0.000)
Mining sector (yes=1)	0.5281***
	(0.000)
Manufacturing sector (yes=1)	0.0222***
	(0.000)
Electricity, gas, and water (yes=1)	0.1790***
	(0.000)
Construction sector (yes=1)	-0.0389***
	(0.000)
Trade, hotel, and restaurant sector (yes=1)	-0.0836***
	(0.000)
Transport, storage, and communications (yes=1)	-0.0171***
	0.1188***

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 2. Estimated parameters of the wage function from stochastic frontier estimation
Dependent variable: ln actual hourly wage. *(Cont.)*

Variables	Parameters
Financial intermediation sector (yes=1)	0.2407***
	(0.000)
Real estate activities sector (yes=1)	-0.0017***
	(0.000)
Public services (yes=1)	0.0217***
	(0.000)
Atlantic region (yes=1)	-0.1397***
	(0.000)
Easter region (yes=1)	-0.0505***
	(0.000)
Bogota (yes=1)	0.0578***
	(0.000)
Pacific region (yes=1)	-0.0336***
	(0.000)
Constant	-0.5677***
	(0.000)
Include dummies of year of survey	yes
Include dummies of month of Survey	yes
Observations	795,619

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Source: Author's calculations based on Great Household Integrated Survey (GEIH).

In turn, we find different wage earnings across economic sectors. Then, individuals that work in sectors such as mining, manufacture, electricity, financial intermediation, and public sector received higher wages compared to those who work in the agricultural sector; while those who work in construction, trade, transport and communication receive a lower wage (compared to the agricultural sector). As we mention in the descriptive section, the geographical differences are very important; to have an idea about the regional differences, we control by the geographical regions defined by DANE: Atlantic region; Easter region, Central region, Pacific region, and Bogotá[14]. As we observed workers located in regions such as the Atlantic, Easter and the Pacific received a lower wage compared to those located in the Central region. Only Bogotá, the capital

[14] The Atlantic region is defined by the departments of Atlántico, Bolívar, Cesar, Córdoba, La Guajira, Magdalena and Sucre; the Easter region by the departments of Boyacá, Cundinamarca, Meta, Norte de Santander, Santander; the Central region by the departments of Antioquia, Caldas, Caquetá, Huila, Quindío, Risaralda and Tolima; Pacific region by the departments of Cauca, Chocó, Nariño and Valle del Cauca; Bogotá region by Bogotá, D.C.

of the country, has higher wages than the Central region. In the next section, we explore with more details these differences, exploring the different reservation wages by group cities, classified by CPC according to their level of competitiveness and development.

4.2. Reservation wages

4.2.1 All urban areas

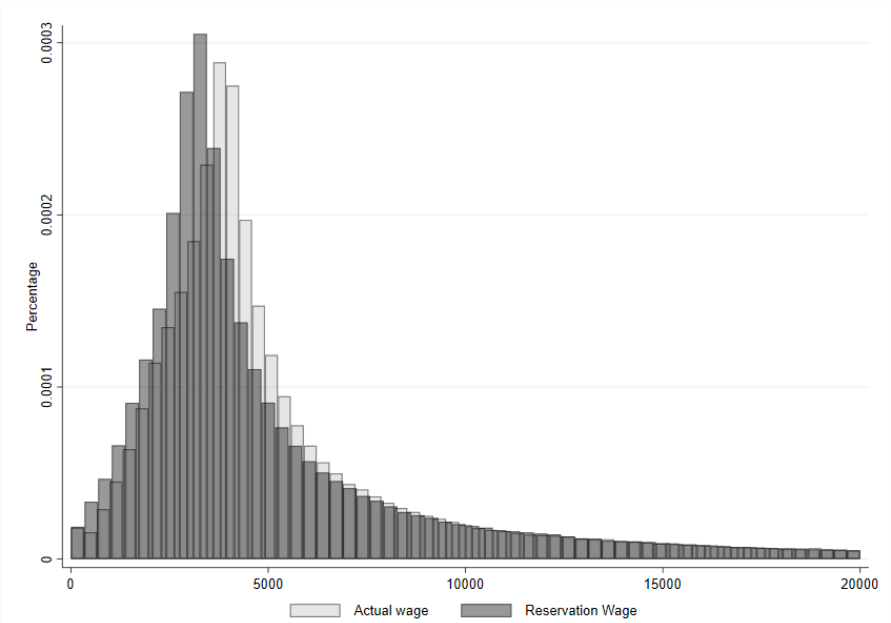
Reservation wages for salaried individuals are calculated from equation (7) using the estimated parameter $\hat{\delta}_i$ from the stochastic frontier estimation[15]. Figure 1 shows the frequency distribution of the actual and reservation wage salary in real terms at prices of 2018. As we can observe, the reservation wage distribution is concentrated to the left of the wage distribution, with a median reservation wage per hour of $3,750 (prices of 2008), compared to the median wage of $4,537. In relative terms, the reservation wage represents 82.6% of the median actual wage. Our results are similar to those found by other authors such as Hofler and Murphy (1994) in the case of the United States (around 80% of the average wage) and Villa (2006) for the case of Colombia (77% of the average wage). Figure 1 also shows the importance of considering in the analysis the quantile distribution of the reservation wages, given that both the reservation wage and the actual wage distributions have a long right tail.

Table 3 shows the reservation wage estimation at the percentile 10 (Q1), percentile 25 (Q2), percentile 50 (Q3), percentile 75 (Q4) and percentile 90 (Q5). It is worth mentioning that the ratio between the reserve wage and the observed wage increases with the quantile distribution, going from 73.4% in Q1 to 86.7% in Q5. This result is in line with the idea that wealthy individuals have a higher opportunity cost of work compared to those with lower income, therefore their reservation wage should be higher (Holfer & Murphy, 1994). These results remain

[15] We also explore the self-reported reservation wage by those who are unemployed in the GEIH during 2017-2019. In this case, individuals answer what is the wage at which they are willing to accept a job. Even though those self-reported estimates are bias, we find some similarities with respect to our estimates. For example, we find a positive relation between self-reported reservation wage and the level of education (and with age). Similarly, we found that women present lower self-reported reservation wages than men. Moreover, as shown by our results, presence of children reduces the self-reported reservation wages of women and men, being the higher reduction in women. In contrast to the results found in the literature and in this paper, self-reported reservation wages increase with the duration of unemployment, specifically for periods longer than 3 months unemployment and even longer than 6 months.

across any dimensions such as level of education, occupations, economic sectors, age, and gender. Table 3 also presents the reservation wage estimations using quantiles for the different socioeconomic characteristics previously mentioned.

Figure 1. Frequency histograms of actual and reservation wage



Source: Authors's calculations based on Great Household Integrated Survey (GEIH).
Note: The graph was truncated at the $ 20,000 hourly wage.

Following Hofler and Murphy (1994), we also check if our results are consistent with those predicted by the search theory. As it is presented in equation (5), one important element that affects the reservation wage is the discount factor defined by β. This discount factor is implicitly related to the preferences, the grade of attachment to the labour market or the opportunity cost of work versus leisure. Then, different demographic groups might have different discount factors and therefore different reservation wages. For example, medium age workers which are more attached to the labour market will set higher reservation wages than younger groups weakly attached to the labour force which have not yet decided their career path. Similarly, women have different preferences and also different opportunity cost of work than men, reflecting a lower reservation wage comparing to men. (see Table 3).

Table 3. Actual and reservation wages by quintiles
(Colombian $2018=100)*

	Q1[1/]			Q2[2/]			Q3[3/]			Q4[4/]			Q5[5/]		
	Actual wage	Reserv. wage	%	Actual wage	Reserv. wage	%	Actual wage	Reserv. wage	%	Actual wage	Reserv. wage	%	Actual wage	Reserv. wage	%
Total sample	2,547.4	1,869.7	73.4	3,554.5	2,810.3	79.1	4,537.2	3,750.2	82.7	7,448.9	6,310.9	84.7	14,201.7	12,309.4	86.7
Sex:															
Male	2,686.2	1,971.3	73.4	3,605.2	2,842.5	78.8	4,637.8	3,820.5	82.4	7,571.4	6,443.0	85.1	14,531.3	12,544.1	86.3
Female	2,421.7	1,775.0	73.3	3,501.4	2,778.1	79.3	4,454.3	3,694.2	82.9	7,328.4	6,181.2	84.3	13,931.7	12,119.5	87.0
Education:															
Prim/no educ.	1,464.9	991.8	67.7	2,287.7	1,770.9	77.4	3,262.3	2,733.9	83.8	4,121.6	3,590.0	87.1	5,370.0	4,830.4	90.0
Secondary	2,166.6	1,552.1	71.6	3,103.1	2,448.3	78.9	3,902.3	3,243.8	83.1	4,917.3	4,244.6	86.3	6,864.1	6,184.8	90.1
Technical	3,087.3	2,276.1	73.7	3,798.6	2,987.4	78.6	4,696.6	3,853.8	82.1	6,493.8	5,604.8	86.3	9,374.1	8,471.4	90.4
College	4,188.7	2,812.0	67.1	5,982.3	4,440.1	74.2	9,098.5	7,438.8	81.8	13,805.4	12,157.0	88.1	19,985.4	18,416.8	92.2
Graduate level	8,857.2	5,938.0	67.0	12,725.9	9,548.5	75.0	18,175.8	14,775.8	81.3	24,776.9	21,448.0	86.6	33,567.2	30,546.2	91.0
Age:															
<25	1,831.4	1,286.5	70.2	2,782.6	2,192.3	78.8	3,694.7	3,085.7	83.5	4,578.9	3,948.2	86.2	6,226.6	5,527.9	88.8
26-35	2,746.1	2,036.1	74.1	3,644.8	2,890.4	79.3	4,553.4	3,768.3	82.8	6,822.4	5,780.0	84.7	11,156.1	9,722.7	87.2
36-45	3,020.8	2,201.5	72.9	3,904.3	3,065.4	78.5	5,193.0	4,247.8	81.8	9,147.5	7,691.2	84.1	16,039.6	13,972.2	87.1
46-55	3,233.0	2,331.5	72.1	4,094.9	3,199.2	78.1	6,284.3	5,118.6	81.5	13,162.8	11,123.9	84.5	21,954.6	19,318.7	88.0
56-65	3,525.2	2,564.5	72.7	4,717.6	3,714.0	78.7	10,191.6	8,545.0	83.8	19,651.6	16,859.1	85.8	26,745.6	24,002.5	89.7

Source: Author's calculations.
*The actual wage corresponds to that reported in the Great Household Integrated Survey (GEIH) and the reservation wage to that obtained from the stochastic frontier estimations.
[1/] Percentile 10, [2/] Percentile 25, [3/] Percentile 50, [4/] Percentile 75, [5/] Percentile 90, [6/]Net of the worker´s own income.

Table 3. Actual and reservation wages by quintiles
(Colombian $ - 2018=100)*

(Cont.)

