



RESEARCH ARTICLE

Estimating the reservation wage across cities in Colombia: A stochastic frontier approach *

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Abstract

We use the stochastic frontier approach to estimate the reservation wage across different cities in Colombia. Using the Household Surveys from 2008–2019 for 23 urban cities, we find empirical evidence supporting search theory predictions that suggest a positive relationship between the reservation wage and both education level and net family labor income. We examine these relations across different quantiles of the distribution. We also find a gender gap in the reservation wage and explore this gap, controlling by the level of education and the presence of children in the household. In contrast to the results found in the literature for some developed economies, we find that the presence of children reduces the reservation wage of both women and men. This result is explained by the availability and affordability of childcare services between countries. Finally, we find that the reservation wage increases with the development and productivity of cities.

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

JEL codes: C14, J22, J64.

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1. Introduction

The reservation wage is defined as the minimum wage at which an individual is willing to work, or 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 experience of unemployment. An extensive empirical and theoretical literature has found a negative relationship between reservation wages and the duration of unemployment for developed economies (Addison JT, 2021; Cox JC, 1992; Krueger AB, 2016). Burdett and Vishwanath 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. Therefore, when an unemployed worker receives an offer lower than expected, he revises his perception of the offer distribution and thus his reservation wage declines. Moreover, Krueger and Mueller 2016 found that reservation wages decrease over the spell of unemployment, mainly for older individuals and those with savings. Therefore, unemployed workers with positive savings at the beginning of the spell reduce their reservation wage as they reduce their savings during the search process.¹ Additionally, unfavorable labor market conditions are associated with lower reservation wages (Addison JT, 2021).²

The literature has found that reservation wages can vary based on socioeconomic characteristics such as gender, age, and location. Addison, Centeno, and Portugal 2021 found that older workers tend to have higher reservation wages, with men typically having higher reservation wages than women. Brown, Roberts, and Taylor 2011 also found that the presence of children raises the reservation wage for both men and women in the UK, but significantly more for women. Their results suggest that children increase the opportunity cost of accepting work outside the home.³ Recently, Brown, Popli, and Sasso 2022 explored the gender reservation wage gap in the case of Italy across regions and found significant variations. For example, the authors found an important variation in the reservation wage gap across regions. However, in the case of developing countries such as Colombia, there are few studies on reservation wages and none on gender reservation wage gap across regions. The purpose of our paper is to address this gap in the literature.

Our approach differs from that of Brown et al. 2022 in some key ways. First, we estimate reservation wages using the stochastic frontier model (SFM), which eliminates the potential response bias in self-reported reservation wages (Rosenman R, 2011). For robustness, however, we also present results using the self-reported reservation wages from the Colombian National Survey (DANE). The SFM uses the accepted wage of employed individuals as outcome to estimate the reservation wage. This method has the advantage of using information from all employed individuals with similar characteristics, which allows us to estimate both the minimum wage that an individual is willing to accept⁴ and the reservation wage as the share of the current wage of the worker. An interesting outcome of this approach is that the ratio of the reservation wage to the current wage increases with household income and education. Moreover, this ratio enables a nonparametric estimation of the labor supply curve in Colombia (Mui P, 2021).

Second, the Colombian case is particularly interesting as it offers a unique insight into the impact of affordable childcare services on women's reservation wages, especially for those with children. In con-

¹Some authors also report evidence of a positive relationship between reservation wages and wealth (Bloemen and Stancaelli, 2001).

²A possible floor of the reservation wage in Colombia is unemployment insurance. Law 1636 of 2013 establishes an unemployment benefit to those who lose their jobs.

³In 2020, after the Covid-19 pandemic, given that most schools and nurseries were closed, there was an increase in family responsibility among women, affecting their reservation wage. As a result, female labor participation decreased, especially among those with children (Bonilla et al. 2021).