	Q1[1/]			Q2[2/]			Q3[3/]			Q4[4/]			Q5[5/]		
	Actual wage	Reserv. wage	%	Actual wage	Reserv. Wage	%	Actual wage	Reserv. wage	%	Actual wage	Reserv. wage	%	Actual wage	Reserv. wage	%
Net household income*															
<=$3000	1,990.3	1,420.0	71.3	2,988.4	2,374.0	79.4	3,952.7	3,338.4	84.5	5,396.2	4,709.3	87.3	9,061.2	8,118.5	89.6
$3001-$5000	2,436.2	1,785.4	73.3	3,367.3	2,663.0	79.1	4,124.8	3,416.3	82.8	5,542.5	4,738.0	85.5	8,970.7	7,899.8	88.1
$5001-$7000	2,539.4	1,863.6	73.4	3,541.9	2,804.4	79.2	4,426.8	3,655.0	82.6	6,310.0	5,379.2	85.2	10,464.5	9,164.1	87.6
>=$7001	2,876.1	2,103.4	73.1	3,816.2	3,007.7	78.8	5,307.6	4,338.5	81.7	10,017.4	8,417.5	84.0	18,369.9	15,897.0	86.5
Occupation:															
Manager, prof.	3,938.5	2,799.4	71.1	5,753.3	4,355.7	75.7	9,957.1	8,042.4	80.8	16,864.3	14,390.2	85.3	24,850.3	22,066.4	88.8
Serv, tech, sales	2,538.1	1,853.6	73.0	3,479.3	2,744.6	78.9	4,297.2	3,544.3	82.5	5,974.2	5,117.1	85.7	9,211.4	8,204.4	89.1
Craft, oper.work	2,254.9	1,655.7	73.4	3,179.2	2,537.2	79.8	3,913.4	3,259.6	83.3	4,808.3	4,144.0	86.2	6,528.4	5,844.8	89.5
Unski. workers	1,780.5	1,233.5	69.3	2,639.6	2,045.4	77.5	3,726.8	3,101.7	83.2	4,488.5	3,869.1	86.2	5,773.3	5,144.9	89.1
Tenure															
Less than 1 year	1,929.5	1,325.9	68.7	2,898.4	2,223.8	76.7	3,738.6	3,059.1	81.8	4,903.4	4,122.5	84.1	7,692.6	6,582.1	85.6
With 1 year	2,194.8	1,570.7	71.6	3,164.7	2,478.2	78.3	3,998.5	3,314.0	82.9	5,392.2	4,576.9	84.9	8,812.2	7,604.1	86.3
Between 2-5 years	2,811.8	2,101.1	74.7	3,715.3	2,964.3	79.8	4,613.7	3,835.2	83.1	7,005.3	5,964.3	85.1	12,134.3	10,532.3	86.8
More than 5 years	3,503.7	2,646.1	75.5	4,314.9	3,472.3	80.5	6,468.1	5,368.2	83.0	12,526.8	10,686.6	85.3	21,222.1	18,645.8	87.9
Region:															
Atlantic	2,341.2	1,725.2	73.7	3,418.8	2,723.5	79.7	4,357.6	3,638.9	83.5	7,157.2	6,073.9	84.9	13,768.5	12,083.7	87.8
Easter	2,617.9	1,951.1	74.5	3,535.9	2,820.5	79.8	4,548.1	3,784.0	83.2	7,377.0	6,267.1	85.0	13,824.7	11,911.0	86.2
Central	2,726.3	2,000.8	73.4	3,639.1	2,864.2	78.7	4,569.2	3,752.8	82.1	7,330.2	6,187.9	84.4	13,817.0	11,928.3	86.3
Pacific	2,231.6	1,569.1	70.3	3,394.9	2,640.7	77.8	4,523.9	3,722.8	82.3	7,787.8	6,591.8	84.6	15,169.3	13,106.6	86.4
Bogota	3,035.8	2,220.8	73.2	3,837.9	3,025.4	78.8	5,066.4	4,174.3	82.4	8,356.9	7,112.9	85.1	16,635.1	14,531.7	87.4

Source: Author's calculations.

*The net household income excludes the work´s income. The actual wage corresponds to that reported in the Great Household Integrated Survey (GEIH) and the reservation wage to that obtained from the stochastic frontier estimations. [1/] Percentile 10, [2/] Percentile 25, [3/] Percentile 50, [4/] Percentile 75, [5/] Percentile 90.

Table A1 in the appendix shows the t-test for the gender gap on the reservation wage (reservation wage of men compared to women) which is positive and significant at each quantile (we discuss with more details this gender gap on the reservation wage in the next section). In Table 3, we observed that the reservation wage increases with age across all quantiles. Thus, individuals with less than 25 years old have a lower reservation wage than older individuals. Table A1 in the appendix shows the t-test for these differences, indicating that they are positive and statistically significant across all the distribution. The difference in the reservation wage by age also increases with the quantile. Then, for individuals in a higher quantile, the difference in the reservation wage of young workers versus older workers is extremely high. This might be the result of differences in the opportunity cost of those individuals. For instance, for young wealthy individuals, the cost of leaving school is higher than for a poor young individual who probably has become working at an early age.

Another important element that determines the reservation wage is the individual characteristics such as level of education, occupations, economic sectors, and regions that reflect the different job offers received by each individual. Then, individuals with a high level of education (college or graduate level) may present higher wage offers implying higher reservations wages than those with low education or non-education, as is suggested by Hofler and Murphy (1994). We find that this is the case, for all individuals, at all quantiles. According to the t-test, the difference in the reservation wage of educated and non-educated workers is positive and significant (see Table A1 in the appendix), for all quantiles. In line with the results across levels of education, we find that the reservation wages are lower for those individuals with low-skill occupations compared to the reservation wage of individuals with a higher skill across all quantiles. Moreover, characteristics such as tenure, also increase the reservation wage across all distribution.

When comparing the difference across economic sectors, we find interesting results (see Table A2 in Appendix)[16]. The mining sector exhibits on average the highest reservation wage, while

[16]According to the t-test, in general the differences in the reservation wages across sectors are statistically significant, except for some cases such as mining, financial intermediation and electricity, gas and water in Q1, agriculture and manufacture in Q2, agriculture and real estate in Q3 and Q4 and between financial intermediation and electricity gas and water, and agriculture and construction sectors in Q5. To save space tables are not shown on the paper. Information is available upon request.

the trade, hotel and restaurant sectors have the lowest reservation wage, across all quantiles. Excluding the mining sector[17], the public sector has the highest reservation wage followed by the financial, intermediation and the electricity, gas, and water sectors in the Q4 and Q5 quintiles. For quintiles Q1, Q2 and Q3, the highest reservation wages are observed in the financial sector followed by the electricity, gas and water, and the public sector.

Interesting differences are also observed when comparing reservation wages across geographical regions (see Table 3). For quintiles Q1, Q2 and Q3 the lowest reservation wage is observed in the Pacific and the Atlantic region. For quintile Q4 the lowest reservation wage is observed in the Atlantic and Central region, and finally, for Q5 the lowest reservation wage is presented in the Central and the Eastern regions, while Bogotá exhibits the highest reservation wage across all quantiles. These regional differences are all statistically significant, except for the reservation wage of the Central and the Eastern region in Q5[18]. Finally, as it has been found in the literature, individuals who live in households with higher net labour income (excluding worker´s income) are more likely to be able to wait and search for high-paying jobs and therefore should have higher reserve salaries (Prasad, 2003). Indeed, as can be seen for the case of Colombia, reserve wages increase with net family income. This increase is greater for the highest quintiles (see Table 3). Similar results are found in the literature with individuals' wealth (Bloemen & Stancanelli, 2001).

4.2.2 Exploring differences by gender

In this section, we explore the difference in the reservation wage between males and females of all urban areas, considering different characteristics such as education, age, and number of children lower than 14 years old in the household. Table 4 present the reservation wage of males and females by different levels of education[19]. Results show higher reservation wages for males across all different levels of education compared to women. However, the difference in the

[17] Workers in the mining sector are on average more educated (with college or graduate level of education) than other economic sectors.
[18] To save space tables of the t-tests differences of means are not presented on the paper. Information is available upon request from the authors.
[19] Differences are statistically significant in all cases. T-tests are available upon request from the authors.

reservation wage between men and women increases with the educational level, especially in quintiles 4 and 5. The reservation wage gap can express gender differences with respect to preferences or personality traits (Barber & Odean, 2001), such as careers choices of women compared to men, differences in career promotions[20] or different risk preferences (women tend to be more risk-averse, which may induce a reduction on their reservation wage, (Eckel & Grossman, 2008; Raimers, 1985)[21]. Moreover, the highest increase in reservation wages is observed when individuals (women and men) pass from college to graduate level of education.

By age, we find that the difference in the reservation wage between women and men remains; however, this difference is more pronounced between the age of 26-45 especially for quintiles 1 to 2. For quintiles 3 to 4, we find that younger women (lower than 25 years old) have higher reservation wages than men, but this difference becomes positive and increasing with age, up to 55 years old. At quintile 5, we find that women lower than 25 years old present higher reservation wages than men, but this difference becomes positive and increasing up to the age of 65. As we explore later, these results may be related to the fertility age of women and the presence of children in the household.

Additionally, we explore the differences in reservation wages of women and men by tenure. We find that for quintiles 1 and 2 the reservation wage gap between women and men decreases with tenure; however, this is not the case for women and men in quintiles 3 to 5, where the gap in the reservation wage increases with tenure. To understand these differences in reservation wages, we estimate the reservation wage for women and men with the presence of children. According to the literature, the presence of children helps to explain those ones between women and men, since children raise the opportunity cost of accepting a job (Gronau, 1973; Brown, et al., 2011; Kahn &

[20] For instance, Bosquet, Combes and García-Peñalosa (2019) found for French academic economists that women have fewer promotions. The authors find that a high percentage in the promotion gap (76%) is explained by women seeking less promotions. Hospido, Laeven, Lamo (2019) examine gender differences in career promotions using information from the European Central Bank (ECB) and found that women are less likely to be promoted to a higher salary band. This result is partly explained by the presence of children. Finally, Caliendo, Lee, and Mahlstedt (2014) also explore the determinants of the gender gap in reservation wages, finding that productivity differences and expectations matter in explaining the gender gap.

[21] Another possible explanation for the lower reservation wage of women compared to men may be related to the existing subsidy of the government payments to retirees' women compared to retirees' men (women retired at the age of 57 and men at the age of 65), which forces women to reduce their reservation wage to find a job and be able to receive the future government payment.

Whittington, 1996). For example, Brown, et al. (2011) indicate that children raise the reservation wage for both men and women, but significantly more for women. While, Caliendo, Lee and Mahlstedt (2014) explain that the gender reservation wage gap may be the result of differences in expectations, which change differently over time for men and women and are widen with the presence of children. According to these authors: "*the search theory literature suggests that a gender gap in reservation wages might exist because females have a much smaller value of non-market time while unemployed than males, or that they encounter different wage offer distributions and work in segmented labor markets. Differing expectations in reservation wages could also arise due to gender differences in preferences or personality traits.*" pp. 20.

Results in Table 4 show that for quintiles 1 to 3 there are not bigger differences between reservation wages for women and men without children. However, in the presence of children, the reservation wage of women and men decreases, being the highest reduction on the women´s reservation wage. For quintiles 4 and 5, the difference between reservation wage of women and men without children remains but it is also lower compared to the difference in the reservation wage of women and men with the presence of kids. Moreover, the reservation wage at higher quintiles also decreases with the presence of kids for both women and men. These results are different from those found by Brown, et al., 2011 suggesting that even though the presence of children may increase the opportunity cost of accepting a job for women and men, it also increases the value of being employed because of larger income needs of the family. Then the effect on the reservation wage depends on those two forces. In the case of Colombia, the presence of children increases the incentives to work, implying a reduction in the reservation wage to find a job. Thus, the income effect predominates over the substitution effect. Unlike developed countries, in Colombia, childcare can be done by family members or at a low cost. Moreover, some characteristics of the job such as the timetable flexibility may also be preferred for individuals with children, (especially women) even if this implies a lower wage (Arango and Lora, 2017).

.

Table 4. Actual and reservation wages by sex, considering socioeconomic characteristics (Colombian $ - 2018=100)*

	Q1[1/]			Q2[2/]			Q3[3/]			Q4[4/]			Q5[5/]		
	Actual	Reserv.	%	Actual	Reserv.	%	Actual	Reserv.	%	Actual	Reserv.	%	Actual	Reserv.	%
Education															
Males															
Prim/no educ.	1,639.3	1,136.7	69.3	2,513.1	1,966.3	78.2	3,425.1	2,863.9	83.6	4,297.9	3,748.3	87.2	5,689.7	5,157.7	90.7
Secondary	2,386.2	1,725.4	72.3	3,262.2	2,571.7	78.8	4,015.9	3,328.2	82.9	5,242.2	4,521.4	86.2	7,397.8	6,693.6	90.5
Technical	3,258.0	2,378.5	73.0	3,932.8	3,062.1	77.9	5,117.8	4,183.1	81.7	7,352.6	6,361.8	86.5	10,714.5	9,720.5	90.7
College	4,369.8	2,877.7	65.9	6,520.1	4,785.7	73.4	10,033.6	8,180.7	81.5	15,275.9	13,408.2	87.8	22,109.0	20,410.5	92.3
Graduate level	9,501.3	6,322.0	66.5	13,708.8	10,133.1	73.9	19,422.4	15,675.3	80.7	26,634.1	23,027.6	86.5	39,411.9	36,170.7	91.8
Females															
Prim/no educ.	1,327.8	863.2	65.0	2,032.0	1,544.8	76.0	3,008.5	2,500.6	83.1	3,924.0	3,398.4	86.6	4,841.9	4,343.8	89.7
Secondary	1,964.2	1,389.3	70.7	2,899.9	2,291.6	79.0	3,782.2	3,158.8	83.5	4,591.8	3,976.5	86.6	6,160.3	5,555.1	90.2
Technical	2,954.2	2,189.3	74.1	3,713.6	2,940.7	79.2	4,476.8	3,689.6	82.4	5,935.8	5,115.4	86.2	8,338.9	7,511.7	90.1
College	4,092.6	2,772.9	67.8	5,719.2	4,251.5	74.3	8,579.2	7,018.0	81.8	12,924.9	11,398.4	88.2	18,405.2	17,000.1	92.4
Graduate level	8,445.2	5,703.7	67.5	12,105.6	9,162.3	75.7	17,168.8	14,094.7	82.1	23,414.9	20,396.9	87.1	29,674.5	26,925.7	90.7
Age															
Males															
<25	1,866.0	1,295.1	69.4	2,827.0	2,218.5	78.5	3,695.8	3,075.3	83.2	4,585.8	3,945.3	86.0	6,216.1	5,521.6	88.8
26-35	2,906.3	2,157.9	74.2	3,689.6	2,921.8	79.2	4,626.4	3,818.2	82.5	6,839.6	5,823.5	85.1	11,029.5	9,615.9	87.2
36-45	3,226.2	2,354.1	73.0	4,015.3	3,147.4	78.4	5,473.2	4,483.6	81.9	9,413.2	7,959.2	84.6	16,584.6	14,453.5	87.2
46-55	3,369.3	2,419.4	71.8	4,219.2	3,269.4	77.5	6,617.8	5,409.7	81.7	13,704.8	11,546.9	84.3	23,176.1	20,265.1	87.4
56-65	3,584.9	2,575.7	71.8	4,821.8	3,746.5	77.7	10,254.3	8,511.1	83.0	20,095.4	17,096.9	85.1	28,476.2	25,472.1	89.5
Females															
<25	1,803.9	1,280.6	71.0	2,736.9	2,165.7	79.1	3,692.9	3,095.0	83.8	4,571.9	3,952.0	86.4	6,236.5	5,532.4	88.7
26-35	2,593.0	1,915.7	73.9	3,598.4	2,859.2	79.5	4,490.8	3,726.2	83.0	6,806.4	5,737.4	84.3	11,286.0	9,817.3	87.0
36-45	2,813.6	2,048.4	72.8	3,809.0	2,997.5	78.7	4,959.7	4,060.6	81.9	8,880.4	7,438.4	83.8	15,598.5	13,557.1	86.9
46-55	3,087.9	2,241.0	72.6	3,999.5	3,147.6	78.7	5,948.7	4,835.1	81.3	12,718.6	10,760.9	84.6	21,100.0	18,572.6	88.0
56-65	3,452.5	2,541.8	73.6	4,608.6	3,675.8	79.8	10,145.4	8,570.5	84.5	19,273.5	16,623.4	86.3	25,613.1	22,944.3	89.6

Source: Author's calculations.

*The actual wage corresponds to that reported in the Great Household Integrated Survey (GEIH) and the reservation wage to that obtained from the stochastic frontier estimations.

[1/] Percentile 10, [2/] Percentile 25, [3/] Percentile 50, [4/] Percentile 75, [5/] Percentile 90.

Table 4. Actual and reservation wages by sex, considering socioeconomic characteristics (Colombian $ - 2018=100)* *(cont.)*

	Q1[1]/			Q2[2]/			Q3[3]/			Q4[4]/			Q5[5]/		
	Actual	Reserv.	%	Actual	Reserv.	%	Actual	Reserv.	%	Actual	Reserv.	%	Actual	Reserv.	%
Tenure															
Males															
Less than 1 year	2,059.1	1,415.7	68.8	3,012.6	2,302.0	76.4	3,781.9	3,082.2	81.5	5,012.3	4,207.9	84.0	7,816.9	6,704.2	85.8
With 1 year	2,361.6	1,693.9	71.7	3,255.9	2,547.6	78.2	4,048.5	3,333.9	82.3	5,545.3	4,697.1	84.7	9,056.9	7,833.4	86.5
Between 2-5 years	2,924.6	2,178.1	74.5	3,750.6	2,979.6	79.4	4,694.9	3,892.1	82.9	7,132.6	6,102.3	85.6	12,451.6	10,806.6	86.8
More than 5 years	3,536.9	2,652.1	75.0	4,362.3	3,498.7	80.2	6,518.2	5,436.9	83.4	12,326.2	10,514.9	85.3	21,717.6	18,969.7	87.3
Females															
Less than 1 year	1,832.6	1,258.6	68.7	2,793.8	2,146.1	76.8	3,705.8	3,039.4	82.0	4,812.4	4,047.3	84.1	7,592.1	6,474.8	85.3
With 1 year	2,081.1	1,472.8	70.8	3,068.9	2,413.1	78.6	3,965.6	3,294.8	83.1	5,259.1	4,471.5	85.0	8,639.0	7,430.3	86.0
Between 2-5 years	2,702.4	2,019.2	74.7	3,686.4	2,947.5	80.0	4,545.2	3,787.6	83.3	6,871.8	5,838.4	85.0	11,816.5	10,267.7	86.9
More than 5 years	3,478.6	2,639.8	75.9	4,274.5	3,449.4	80.7	6,414.8	5,301.6	82.6	12,687.3	10,849.7	85.5	20,817.4	18,389.7	88.3
Without children															
Males															
<25	2,003.7	1,421.4	70.9	2,990.9	2,364.2	79.0	3,820.6	3,188.7	83.5	4,835.0	4,163.0	86.1	6,791.9	6,022.4	88.7
26-35	2,974.4	2,194.9	73.8	3,779.8	2,998.4	79.3	4,929.0	4,057.0	82.3	7,888.2	6,655.3	84.4	13,020.2	11,374.4	87.4
36-45	2,961.7	2,133.4	72.0	3,828.2	2,979.5	77.8	5,008.9	4,058.3	81.0	8,588.1	7,194.4	83.8	15,393.5	13,269.6	86.2
46-55	3,267.4	2,351.8	72.0	4,103.1	3,192.3	77.8	6,324.2	5,124.3	81.0	13,185.4	11,139.2	84.5	21,880.2	19,226.6	87.9
56-65	3,612.3	2,626.3	72.7	4,966.0	3,913.5	78.8	11,006.9	9,211.8	83.7	20,321.5	17,459.8	85.9	27,592.2	24,773.1	89.8
Females															
<25	1,710.1	1,183.5	69.2	2,608.9	2,042.3	78.3	3,575.5	2,978.6	83.3	4,349.9	3,758.1	86.4	5,696.3	5,072.2	89.0
26-35	2,639.1	1,951.5	73.9	3,561.6	2,827.1	79.4	4,390.0	3,648.8	83.1	6,252.8	5,328.6	85.2	9,935.0	8,683.4	87.4
36-45	3,045.7	2,234.7	73.4	3,939.2	3,107.1	78.9	5,286.6	4,340.6	82.1	9,388.6	7,895.0	84.1	16,313.5	14,262.9	87.4
46-55	3,181.9	2,309.0	72.6	4,083.8	3,207.9	78.6	6,235.1	5,107.6	81.9	13,133.4	11,102.0	84.5	22,093.2	19,421.1	87.9
56-65	3,321.3	2,412.3	72.6	4,327.8	3,406.9	78.7	8,422.8	7,088.5	84.2	17,937.5	15,278.2	85.2	24,942.9	22,092.1	88.6
# of children															
Males															
Without children	2,694.6	1,968.4	73.1	3,622.4	2,849.8	78.7	4,708.6	3,867.7	82.1	7,960.6	6,772.6	85.1	15,697.2	13,515.0	86.1
With 1 kid	2,726.8	2,001.4	73.4	3,622.1	2,854.2	78.8	4,646.7	3,819.9	82.2	7,416.9	6,306.2	85.0	13,877.6	11,959.4	86.2
With 2 kids	2,721.1	2,013.6	74.0	3,620.2	2,877.2	79.5	4,672.8	3,874.9	82.9	7,540.7	6,459.5	85.7	14,095.2	12,215.0	86.7
More than 2 kids	2,352.8	1,707.8	72.6	3,284.2	2,600.3	79.2	4,153.1	3,458.7	83.3	5,737.6	4,932.9	86.0	9,791.4	8,675.0	88.6
Females															
Without children	2,626.0	1,933.7	73.6	3,651.1	2,889.5	79.1	4,739.5	3,908.5	82.5	8,508.7	7,173.4	84.3	16,252.8	14,154.8	87.1
With 1 kid	2,443.3	1,798.4	73.6	3,501.4	2,783.9	79.5	4,403.9	3,654.2	83.0	6,937.3	5,869.8	84.6	12,851.6	11,141.1	86.7
With 2 kids	2,265.6	1,658.3	73.2	3,371.0	2,686.5	79.7	4,314.2	3,603.8	83.5	6,595.0	5,614.1	85.1	12,426.9	10,778.1	86.7
More than 2 kids	1,815.6	1,270.8	70.0	2,767.2	2,172.3	78.5	3,862.2	3,229.6	83.6	5,010.9	4,294.8	85.7	8,478.4	7,412.1	87.4

Source: Author's calculations.

*The actual wage corresponds to that reported in the Great Household Integrated Survey (GEIH) and the reservation wage to that obtained from the stochastic frontier estimations.

[1/] Percentile 10, [2/] Percentile 25, [3/] Percentile 50, [4/] Percentile 75, [5/] Percentile 90.

Another interesting result is that the presence of children reduces the reservation wage of individuals during all their cycle of life, except when individuals are between 36-45 years old. These results may be related to the high level of productivity of the individuals at this age or the individual's decision to participate or not in the labour market (De Coen, Forrier & Sels, 2013), which in the case of women is related with her decision to become a mother at an older age. In which case, the presence of children may increase the opportunity cost of accepting a job, resulting in an increase in the reservation wage.

4.2.3 Differences by groups of cities

To explore with more detail the geographical differences across the country, we use four groups of cities, considering the classification of cities in the CPC index in 2020. The first group includes the most developed cities, and the last group the less developed cities. As we mention previously, the first group includes individuals who work in Bogotá; the second group those who work in Medellín, Manizales, Bucaramanga, Tunja, Cali, Pereira, and Barranquilla; the third group those who work in Popayán, Armenia, Cartagena, Neiva, Pasto, Ibagué, Cúcuta and Santa Marta; the fourth group includes the individuals who work in Villavicencio, Montería, Sincelejo, Valledupar, Florencia, Quibdó and Riohacha.