⁴One limitation of this methodology is that it captures only the reservation wage of individuals who accept a job offer and are employed. The reservation wage of individuals who do not accept job offers and remain unemployed is not captured. However, if the characteristics of those who reject job offers are similar to those who accept job offers, we do not expect our estimation to be significantly biased.

trast to Italy and other developed economies (e.g. the UK) where access to affordable childcare services is limited, Colombia has a more affordable public childcare services.⁵ Since 2006, the National Government of Colombia has implemented public policies aimed at providing care for young children, such as the De Cero a Siempre program which offers free education to children under the age of 5 and gives priority to low-income households. According to Bernal 2014, around 53 % of children between 0 to 5 years old have access to childcare services in Colombia; this level of participation is one of the highest in the region. This difference in the availability and affordability of childcare services could explain, between countries, the variations in women's reservation wages, especially for those with children.

For the case of Colombia, Villa 2006 estimated the reservation wages using the stochastic frontier approach proposed by Hoffer and Murphy 1994. The author found that the reservation wage increases with wealth and non-labor income but decreases with the number of children in the household, individual age, education, and if the individual is head of the household. Our study builds upon Villa 2006 by incorporating several new elements. First, we use data from the Great Integrated Household Survey (GEIH), collected by the Department of Statistics (DANE) from 2008 to 2019, which covers a longer period than Villa used. Second, we examine the geographic heterogeneity of Colombia by analyzing the reservation wage across different cities and considering gender. Third, we examine the reservation wage by quintile and find significant differences between the first and last quintiles. Finally, we use our results to present a nonparametric estimation of the labor supply curve in Colombia, following Mui and Shofer 2021.

Our results show that the reservation wage in Colombia is positively correlated with education and family net labor income. Middle-aged workers, who are more established in the labor market, have higher reservation wages than younger workers who have not yet decided on their career paths, an outcome that supports the predictions of search theory. Regarding the gender reservation wage gap, our results are similar to those of Brown et al. 2022 for Italy, where women have lower reservation wages than men. This gap is present across all regions and percentiles of the wage distribution and is most pronounced at the bottom of the wage distribution.

The effect of children on the reservation wage is different in Colombia compared to Italy (Brown S, 2022) and the UK (Brown S, 2011). In Colombia, children reduce the reservation wage for both women and men, whereas in the UK, children increase the reservation wage for women; in Italy, children are not found to have any effect on the reservation wage. These differences can be attributed to the cost of childcare services in each country. Affordable childcare services are limited in the UK and Italy, whereas in Colombia, recently implemented public policies provide free care for children under 5 years old. Moreover, informal childcare services are also provided by family members, at a low cost. These forms of assistance allow women, who are the primary providers of childcare in their families, to reduce their reservation wages to participate in the labor market.⁶ Additionally, in developing countries, the presence of children in a household may also increase the value of being employed due to the increasing financial needs of the family, reducing thereby the reservation wage.

Our results are similar to those of Brown et al. 2022, who compared the reservation wage by regions in Italy (North vs South). In the South, the presence of children or other family members reduces the women's reservation wage more than it does for men, resulting in an increase in the reservation wage gap. Conversely, in the North, the presence of children increases women's reservation wage more than it does for men, which reduces the reservation wage gap. This difference can be attributed to the cost of childcare services in each region. In the North, the cost of formal childcare services is higher compared to the South, where family childcare is a more affordable option and family budget constraints are more likely to be binding (Brown S, 2022).

⁵In the case of Italy, Istat (2014) indicates that only 15 % of children have access to government-funded nurseries. Cgiuri (2000) states that the private nurseries are unaffordable for most Italian families.

⁶Cardona and Morales 2015 found that in Medellín, the public childcare program Buen Comienzo [Good Start] increases the labor participation of women between 3 to 9 pp.

Additionally, our results suggest a positive relationship between the reservation wage and productivity. We found that the reservation wage increases with the level of development and productivity of cities. However, highly skilled workers in low-productivity cities tend to set higher reservation wages than those in cities with average productivity. This difference could be because these skilled workers are willing to accept a job in a low-productivity city only if the wage is sufficient to compensate for the lack of access to quality healthcare and education systems as well as other amenities.