Table 5 presents the results of reservation wages by each group of cities and across quantiles. In the first quintile, as we expect, the reservation wage increases with the level of development and productivity of the cities [22]. In turn, for cities in group 4, the reservation wage is lower than the reservation wage for cities in group 1. This result remains until the third quantile; however, in the fourth and fifth quantiles, the reservation wage in group 4 is higher than the reservation wage in groups 2 and 3. However, even excluding the mining sector (which is relatively important for this group of cities), these results remain. A possible explanation for these results is that given the lower level of quality life of this group of cities, professionals and qualified workers are compensated with a higher wage.

[22] Differences are statistically significant in all cases. T-tests are available upon request from the authors.

Table 5. Actual and reservation wages by group of cities, considering socioeconomic characteristics (Colombian $ - 2018=100)*

	Q1[1/]			Q2[2/]			Q3[3/]			Q4[4/]			Q5[5/]		
	Actual	Reserv.	%	Actual	Reserv.	%	Actual	Reserv.	%	Actual	Reserv.	%	Actual	Reserv.	%
Total sample	2,547.4	1,869.7	73.4	3,554.5	2,810.3	79.1	4,537.2	3,750.2	82.7	7,448.9	6,310.9	84.7	14,201.7	12,309.4	86.7
Group 1	3,035.8	2,220.8	73.2	3,837.9	3,025.4	78.8	5,066.4	4,174.3	82.4	8,356.9	7,112.9	85.1	16,635.1	14,531.7	87.4
Group 2	2,758.1	2,056.0	74.5	3,652.9	2,914.3	79.8	4,571.2	3,788.7	82.9	7,133.9	6,074.2	85.1	13,264.1	11,513.4	86.8
Group 3	2,480.3	1,795.4	72.4	3,488.5	2,732.3	78.3	4,452.0	3,661.1	82.2	7,319.4	6,136.4	83.8	13,946.6	11,995.9	86.0
Group 4	2,226.1	1,612.7	72.4	3,304.6	2,608.5	78.9	4,407.4	3,663.1	83.1	7,961.8	6,773.0	85.1	15,313.5	13,356.7	87.2
By Sex:															
Group 1															
Male	3,077.0	2,253.6	73.2	3,877.9	3,032.6	78.2	5,212.4	4,291.2	82.3	8,528.6	7,287.5	85.4	17,379.1	15,081.5	86.8
Female	2,978.3	2,193.4	73.6	3,804.3	3,019.7	79.4	4,924.7	4,065.2	82.5	8,192.0	6,955.7	84.9	15,962.3	13,997.4	87.7
Group 2															
Male	2,851.8	2,120.0	74.3	3,675.8	2,922.9	79.5	4,652.1	3,846.7	82.7	7,202.1	6,156.4	85.5	13,356.4	11,571.5	86.6
Female	2,673.6	1,995.1	74.6	3,627.6	2,906.0	80.1	4,497.2	3,739.5	83.2	7,066.1	5,992.3	84.8	13,188.5	11,453.4	86.8
Group 3															
Male	2,613.5	1,884.1	72.1	3,546.0	2,769.7	78.1	4,535.6	3,716.3	81.9	7,456.6	6,277.7	84.2	14,246.6	12,201.4	85.6
Female	2,364.1	1,712.6	72.4	3,436.3	2,697.4	78.5	4,379.9	3,615.6	82.5	7,201.2	6,009.6	83.5	13,658.7	11,815.6	86.5
Group 4															
Male	2,433.9	1,772.6	72.8	3,411.7	2,688.4	78.8	4,529.5	3,750.0	82.8	8,247.3	7,064.0	85.7	16,092.2	13,990.3	86.9
Female	2,074.3	1,491.8	71.9	3,207.4	2,531.6	78.9	4,325.8	3,596.4	83.1	7,731.6	6,512.1	84.2	14,751.7	12,908.2	87.5
Education															
Group 1															
Prim & Second	2,643.0	1,928.6	73.0	3,495.2	2,751.3	78.7	4,211.0	3,481.3	82.7	5,525.1	4,774.6	86.4	7,688.3	6,955.8	90.5
Technical	3,344.5	2,440.0	73.0	4,048.5	3,128.2	77.3	5,302.4	4,357.6	82.2	7,508.7	6,527.1	86.9	10,797.5	9,833.5	91.1
College & Graduate	5,544.2	3,776.9	68.1	8,290.2	6,226.8	75.1	13,417.3	11,032.6	82.2	22,178.3	19,593.0	88.3	36,369.1	33,833.1	93.0
Group 2															
Prim & Second	2,350.9	1,726.7	73.4	3,258.3	2,600.3	79.8	3,964.7	3,309.6	83.5	4,956.7	4,287.2	86.5	6,761.3	6,098.5	90.2
Technical	3,252.8	2,424.1	74.5	3,891.5	3,070.3	78.9	4,840.1	3,987.0	82.4	6,621.7	5,733.3	86.6	9,380.4	8,479.0	90.4
College & Graduate	4,822.5	3,291.7	68.3	7,209.3	5,422.7	75.2	11,409.9	9,295.5	81.5	17,923.8	15,466.6	86.3	26,311.4	23,795.3	90.4
Group 3															
Prim & Second	2,029.7	1,422.8	70.1	2,926.4	2,281.6	78.0	3,793.2	3,144.8	82.9	4,724.5	4,060.9	86.0	6,554.4	5,878.1	89.7
Technical	2,980.9	2,170.9	72.8	3,711.1	2,897.3	78.1	4,531.2	3,707.3	81.8	6,171.4	5,279.7	85.6	8,798.0	7,902.3	89.8
College & Graduate	4,457.5	2,989.1	67.1	6,697.3	4,980.4	74.4	10,887.3	8,801.9	80.8	17,276.7	14,705.1	85.1	24,238.9	21,302.4	87.9
Group 4															
Prim & Second	1,787.8	1,245.6	69.7	2,654.2	2,067.8	77.9	3,650.2	3,038.8	83.2	4,621.1	4,007.3	86.7	6,685.0	6,054.8	90.6
Technical	2,791.8	2,052.4	73.5	3,650.5	2,880.1	78.9	4,422.1	3,654.1	82.6	6,149.8	5,313.7	86.4	9,478.2	8,646.0	91.2
College & Graduate	4,442.8	3,058.7	68.8	6,900.5	5,276.7	76.5	11,338.8	9,380.2	82.7	17,728.8	15,327.5	86.5	24,540.8	22,025.8	89.8

Source: Author's calculations.

*The actual wage corresponds to that reported in the Great Household Integrated Survey (GEIH) and the reservation wage to that obtained from the stochastic frontier estimations. [1/] Percentile 10, [2/] Percentile 25, [3/] Percentile 50, [4/] Percentile 75, [5/] Percentile 90.

Table 5. Actual and reservation wages by group of cities, considering socioeconomic characteristics ($ - 2018=100)* (*Cont)*

	Q1[1/]			Q2[2/]			Q3[3/]			Q4[4/]			Q5[5/]		
	Actual	Reserv.	%	Actual	Reserv.	%	Actual	Reserv.	%	Actual	Reserv.	%	Actual	Reserv.	%
Group 1															
Manager or prof.	4,260.4	3,025.3	71.0	6,252.3	4,730.1	75.7	10,606.1	8,541.6	80.5	19,131.9	16,394.8	85.7	32,485.5	29,768.3	91.6
Service, tech, sales w.	2,869.6	2,079.7	72.5	3,703.5	2,897.5	78.2	4,689.5	3,847.8	82.1	6,708.3	5,788.6	86.3	10,518.4	9,439.9	89.7
Craft, operative w.	2,752.4	2,054.9	74.7	3,497.4	2,789.0	79.7	4,109.0	3,395.8	82.6	5,176.9	4,439.3	85.8	6,808.4	6,078.6	89.3
Unskilled	2,511.9	1,792.2	71.3	3,485.0	2,758.3	79.1	4,175.7	3,472.8	83.2	5,340.8	4,649.2	87.1	7,237.0	6,529.2	90.2
Group 2															
Manager or prof.	3,953.4	2,839.1	71.8	5,640.8	4,295.6	76.2	9,443.6	7,604.5	80.5	16,153.4	13,718.4	84.9	24,649.5	21,958.3	89.1
Service, tech, sales w.	2,728.6	2,022.0	74.1	3,597.2	2,856.9	79.4	4,381.0	3,623.6	82.7	6,012.4	5,173.0	86.0	9,193.8	8,203.1	89.2
Craft, operative w.	2,443.4	1,828.4	74.8	3,327.0	2,682.9	80.6	3,985.5	3,334.5	83.7	4,890.7	4,219.7	86.3	6,542.9	5,864.6	89.6
Unskilled	2,151.3	1,551.0	72.1	3,071.5	2,442.1	79.5	3,917.5	3,274.2	83.6	4,666.3	4,038.7	86.6	5,999.3	5,363.2	89.4
Group 3															
Manager or prof.	3,879.9	2,707.2	69.8	5,637.3	4,217.2	74.8	9,878.3	7,897.6	79.9	16,609.6	14,032.6	84.5	23,981.8	20,962.9	87.4
Service, tech, sales w.	2,483.3	1,787.5	72.0	3,428.5	2,678.8	78.1	4,224.6	3,469.4	82.1	5,832.9	4,958.2	85.0	8,893.3	7,858.1	88.4
Craft, operative w.	2,084.0	1,478.4	70.9	2,994.8	2,350.2	78.5	3,789.0	3,144.8	83.0	4,635.6	3,971.0	85.7	6,289.0	5,603.0	89.1
Unskilled	1,797.8	1,240.2	69.0	2,602.2	2,004.5	77.0	3,655.7	3,037.8	83.1	4,348.4	3,739.5	86.0	5,440.9	4,835.4	88.9
Group 4															
Manager or prof.	3,872.5	2,757.8	71.2	5,898.1	4,503.0	76.3	10,667.0	8,753.6	82.1	17,459.8	15,047.9	86.2	24,524.5	21,925.3	89.4
Service, tech, sales w.	2,278.2	1,652.5	72.5	3,260.1	2,569.9	78.8	4,130.1	3,422.6	82.9	5,814.4	4,987.1	85.8	9,262.0	8,275.4	89.3
Craft, operative w.	1,907.4	1,364.0	71.5	2,769.6	2,197.0	79.3	3,652.9	3,053.0	83.6	4,536.0	3,923.9	86.5	6,687.2	6,037.1	90.3
Unskilled	1,461.7	968.4	66.3	2,122.5	1,594.3	75.1	3,210.2	2,650.3	82.6	4,201.4	3,614.5	86.0	5,209.4	4,648.7	89.2

Source: Author's calculations.

*The actual wage corresponds to that reported in the Great Household Integrated Survey (GEIH) and the reservation wage to that obtained from the stochastic frontier estimations. [1/] Percentile 10, [2/] Percentile 25, [3/] Percentile 50, [4/] Percentile 75, [5/] Percentile 90.

We also find that the reservation wage of females are always lower than the reservation wage of males across all groups of cities, and quantiles (see Table 5). However, at the fourth and fifth quantiles, the reservation wage of males and females is higher in group 4 compared to the reservation wage of cities in groups 2 and 3.

Table 5 also presents the results of the reservation wage by education levels across city groups. Then, as we found in the previous section, the reservation wage increases with the level of education, this result is consistent across all quintiles and groups of cities. Individuals with college education and graduate education present a higher reservation wage than those individuals with primary and secondary education, in all cases. Moreover, individuals with primary and secondary education from group 4 are the ones, which the lowest reservation wages across quantiles. In contrast, individuals with graduate level and college education of group 4 present a higher reservation wage than those with the same level of education at cities of group 3, reflecting the heterogeneity of reserve wages in this group. Similar results are found at the fifth quantile with individuals with technical education, which presents a higher reservation wage than those with the same education in group cities 2 and 3.

We also present the results of the reservation wage by occupations across city groups (Table 5). As before, we found that managers and professionals present the higher reservation wage across all groups of cities and quantiles. The second highest reservation wage is found for those individuals who work in service, technical and sales activities, while the lowest reservation wage is observed in unskilled individuals and workers in operative occupations. In general, people with jobs in cities in the fourth group has lower reservation wages than those located in the groups of cities with higher productivity, except in the case of managers and professionals of group 4, which present a higher reservation wage compared to the individuals in the same occupation in city groups 2 and 3.

Finally, we compare the results of the reservation wage by economic sectors across city groups (Table A3). In general, as mentioned above, the highest reservation wages were estimated in the cities of group 1. Results show that for all quantiles in the groups of cities 1 2, and 3, the sectors with the highest reservation wage are mining, financial intermediation and electricity gas and water. In group 4, people working in the public sector have the highest wages after the mining

sector, for quantiles 3 to 5. In contrast, the lowest reservation wages are found in the trade and hospitality sector for all groups of cities and quantiles. It is important to highlight the dispersion that exists in the reservation wages of the public sector across cities and quantiles. For example, while in quintile 1, the highest wage is observed in Medellín and the lowest in Quibdó, in quintile 5, the highest wage is observed in Quibdó and the lowest in Barranquilla (see Table A4).

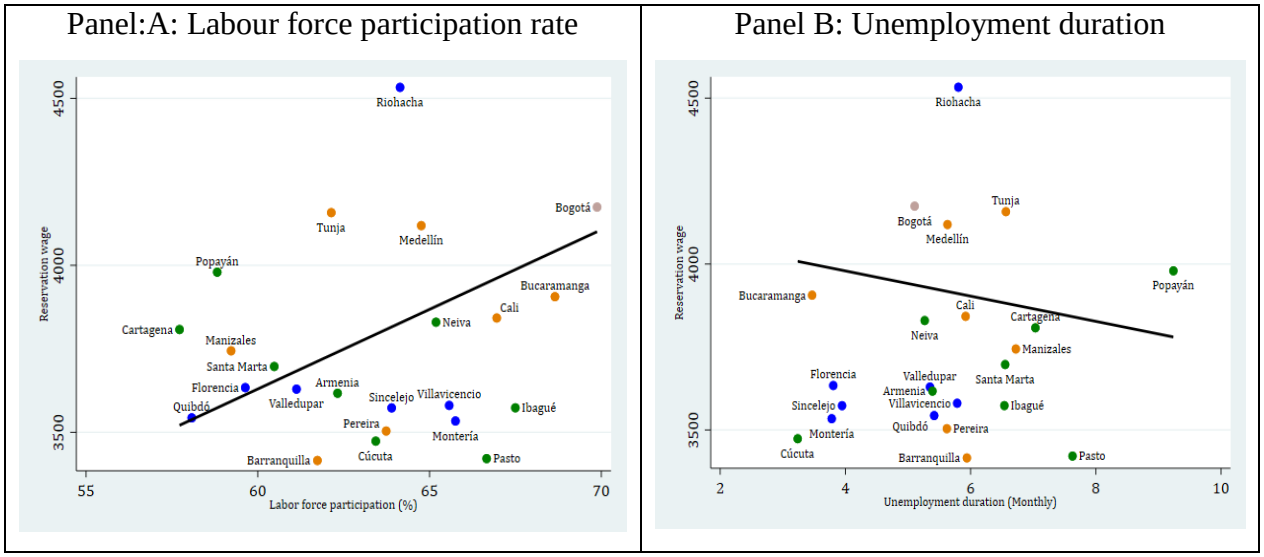
In summary, when analyzing the reservation wage by groups of cities, we find that at the median of the distribution, those cities with higher productivity present the highest reservation wages. However, these results are not true when comparing the reservation wage at the top of the distribution. In the last quintile (Q5), we find that individuals in cities of group 4 present a higher reservation wage than those individuals in cities more developed such as those of groups 2 and 3. Similar results are found when we compare the reservation wage by males and females, level of education, occupation, and other socioeconomic characteristics of individuals. A possible explanation for these results is that the lower quality of life of cities of group 4 increase the reservation wage of workers, especially those who can find easily a job offer in a more developed city. In this case, professionals and qualified workers are only willing to accept a job if they received a higher wage, which outweighs the additional cost of not having good health care and education systems, among other amenities.

5. Relation between reservation wage and labour market indicators

Finally, we explore the aggregate dynamic of the estimated reservation wage by city with some indicators of the labour market such as labour force participation rate or the unemployment duration. Panel A of Figure 2 presents the relation of the labour force participation and the estimated reservation wage by the 23 main cities. Cities with higher reservation wages present higher labour force participation: this is the case of Bogotá, Cali, Medellín, and Bucaramanga. As is suggested by the search model, individuals decide to participate in the labour market only if their wage offer is higher than their reservation wage. Then, the participation rate is the result of the individual reservation wage and the wage offer at each labour market. There for at the aggregate level we can find a positive or negative relationship between participation rate and the aggregate reservation wage. In general, we find a positive relation between reservation wage and participation, however, there is also a big dispersion across cities, especially for those cities that

belong to group 4. Arango and Posada (2003) suggested that the positive relationship between the reservation wage and labour force participation in some cities might be explained by their high level (and better quality) of education; this is the case, for example, of Bogotá, Medellín and Bucaramanga[23]. However, other factors also can explain a negative relationship between labour force participation and the reservation wage such as a higher family income or wealth, higher preferences for leisure, higher labour income taxes, higher unemployment insurance or higher subsidies. For example, although Riohacha and Quibdó have a low labour participation rate, they have a high reservation wage, compared to other cities with higher participation rates such as Bucaramanga, Ibague, or Pasto, especially in the case of individuals with higher education (see Table A5).

Figure 2: Reservation wage and labour indicators



Note: the colors represent the cities that belong to the same group.
Source: GEIH, Author's calculations.

In turn, panel B of Figure 2 presents the aggregate relation between reservation wages and unemployment duration. In general, the search literature has found evidence of a negative relation between reservation wage and duration of unemployment (Krueger & Mueller, 2016 and Danforth, 1979). Across cities we found a negative relationship between reservation wages and unemployment duration, however again we find a big dispersion across cities, especially for those

[23] Table A5 shows the actual and reservation wages across cities by the level of education for quintiles 2 and 4. In general, wages increase with the education of individual in the different cities of the sample. And the highest wages are paid in their order in Bogotá, Medellín, and Cali.

belonging to group 4, (as the case of Riohacha, Florencia, Sincelejo, Monteria, among others). Even though some important differences among cities, we find that the relation of these aggregate indicators is according to the theory.

6. Final remarks

This paper presents positive evidence of reservation wages according to the search theory. First, we found that the reservation wage is positively related to the individual's level of education. Therefore, we found that individuals with a high level of education (college or graduate level) present higher reservations wages than those with low education or non-education, as is also suggested by Hofler and Murphy (1994). In line with these results, we find that the reservation wages are lower for those individuals with low-skill occupations compared to the reservation wage of individuals with higher skills. Furthermore, we find that the reservation wage is also positively related to tenure.

Second, as it is found in the literature (Prasad, 2003; Bloemen & Stancanelli, 2001), we find that individuals who live in households with higher net labour income (excluding worker´s income) are more likely to be able to wait for a job offer, therefore they have higher reservation wages. Third, we found that medium age workers which are more attached to the labour market will set higher reservation wages than younger workers weakly attached to the labour force who have not yet decided their career path. In the same way, we found that women which are weakly attached to the labour market present lower reservation wages than men.

Fourth, we explore this gender gap in the reservation wage controlling by the level of education, age, and the presence of children. We found higher reservation wages for males across all different levels of education compared to women. However, the difference in the reservation wage between men and women increases with the educational level, especially in quintiles 4 and 5. According to the theory, these differences can express differences in preferences, personality traits such as risk aversion, among others (Barber and Odean, 2001; Eckel and Grossman, 2008; Raimers, 1985). However, considering the presence of children, we found that the reservation wage of women and

men decrease, being the highest reduction on the women´s reservation wage, contrary to the results found in the literature (Brown, et al., 2011 suggest that the presence of children may increase the opportunity cost of accepting a job for women and men). This result can imply that, in the case of Colombia, the presence of children increases the income needs of the family, and so the incentives for being employed. A reduction in the reservation wage can also reflects some characteristics of the job such as the flexibility preferred for individuals with children, (especially women), even if this implies a lower wage (Arango & Lora, 2017). We only found an increase in the reservation wage with the presence of children at the age between 36-45 years old, which may be related to the high level of productivity of the individuals at this age or the individual's decision to participate or not in the labour market (De Coen, Forrier & Sels, 2013).

We also explore the reservation wage across cities. We divide the 23 main cities in Colombia into four groups: the first group (group 1) includes the most developed cities and the last group (group 4) the less developed cities. We found that the reservation wage increases with the level of development and productivity of the cities (from 1 to 3 quantiles). However, in the fourth and fifth quantiles, the reservation wage in group 4 is higher than the reservation wage in groups 2 and 3. An explanation for these results is that given the lower level of quality life of this group of cities, professionals and qualified workers are compensated with a higher wage. Therefore, we found that individuals with graduate level and college education of group 4 present a higher reservation wage than those with the same level of education at cities of group 3. So that´s to say, qualified workers who can easily find a job offer in a more developed city are only willing to work in a low developed city if their wage offer is higher and compensated for the additional cost of not having good health care and good education, among other amenities.

Additionally, we compare the results of the reservation wage by economic sectors across city groups. In general, the highest reservation wages are observed in the cities of group 1. Results show that for all quantiles in the groups of cities 1, 2, and 3, the sectors with the highest reservation wage are mining, financial intermediation and electricity gas and water. In group 4, the public sector registers the highest wages after the mining sector, for quintals 3 to 5. In contrast, the lowest reservation wages are found in the trade and hospitality sector for all groups of cities and quantiles. It is important to highlight the dispersion that exists in the reservation wages of the public sector across cities and quantiles. For example, while in quintile 1, the highest wage is observed in

Medellín and the lowest in Quibdó, in quintile 5, the highest wage is observed in Quibdó and the lowest in Barranquilla.

Finally, it is interesting to remark that the higher the family income or the educational level of a person, the greater the relationship between the reservation wage and the actual wage. This result could indicate that the higher the person's household income or education, the more they value the decision to accept a job and the more likely they are to establish a reservation wage close to the wage that she (he) could actually receive. This means that this person is more willing to have a longer period of unemployment compared to an individual with lower income or education.

References

Addison, J. T., Centeno, M., & Portugal, P. (2004). Reservation wages, search duration, and accepted wages in Europe. *IZA discussion paper series*, No. 1252.

Aigner, D., Lovell, C. K., & Schmidt, P. (1977). Formulation and estimation of stochastic frontier production function models. *Journal of econometrics*, 6(1), 21-37

Arango, L. E., & Lora, E. (2017). *Desempleo femenino en Colombia*. Banco de la República, Colombia.

Arango, L. E., Posada, C. E. (2003). La participación laboral en Colombia. *Borradores de Economía* No. 217, Banco de la República.

Arango, L. E., Flórez, L. A., & Delgado, M. A. O. (2019). Precio del carbón y dinámica laboral en Valledupa. *Revista de economía del Rosario*, 22(2), 313-370.

Barber, B. & Odean, T. (2001). Boys will be boys: gender, overconfidence, and common stock investment. *Quarterly Journal of Economics*, 116 (1), 261–292.

Battese, G. E., & Coelli, T.J. (1988). Prediction of firm-level technical efficiencies with a generalized frontier production function and panel data. *Journal of econometrics*, 38(3), 387-399

Battese, G. E., & Coelli, T.J. (1992). Frontier production functions, technical efficiency and panel data: with application to paddy farmers in India. *Journal of Productivity Analysis*, 3(1-2), 153-169.

Belotti, F., & Ilardi, G. (2012). Consistent Estimation of the "True" Fixed-Effects Stochastic Frontier Model. *CEIS Working Paper*, No. 231

Bloemen, H.G & Stancanelli, E.G. (2001). Individual wealth, reservation wages and transitions into employment. *Journal of Labor Economics*, 19(2), 400-439.