Because the reservation wage is unobservable, it must be estimated indirectly. There are three commonly used methods for its estimation in the literature. The first is a survey-based approach in which unemployed individuals are directly asked about their reservation wages. This method has been criticized for the potential presence of response bias (Rosenman R, 2011). The second, used by Kiefer and Neumann 1979, predicts the reservation wage for unemployed individuals based on their accepted wages after spells of unemployment.⁷ This method has been applied to the UK and Germany (Bloemen HG, 2002; Christensen, 2005). The third method utilizes stochastic frontier models that are commonly used to measure inefficiencies in production functions.⁸

The first application of stochastic frontier models to estimate reservation wages was by Hofler and Murphy 1994, employing information from the US.⁹ This method been also used for developed economies such as Germany and the UK as well (Jensen U, 2010; Watson D, 2008). The authors' findings align with the predictions of search theory, which suggests that reservation wages are influenced by factors such as age, education, labor market density, and wealth. Hofler and Murphy also found that men tend to have higher reservation wages than women. More recently, using cross-sectional data from Germany, Leppin 2014 compared the estimation of reservation wages using the Kiefer and Neumann approach versus the stochastic frontier approach. The author found that the best results are achieved with the stochastic frontier model.¹⁰ In this paper, we use the stochastic frontier approach to estimate the reservation wages in Colombia and as a robustness present the results using the self-reported reservation wages of unemployed workers from the DANE.

This paper is divided into six sections. First is this introduction. The second section provides a brief overview of the Colombian labor market across cities and gender, highlighting the country's significant heterogeneity. The third section outlines the methodology applied in the estimations. The fourth section explains the data utilized for the analysis. The fifth section presents and evaluates the results. The last section contains our conclusions.

2. Characterization of the labor market in Colombia across cities and gender

One of the distinctive features of the Colombian labor market is its high level of heterogeneity, as reported by Arango and Hamann 2013. During the 2001–2011 period, the authors found significant differences across cities in key labor market indicators such as unemployment rate, participation rate, occupation rate, informality rate, and wages, even though regulations and institutions were (and remain)

⁷Another possible method is to impute wages to inactive workers, using different propensity-score matching.

⁸A detailed explanation of stochastic frontier models can be found in Kumbhakar and Lovell 2000.

⁹Hofler and Polachek 1985 use stochastic frontier models to estimate the ignorance of the labor market defined as “the difference between the wage (price) individuals earn (pay) with full information and the wage (price) they receive (pay) given their limited information stocks” (p. 267). A similar methodology is used by Polachek and Yoon 1996.

¹⁰The Kiefer and Neumann approach (K&N) and the stochastic frontier approach allow us to estimate reservation wages for different groups of individuals: the stochastic frontier models estimate the reservation wages of employed persons, whereas the K&N model estimates the reservation wages of unemployed workers. The fact that the estimation is for different groups of individuals (employed and unemployed) does not imply that they are not comparable (JS, 2014). Mui and Schofer 2021 provide evidence by calculating the reservation wage ratio (reservation wage divided by actual or potential wage) for the entire labor forces of both the US and Germany (employed, unemployed, and out of the labor force). The authors found no difference in the distribution of reservation wage ratios for unemployed and employed workers (see Figure 1 page. 37).

uniform. It is therefore crucial to consider heterogeneity when studying reservation wages. For instance, the average unemployment rate (UR) across cities was 12.4 % during our analyzed period of 2008–2019, with a standard deviation of 2.26 pp. **1**, Panel A shows the average unemployment rate divided into quartiles by city; those with the highest unemployment rates (14 % to 18 %) in the last quartile, such as Cúcuta, Quibdó, Popayán, Ibagué, Pereira, and Armenia, are depicted in the darkest gray area. Cities with the lowest unemployment rates (less than 10 %) in the first quartile, such as Barranquilla, Bogotá, Cartagena, Santa Marta, and Bucaramanga, are depicted in the lightest gray area. The gap between the maximum and minimum unemployment rate is 9 pp. A similar pattern is observed in the labor force participation rate (LP), where the average LP across all cities was 63.3 % with a gap of 12 pp between the maximum and minimum participation rates.