Bonilla, L., Flórez, L., Hermida, D., Lasso, F., Morales, L., Pulido, K., Pulido J. (2021) Recuperacion de la ocupación y dinámica reciente de la participación laboral. *Reporte del Mercado Laboral*, No. 17: Banco de la República.

Böheim, R. (2002). The association between reported and calculated reservation wages. ISER Working Paper Series, 2002-07, *Institute for Social and Economic Research*.

Bosquet, C., Combes, P.P. & García-Peñalosa, C. (2019). Gender and promotions: evidence from academic economists in France. *The Scandinavian Journal of Economics,* 121(3), 1020-1053.

Brown, S., Roberts, J., & Taylor, K. (2011). The gender reservation wage gap: evidence from British panel data. *Economics Letters*, 113(1), 88-91.

Burdett, K., & Vishwanath, T. (1988). Declining reservation wages and learning. *The Review of Economic Studies*, 55(4), 655-665.

Caliendo, M., Lee,W.S. & Mahlstedt, R. (2014). The gender wage gap: does a gender gap in reservation wages play a part?. *IZA discussion paper series*, No.8305.

Christensen, B. (2005). Die Lohnansprüche deutscher Arbeitsloser:Determinanten und Auswirkungen von Reservationslöhnen. *Kieler Studie*, 333, Springer Verlag, Berlin.

Coelli, T., Estache, A., Perelman, S. and Trujillo, L. (2003). *A primer on efficiency measurement for utilities and transport regulators.* Washington, D.C: World Bank Group.

Cornwell, C., Schmidt, P., & Sickles, R. C. (1990). Production frontiers with cross-sectional and time-series variation in efficiency levels. *Journal of econometrics*, 46(1-2), 185-200.

Cornwell, C. & Schneider, K. (2000). Labor market policy and German reservation wages in the 1990s: A stochastic frontier approach. Unveröffentlichtes Manuskript, University of Georgia and Dortmund.

Cox, J.C & Oxaca, R.L. (1992). Direct test of the reservation wage property. *The Economic Journal*, 102 (415), 1423-1432.

Chen, Y. Y., Schmidt, P., & Wang, H. J. (2014). Consistent estimation of the fixed effects stochastic frontier model. *Journal of Econometrics*, 181(2), 65-76.

Danforth, J.P. (1979). On the role of consumption and decreasing absolute risk aversion in the theory of job search. In: S.A. Lippman, J.J. McCall (Eds.), *Studies in the Economics of Search* (109–131). North-Holland, New York.

De Coen A, Forrier A, Sels L. (2013). The impact of age on the reservation wage: the role of employment efficacy and work intention: a study in the Belgian context. *Journal of Applied Gerontology*. 2015;34(3), NP83-NP-112.

Eckel, C. & Grossmann, P. (2008). *Men, woman and risk aversion: experimental evidence*. In C. Smith (ed.), Handbook of Experimental Economics Results (1061-1073). New York: Elesievier.

Greene, W. (2005a). Reconsidering heterogeneity in panel data estimators of the stochastic frontier model. *Journal of econometrics*, 126(2), 269-303.

Greene, W. (2005b). Fixed and random effects in stochastic frontier models. *Journal of productivity analysis*, 23(1), 7-32.

Gronau, R. (1973). The intrafamily allocation of time: the value of the housewives' time. *The American Economic Review*, 63(4), 634-651.

Groot, W., & Oosterbeek, H. (1994). Stochastic reservation and offer wages. *Labour Economics*, 1(3-4), 383-390.

Hofler, R. A., & Murphy, K. J. (1994). Estimating reservation wages of employed workers using a stochastic frontier. *Southern Economic Journal*, 961-976

Hofler, R. A., & Polachek, S. W. (1985). A new approach for measuring wage ignorance in the labor market. *Journal of Economics and Business*, 37(3), 267-276.

Hospido, L., Laeven, L. & Lamo, A. (2019). The gender promotion gap: evidence from Central Banking. *IZA discussion paper series*, No. 12306.

Jensen, U., Gartner, H., & Rässler, S. (2010). Estimating German overqualification with stochastic earnings frontiers. *AStA Advances in Statistical Analysis*, 94(1), 33-51.

Jondrow, J., Lovell, C. K., Materov, I. S., & Schmidt, P. (1982). On the estimation of technical inefficiency in the stochastic frontier production function model. *Journal of econometrics*, 19(2-3), 233-238.

Kahn, J.R., Whittington, L.A. (1996). The labor supply of Latinas in the USA: Comparing labor force participation, wages, and hours worked with Anglo and Black women. *Popul Res Policy Rev*, 15, 45–77.

Kiefer, N. M., & Neumann, G. R. (1979). An empirical job-search model, with a test of the constant reservation-wage hypothesis. *Journal of political Economy*, 87(1), 89-107.

Krueger, A.B & Mueller, A.I (2016). A contribution to the empirical of reservation wages. American Economic Journal: *Economic Policy*, 8(1), 142-179.

Kumbhakar, S. C. (1990). Production frontiers, panel data, and time-varying technical inefficiency. *Journal of econometrics*, 46(1-2), 201-211

Kumbhakar, S. C., & Lovell, C. K. (2003). *Stochastic frontier analysis*. Cambridge university press.

Kumbhakar, S. C., & Wang, H. J. (2005). Estimation of growth convergence using a stochastic production frontier approach. *Economics Letters*, 88(3), 300-305

Lancaster, T., & Chesher, A. (1983). An econometric analysis of reservation wages. *Econometrica: Journal of the Econometric Society*, 1661-1676.

Lee, Y. H., & Schmidt, P. (1993). A production frontier model with flexible temporal variation in technical efficiency. The measurement of productive efficiency: *Techniques and applications*, 237-255.

Leppin, J. S. (2014). The estimation of reservation wages: A simulation-based comparison. *Jahrbücher für Nationalökonomie und Statistik*, 234(5), 603-634.

Meeusen, W., & van Den Broeck, J. (1977). Efficiency estimation from Cobb-Douglas production functions with composed error. *International economic review*, 435-444

McCall, J. (1970), Economics of Information and Job Search, *Quarterly Journal of Economics*, 84, 113-126.

Mortensen, D.T. (1970), Job Search, the Duration of Unemployment and the Phillips Curve, *American Economic Review*, 60, 505-517.

Polachek, S. W., & Yoon, B. J. (1996). Panel estimates of a two-tiered earnings frontier. *Journal of applied econometrics*, 169-178.

Prasad, E. (2003) What determines the reservation wages of unemployed workers?: new evidence from German micro data. *Discussion Paper 694*. Institute for the Study of Labor, Bonn.

O´Donnel, C. Rao, D & Battese, G. (2008). Metafrontier frameworks for the study of firm-level efficiencies and technology ratios. *Empirical Economics,* 34(1), 231-255.

Otero-Cortés, A., Herrera, F. & Monroy, J. M., (2019). Análisis de la Pobreza y Condiciones de Vida en Valledupar. *Documento de Trabajo sobre Economía Regional y Urbana*; No. 278.

Raimers, C. (1985). Cultural differences in labor force participation among married women. *The American Economic Review*, 75(2), 251-255.

Rogerson, R., Shimer, R., & Wright, R. (2005). Search-theoretic models of the labor market: A survey.*Journal of economic literature*, 43(4), 959-988.

Schmidt, C. M., & Winkelmann, R. (1993). *Reservation wages, wage offer distributions and accepted wages*. In Bunzel, H., Jensen, P., and Westergard-Nielsen, N., editors, Panel Data and Labour Market Dynamics. Amsterdam.

Villa, J. (2006). Propuesta para la estimación del salario de reserva de los empleados en Colombia con el análisis de fronteras estocásticas. *Archivos de Economía*, No. 315. Departamento Nacional de Planeación.

Wang, H. J., & Ho, C. W. (2010). Estimating fixed-effect panel stochastic frontier models by model transformation. *Journal of Econometrics*, 157(2), 286-296.

Watson, D., & Webb, R. (2008). Reservation wage levels in UK and German financial services sectors. *The Service Industries Journal*, 28(8), 1167-1182.

Webb, R., Watson, D., & Hinks, T. (2003). Testing for wage overpayment in UK. financial services: A stochastic frontier approach. *The Service Industries Journal*, 23(5), 123-136.

Wright, R. D. (1987). Search, layoffs, and reservation wages. *Journal of Labor Economics*, 5(3), 354-365.

Appendix

Table A1. Differences of means in the reservation wages

Differences of means by gender (t-test)

	Q1[1/]	Q2[2/]	Q3[3/]	Q4[4/]	Q5[5/]
Actual wage	264.5	103.8	183.5	243.1	599.5
T-test	42.6	24.7	28.7	11.0	10.4
Reserve wage	196.3	64.3	126.3	261.9	424.6
T-test	32.0	15.4	22.5	13.3	8.4

Differences of means by age (t-test)

	Q1[1/]												Q4[4/]					
		<25	26-35	36-45	46-55	56-65			<25	26-35	36-45	46-55	56-65		<25	26-35	36-45	46-55	56-65
Q2[2/]	<25		749.6	915	1045	1278	Q3[5/]	<25						Q5[5/]	<25	1831.8	3743	7176	12911
	T-test		99.0	108.1	106.6	90.2		T-test							T-test	132.4	181.6	241	468.7
	26-35	698.1		165.3	295.4	528.4		26-35	682.6						26-35	4194.8	1911.2	5344	11079
	T-test	125.5		20.5	30.8	35.6		T-test	122.0						T-test	121.8	82.4	164.8	272.4
	36-45	873.1	175		130.1	363.1		36-45	1162.1	479.6					36-45	8444.3	4249.5	3433	9167.9
	T-test	132.1	34		12.4	23.2		T-test	144.9	57.5					T-test	177.4	76.7	68.2	140.7
	46-55	1007	308.8	133.8		233		46-55	2033	1350	870.8				46-55	13791	9596.1	5346.5	5735.2
	T-test	126.1	50.1	19.4		13.9		T-test	162.7	109.8	47				T-test	274.6	149.4	57	56.2
	56-65	1522	823.7	648.6	514.8			56-65	5459. 3	4777	4297	3426. 3			56-65	18475	14280	10030	4684
	T-test	105.6	76.3	52.6	34.5			T-test	278.2	241.1	137.4	66.1			T-test	353.2	161.4	75.5	31.4

Differences of means by level of education (t-test)

	Q1[1/]												Q4[4/]					
		Primary/ no educ	Secundary	Technical	College	Graduate			Primary/ no educ	Secundary	Technical	College	Graduate		Primary/ no educ	Secundary	Technical	College	Graduate
Q2[2/]	Primary/ no educ		560.3	1284.3	1820.2	4946.2	Q3[5/]	Primary/ no educ						Q5[5/]	Primary/ no educ	654.7	2014.8	8567	17858
	T-test		30.2	64.5	76.4	78.2		T-test							T-test	28.8	55.1	107.1	200.8
	Secundary	677.3		724	1259.9	4385.9		Secundary	509.9						Secundary	1354.4	1360.1	7912.4	17203.4
	T-test	45.4		98.4	146.5	288.5		T-test	50.3						T-test	23.3	127.5	484.2	881
	Technical	1216.5	539.2		535.9	3661.9		Technical	1119.8	610					Technical	3641	2286.6	6552.2	15843.2
	T-test	107.1	101.3		50.4	172		T-test	62.7	126.7					T-test	46.8	89.8	225.5	450.6
	College	2669.2	1991.8	1452.7		3126		College	4704.8	4195	3585				College	13586.4	12232.1	9945.5	9291
	T-test	72.1	226.4	130.2		121.1		T-test	91.1	468.5	210.8				T-test	87	329.4	169.1	151.3
	Graduate	7777.6	7100.3	6561.1	5108.4			Graduate	12042.2	11532.3	10922.4	7337.3			Graduate	25715.8	24361.5	22074.8	12129
	T-test	122.5	545.6	391.7	156			T-test	161.8	1004.7	484.8	168.8			T-test	92.1	449.2	237.4	82.8

Source: Author's calculations.
Note: * If |T-test| >1.64 the difference is significant. [1/] Percentil 10, [2/] Percentil 25, [3/] Percentil 50, [4/] Percentil 75, [5/] Percentil 90. Quintiles 1 and 4 are summarized in the upper diagonal of the table and quintiles 2 and 5 are summarized in the lower diagonal of the table.

Table A2. Actual and reservation wage by economic sector and quintiles
(Colombian $ - 2018=100)*

	Q1[1/]			Q2[2/]			Q3[3/]			Q4[4/]			Q5[5/]		
	Actual wage	Reserv. wage	%	Actual wage	Reserv. Wage	%	Actual wage	Reserv. wage	%	Actual wage	Reserv. wage	%	Actual wage	Reserv. wage	%
Econ. sector:															
Agriculture	2,523.1	1,860.9	73.8	3,567.5	2,827.1	79.2	4,471.4	3,699.1	82.7	6,310.8	5,422.3	85.9	10,239.1	8,930.5	87.2
Mining	4,010.3	2,664.9	66.5	6,159.6	4,557.6	74.0	11,356.8	9,438.9	83.1	19,643.8	17,380.9	88.5	29,653.5	27,077.8	91.3
Manufacturing	2,669.0	1,970.5	73.8	3,545.2	2,802.0	79.0	4,255.6	3,508.9	82.5	5,904.8	5,027.8	85.1	9,557.3	8,444.6	88.4
Elec., gas, water	3,611.4	2,641.2	73.1	4,291.2	3,289.8	76.7	5,987.8	4,787.3	80.0	10,217.7	8,512.7	83.3	18,241.9	15,651.8	85.8
Construction	2,424.1	1,803.3	74.4	3,248.9	2,588.9	79.7	4,128.2	3,432.5	83.1	5,991.4	5,115.8	85.4	9,847.5	8,621.2	87.5
Trade, hotel.	2,195.4	1,584.2	72.2	3,076.0	2,419.8	78.7	3,880.1	3,216.9	82.9	4,872.5	4,164.0	85.5	6,937.0	6,113.2	88.1
Transp., com	2,353.2	1,646.9	70.0	3,415.3	2,661.0	77.9	4,239.3	3,485.1	82.2	5,823.2	4,967.7	85.3	8,909.2	7,875.5	88.4
Finan inter.	3,656.5	2,637.1	72.1	4,508.0	3,442.9	76.4	6,867.3	5,508.5	80.2	11,080.9	9,353.6	84.4	18,124.7	15,988.1	88.2
Real estate	3,057.8	2,234.7	73.1	3,753.2	2,958.9	78.8	4,556.8	3,730.0	81.9	6,580.7	5,533.9	84.1	11,368.8	9,853.4	86.7
Public services	2,776.4	2,048.3	73.8	3,990.3	3,180.9	79.7	6,072.6	5,010.2	82.5	11,810.0	10,002.4	84.7	19,798.1	17,258.4	87.2

Source: Author's calculations.
*The actual wage corresponds to that reported in the Great Household Integrated Survey (GEIH) and the reservation wage to that obtained from the stochastic frontier estimations.
[1/] Percentile 10, [2/] Percentile 25, [3/] Percentile 50, [4/] Percentile 75, [5/] Percentile 90.

Table A3. Actual and reservation wages by economic sectors across city groups (Colombian $ 2018=100)*

	Q1[1/]			Q2[2/]			Q3[3/]			Q4[4/]			Q5[5/]		
	Actual	Reserv.	%	Actual	Reserv.	%	Actual	Reserv.	%	Actual	Reserv.	%	Actual	Reserv.	%
Group 1															
Agriculture	3,429.7	2,572.2	75.0	4,023.9	3,251.8	80.8	5,114.4	4,408.0	86.2	7,987.9	7,059.5	88.4	16,304.5	14,887.6	91.3
Mining	4,395.6	2,897.0	65.9	7,430.9	5,220.1	70.2	16,209.6	13,172.9	81.3	33,821.7	29,718.2	87.9	67,770.2	64,435.3	95.1
Manufacturing	3,086.0	2,290.1	74.2	3,728.8	2,931.7	78.6	4,538.8	3,701.6	81.6	6,684.8	5,683.4	85.0	12,199.8	10,672.9	87.5
Elect gas water	3,797.3	2,780.1	73.2	4,702.3	3,629.1	77.2	7,912.0	6,471.9	81.8	16,339.4	14,013.5	85.8	32,977.0	29,696.7	90.1
Construction	2,915.7	2,159.6	74.1	3,660.4	2,923.5	79.9	4,660.7	3,874.1	83.1	6,760.5	5,800.5	85.8	11,694.3	10,129.4	86.6
Trade, hospitality	2,553.2	1,847.4	72.4	3,423.5	2,693.1	78.7	4,261.3	3,533.5	82.9	5,964.7	5,151.2	86.4	9,632.8	8,641.8	89.7
Trans, stor, com.	2,736.6	1,918.7	70.1	3,697.0	2,888.0	78.1	4,872.3	3,999.7	82.1	7,339.4	6,366.4	86.7	13,173.7	11,847.0	89.9
Financial inter.	3,974.1	2,912.5	73.3	5,207.8	4,012.4	77.0	8,176.8	6,747.7	82.5	14,741.1	12,503.2	84.8	27,055.7	23,790.4	87.9
Real estate	3,419.0	2,545.6	74.5	3,981.7	3,153.9	79.2	5,201.0	4,278.0	82.3	8,584.3	7,255.3	84.5	16,534.0	14,612.5	88.4
Public services	3,289.9	2,417.0	73.5	4,222.5	3,343.8	79.2	6,300.3	5,149.8	81.7	11,558.7	9,768.3	84.5	21,064.8	18,379.7	87.3
Group 2															
Agriculture	2,985.5	2,265.7	75.9	3,803.7	3,066.9	80.6	4,708.9	3,935.2	83.6	6,699.3	5,747.7	85.8	11,122.6	9,566.3	86.0
Mining	3,750.8	2,519.1	67.2	5,094.0	3,542.3	69.5	9,053.5	7,089.5	78.3	17,439.8	14,307.9	82.0	30,012.4	25,606.4	85.3
Manufacturing	2,905.5	2,188.1	75.3	3,656.9	2,924.8	80.0	4,349.6	3,600.0	82.8	6,091.1	5,223.0	85.7	9,950.4	8,795.1	88.4
Elect gas water	3,718.7	2,765.4	74.4	4,615.4	3,571.6	77.4	7,201.4	5,841.4	81.1	13,493.7	11,447.2	84.8	24,290.5	21,316.3	87.8
Construction	2,544.4	1,904.5	74.8	3,331.3	2,678.7	80.4	4,172.7	3,486.9	83.6	6,048.9	5,154.6	85.2	9,903.2	8,685.0	87.7
Trade, hospitality	2,351.4	1,719.2	73.1	3,233.7	2,568.1	79.4	3,989.4	3,329.2	83.5	5,098.7	4,385.4	86.0	7,330.1	6,515.1	88.9
Trans, stor, com.	2,481.5	1,763.3	71.1	3,478.1	2,731.4	78.5	4,283.5	3,526.4	82.3	5,851.3	5,006.4	85.6	8,960.2	7,927.8	88.5
Financial inter.	3,719.6	2,734.7	73.5	4,609.0	3,554.0	77.1	7,085.9	5,708.3	80.6	11,774.8	9,970.7	84.7	19,515.4	17,347.7	88.9
Real estate	3,232.7	2,416.1	74.7	3,816.2	3,043.4	79.7	4,573.4	3,758.6	82.2	6,430.8	5,442.7	84.6	10,896.5	9,435.4	86.6
Public services	3,081.7	2,301.0	74.7	4,078.0	3,266.1	80.1	5,993.4	4,967.4	82.9	11,196.4	9,452.5	84.4	19,035.6	16,487.2	86.6

Source: Author's calculations.

*The actual wage corresponds to that reported in the Great Household Integrated Survey (GEIH) and the reservation wage to that obtained from the stochastic frontier estimations. [1/] Percentile 10, [2/] Percentile 25, [3/] Percentile 50, [4/] Percentile 75, [5/] Percentile 90.

Table A3. Actual and reservation wages by economic sectors across city groups (Colombian $ 2018=100)* (*Cont)*

	Q1[1/]			Q2[2/]			Q3[3/]			Q4[4/]			Q5[5/]		
	Actual	Reserv.	%	Actual	Reserv.	%	Actual	Reserv.	%	Actual	Reserv.	%	Actual	Reserv.	%
Group 3															
Agriculture	2,698.1	1,957.4	72.5	3,631.2	2,867.6	79.0	4,549.5	3,724.4	81.9	6,657.2	5,608.6	84.2	10,460.6	9,256.8	88.5
Mining	3,753.6	2,440.6	65.0	5,414.1	3,761.3	69.5	9,537.3	7,696.5	80.7	16,623.4	14,403.7	86.6	26,414.2	23,543.7	89.1
Manufacturing	2,286.5	1,611.6	70.5	3,270.1	2,531.0	77.4	4,046.1	3,300.7	81.6	5,380.1	4,533.8	84.3	8,174.8	7,125.5	87.2
Elect gas water	3,588.5	2,608.5	72.7	4,225.1	3,237.6	76.6	5,739.9	4,566.0	79.5	8,944.5	7,473.6	83.6	14,390.6	12,241.2	85.1
Construction	2,405.0	1,758.1	73.1	3,211.4	2,531.8	78.8	4,052.6	3,342.1	82.5	5,868.6	4,967.5	84.6	9,542.8	8,379.0	87.8
Trade, hospitality	2,183.0	1,559.1	71.4	3,050.2	2,379.6	78.0	3,836.7	3,165.9	82.5	4,693.1	3,986.7	84.9	6,456.4	5,625.7	87.1
Trans, stor, com.	2,319.7	1,611.8	69.5	3,367.7	2,591.1	76.9	4,162.2	3,401.1	81.7	5,574.1	4,710.6	84.5	8,169.6	7,147.0	87.5
Financial inter.	3,695.7	2,653.9	71.8	4,473.6	3,391.8	75.8	6,625.7	5,259.7	79.4	10,268.4	8,578.7	83.5	15,661.4	13,528.9	86.4
Real estate	2,703.0	1,917.6	70.9	3,583.5	2,747.3	76.7	4,342.8	3,518.5	81.0	6,035.7	4,985.1	82.6	9,676.1	8,323.6	86.0
Public services	2,806.2	2,060.8	73.4	3,971.8	3,152.6	79.4	6,090.4	4,996.5	82.0	11,927.5	10,015.1	84.0	19,890.7	17,242.5	86.7
Group 4															
Agriculture	2,450.2	1,782.3	72.7	3,429.0	2,682.5	78.2	4,442.0	3,643.4	82.0	6,362.7	5,492.8	86.3	10,776.8	9,149.6	84.9
Mining	4,709.5	3,317.6	70.4	7,653.1	6,218.9	81.3	13,506.3	11,728.1	86.8	20,862.7	19,023.6	91.2	28,548.8	26,530.6	92.9
Manufacturing	2,143.5	1,522.3	71.0	3,085.8	2,395.7	77.6	3,927.4	3,221.9	82.0	5,149.4	4,364.8	84.8	8,114.3	7,205.6	88.8
Elect gas water	3,503.1	2,523.1	72.0	4,095.0	3,096.0	75.6	5,293.1	4,176.5	78.9	8,164.6	6,707.1	82.1	13,029.5	10,977.5	84.3
Construction	2,195.2	1,603.3	73.0	2,994.4	2,387.4	79.7	3,971.5	3,302.5	83.2	5,809.5	4,967.8	85.5	9,700.5	8,519.8	87.8
Trade, hospitality	1,998.5	1,418.8	71.0	2,810.8	2,194.7	78.1	3,664.9	3,033.7	82.8	4,462.4	3,814.4	85.5	6,130.6	5,384.1	87.8
Trans, stor, com.	1,880.6	1,263.1	67.2	3,170.2	2,446.4	77.2	4,012.9	3,299.5	82.2	5,346.6	4,555.0	85.2	8,071.4	7,071.1	87.6
Financial inter.	3,229.8	2,272.5	70.4	4,107.2	3,108.1	75.7	6,078.6	4,827.7	79.4	9,452.9	7,897.6	83.5	14,159.0	12,343.1	87.2
Real estate	2,566.6	1,841.9	71.8	3,461.8	2,681.5	77.5	4,263.9	3,497.7	82.0	6,171.4	5,132.6	83.2	10,067.3	8,733.0	86.7
Public services	2,386.3	1,750.7	73.4	3,844.6	3,065.0	79.7	6,121.5	5,071.9	82.9	12,414.2	10,631.6	85.6	20,254.6	17,840.6	88.1

Source: Author's calculations.

*The actual wage corresponds to that reported in the Great Household Integrated Survey (GEIH) and the reservation wage to that obtained from the stochastic frontier estimations.

[1/] Percentile 10, [2/] Percentile 25, [3/] Percentile 50, [4/] Percentile 75, [5/] Percentile 90.

Table A4. Actual and reservation wages of the public sector across cities (Colombian $ 2018=100) *

Cities	Q1[1/]			Q2[2/]			Q3[3/]			Q4[4/]			Q5[5/]		
	Actual wage	Reserv. wage	%	Actual wage	Reserv. wage	%	Actual wage	Reserv. wage	%	Actual wage	Reserv. wage	%	Actual wage	Reserv. wage	
Bogotá	3,290	2,417	73.5	4,223	3,344	79.2	6,300	5,150	81.7	11,559	9,768	84.5	21,065	18,380	87.3
Medellín	3,443	2,628	76.3	4,289	3,459	80.6	6,557	5,477	83.5	11,644	10,085	86.6	20,475	18,141	88.6
Barranquilla	2,315	1,655	71.5	3,376	2,641	78.2	4,623	3,802	82.2	8,137	6,880	84.5	15,316	13,376	87.3
Bucaramanga	3,274	2,506	76.6	4,156	3,364	80.9	5,823	4,848	83.3	10,599	8,951	84.5	18,572	16,091	86.6
Cali	2,915	2,177	74.7	3,940	3,168	80.4	5,489	4,591	83.6	9,747	8,283	85.0	17,419	15,275	87.7
Tunja	3,448	2,579	74.8	4,700	3,758	80.0	8,277	6,777	81.9	14,629	12,089	82.6	20,174	17,340	86.0
Pereira	3,144	2,346	74.6	3,998	3,187	79.7	5,523	4,526	82.0	9,985	8,164	81.8	17,183	14,500	84.4
Manizales	3,298	2,450	74.3	4,182	3,314	79.2	6,109	5,028	82.3	11,776	9,962	84.6	20,694	17,941	86.7
Cartagena	2,369	1,750	73.9	3,760	3,023	80.4	5,252	4,328	82.4	9,414	8,005	85.0	15,311	13,416	87.6
Santa Marta	2,440	1,824	74.8	3,622	2,888	79.7	5,007	4,208	84.1	10,281	8,801	85.6	18,247	16,268	89.2
Ibagué	2,988	2,171	72.6	4,063	3,193	78.6	6,155	5,062	82.2	12,096	10,115	83.6	20,465	17,711	86.5
Neiva	3,133	2,312	73.8	4,147	3,270	78.9	6,360	5,184	81.5	12,338	10,344	83.8	20,406	17,555	86.0
Popayán	3,155	2,310	73.2	4,356	3,436	78.9	7,405	6,012	81.2	13,127	10,823	82.4	20,041	17,127	85.5
Armenia	3,074	2,245	73.0	4,029	3,153	78.3	6,180	5,037	81.5	11,905	9,992	83.9	19,587	16,784	85.7
Pasto	2,345	1,633	69.7	4,005	3,149	78.6	6,652	5,421	81.5	13,525	11,316	83.7	22,362	19,289	86.3
Cúcuta	2,980	2,229	74.8	3,934	3,155	80.2	5,743	4,720	82.2	11,592	9,795	84.5	20,378	17,671	86.7
Florencia	2,860	2,094	73.2	4,302	3,379	78.6	7,581	6,232	82.2	13,822	11,592	83.9	21,715	18,820	86.7
Quibdó	1,828	1,257	68.8	3,709	2,845	76.7	7,886	6,646	84.3	16,354	13,931	85.2	23,430	20,522	87.6
Riohacha	2,651	1,998	75.4	4,268	3,441	80.6	7,499	6,339	84.5	13,357	11,659	87.3	21,484	19,291	89.8
Sincelejo	2,243	1,637	73.0	3,608	2,848	78.9	5,466	4,526	82.8	12,342	10,657	86.3	20,293	18,150	89.4
Montería	2,302	1,709	74.2	3,704	2,971	80.2	5,529	4,593	83.1	12,107	10,459	86.4	19,990	17,722	88.7
Valledupar	2,073	1,460	70.4	3,554	2,773	78.0	5,048	4,171	82.6	9,572	8,126	84.9	16,571	14,464	87.3
Villavicencio	3,099	2,359	76.1	4,029	3,275	81.3	5,869	4,921	83.8	10,840	9,228	85.1	17,941	15,357	85.6

Source: Author's calculations.

*The actual wage corresponds to that reported in the Great Household Integrated Survey (GEIH) and the reservation wage to that obtained from the stochastic frontier estimations.

[1/] Percentile 10, [2/] Percentile 25, [3/] Percentile 50, [4/] Percentile 75, [5/] Percentile 90.

Table A5. Differences between actual and reservation wage by education across cities (Colombian $ 2018=100)*

Cities	Prim/no educ.				Secondary				Technical				College				Graduate level			
	Q2		Q4		Q2		Q4		Q2		Q4		Q2		Q4		Q2		Q4	
	Actual wage	Reserv. wage	Actual wage	Reserv. wage	Actual wage	Reserv. wage	Actual wage	Reserv. wage	Actual wage	Reserv. wage	Actual wage	Reserv. wage	Actual wage	Reserv. wage	Actual wage	Reserv. wage	Actual wage	Reserv. wage	Actual wage	Reserv. wage
Bogotá	3,768	3,128	4,728	4,121	4,236	3,501	5,562	4,811	5,302	4,358	7,509	6,527	10,828	8,987	17,120	15,256	20,598	17,113	31,592	28,051
Medellín	3,714	3,144	4,629	4,035	4,157	3,467	5,350	4,662	5,251	4,375	7,338	6,426	10,994	9,252	16,615	14,887	20,762	17,443	30,530	27,220
Barranquilla	3,136	2,642	3,826	3,371	3,691	3,104	4,399	3,806	4,201	3,449	5,510	4,719	7,685	6,218	12,061	10,518	16,889	13,963	24,605	21,952
Bucaramanga	3,393	2,866	4,245	3,757	4,097	3,455	5,175	4,520	4,940	4,112	6,600	5,750	9,088	7,395	13,480	11,833	18,252	14,892	24,633	21,451
Cali	3,556	2,977	4,402	3,883	4,059	3,414	5,207	4,537	5,177	4,287	7,283	6,377	9,954	8,255	15,008	13,310	19,761	16,460	29,198	26,089
Tunja	3,144	2,632	4,034	3,541	3,865	3,206	4,946	4,286	4,746	3,900	6,551	5,710	9,142	7,414	13,428	11,696	16,217	12,925	20,706	17,309
Pereira	3,347	2,808	4,052	3,457	3,912	3,242	4,620	3,937	4,556	3,695	5,924	4,993	8,419	6,698	12,373	10,620	16,161	12,553	21,462	18,033
Manizales	3,397	2,816	4,199	3,636	3,996	3,301	4,949	4,244	4,742	3,848	6,371	5,433	9,359	7,560	13,998	12,223	18,821	15,263	25,688	22,321
Cartagena	3,428	2,945	4,096	3,587	3,904	3,322	4,669	4,069	4,684	3,932	6,178	5,389	8,601	7,092	12,700	11,210	16,291	13,446	21,226	18,227
Santa Martha	3,403	2,873	4,316	3,812	3,909	3,314	4,887	4,286	4,473	3,696	6,028	5,206	8,465	6,953	13,614	12,076	17,824	15,057	24,438	21,469
Ibagué	3,122	2,599	4,084	3,564	3,839	3,170	4,852	4,161	4,509	3,647	6,129	5,197	8,245	6,561	12,655	10,867	17,947	14,316	23,951	20,478
Neiva	3,411	2,872	4,239	3,694	3,968	3,274	5,158	4,428	4,565	3,706	6,288	5,334	8,627	6,847	13,025	11,242	18,246	14,591	24,264	20,547
Popayán	3,032	2,420	3,889	3,278	3,786	3,097	4,854	4,149	4,647	3,793	6,436	5,533	9,337	7,550	13,366	11,574	17,210	13,780	22,659	19,269
Armenia	3,424	2,835	4,088	3,527	3,849	3,148	4,700	3,999	4,427	3,587	6,056	5,161	8,688	6,989	13,241	11,483	17,692	14,079	24,028	20,429
Pasto	2,260	1,709	3,358	2,834	3,329	2,664	4,272	3,597	4,407	3,584	6,030	5,144	8,043	6,417	12,639	10,882	18,624	15,269	24,375	20,751
Cúcuta	3,235	2,741	4,080	3,552	3,695	3,065	4,573	3,934	4,558	3,733	6,109	5,203	7,975	6,339	12,232	10,486	18,322	14,856	24,155	20,827
Florencia	2,811	2,280	3,697	3,199	3,638	2,969	4,730	4,024	4,592	3,694	6,713	5,819	8,961	7,201	13,302	11,573	18,090	14,400	23,561	20,040
Quibdó	2,125	1,681	3,029	2,529	3,075	2,454	4,216	3,565	4,279	3,393	6,277	5,396	10,787	9,052	16,549	14,932	19,086	15,584	23,903	20,283
Riohacha	2,859	2,368	4,102	3,587	3,866	3,268	5,254	4,662	5,023	4,221	8,186	7,347	9,819	8,265	14,286	12,757	18,325	15,419	25,799	22,966
Sincelejo	2,397	1,939	3,451	2,979	3,511	2,918	4,310	3,718	4,228	3,487	5,519	4,730	8,896	7,432	13,789	12,318	18,660	15,639	24,823	21,894
Montería	2,699	2,216	3,570	3,086	3,659	3,064	4,440	3,850	4,281	3,517	5,463	4,676	9,061	7,554	13,705	12,185	18,408	15,231	24,499	21,270
Valledupar	2,618	2,146	3,698	3,212	3,698	3,119	4,676	4,097	4,237	3,499	5,455	4,697	7,890	6,416	12,015	10,455	16,309	13,219	21,972	19,084
Villavicencio	3,255	2,744	4,028	3,516	3,886	3,255	4,995	4,341	4,876	4,023	6,953	6,125	9,134	7,500	13,485	11,866	16,826	13,359	22,315	19,127

Source: Author's calculations. *The actual wage corresponds to that reported in the Great Household Integrated Survey (GEIH) and the reservation wage to that obtained from the stochastic frontier estimations. [1/] Percentile 10, [2/] Percentile 25, [3/] Percentile 50, [4/] Percentile 75, [5/] Percentile 90.


BANCO DE LA REPÚBLICA
COLOMBIA