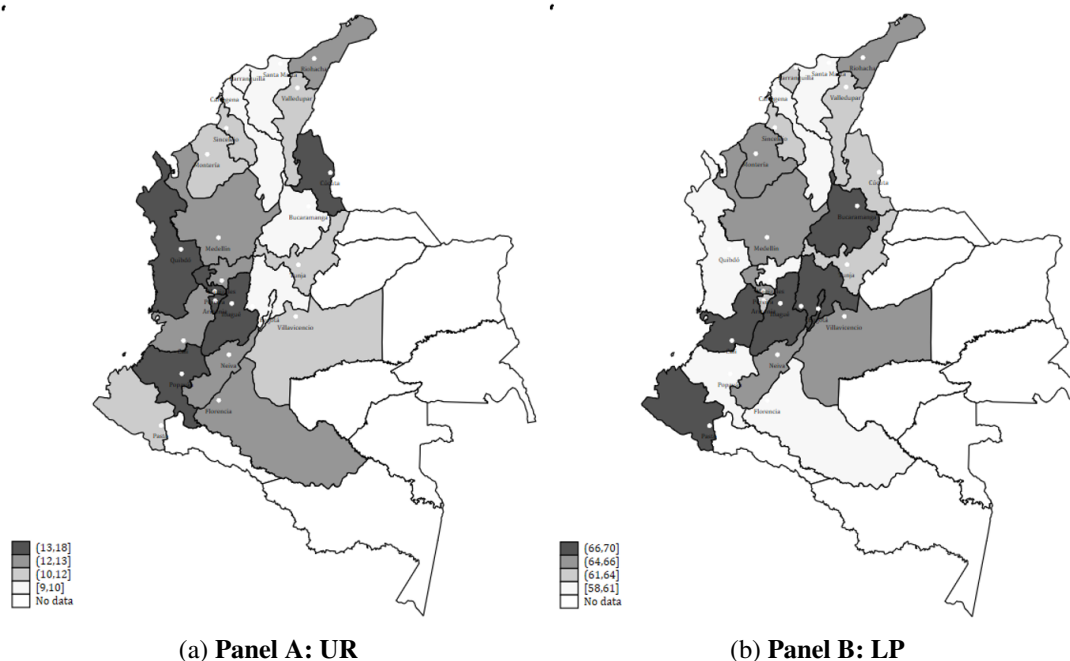


Figura 1: *Labor market indicators by city: Average 2008–2019*

Source: Authors' calculations are based on the Great Integrated Household Survey (GEIH).

The heterogeneity of the Colombian labor market is also evident when analyzed by gender. Figure 2 highlights the disparity in the average unemployment rate between women and men across cities. In general, men have a lower unemployment rate compared to women in all cities, but there is significant variation between cities. For instance, cities with the largest gap in unemployment rate between women and men, such as Cartagena, Valledupar, Quibdó, Riohacha, Santa Marta, and Sincelejo, are located in the north of the country. Cities with the smallest gap in unemployment rate, including Bogotá, Tunja, Neiva, Villavicencio, Pasto, and Bucaramanga, are located in the center of the country. The difference between the minimum and maximum unemployment rate for men is 7.5 pp, whereas for women it is almost double at 13 pp.

The disparity in the participation rate between men and women also exhibits regional heterogeneity, with the highest gap found in northern cities such as Barranquilla, Cartagena, Cúcuta, Pereira, and Sincelejo, and the lowest gap in cities in central cities such as Bogotá, Tunja, Quibdó, Pasto, and Ibagué. The difference between the minimum and maximum participation rate for men is 12 pp, but for women it is 16 pp. The study of reservation wages across cities and gender could provide additional insight into this regional heterogeneity by highlighting the importance of examining reservation wages across these dimensions.

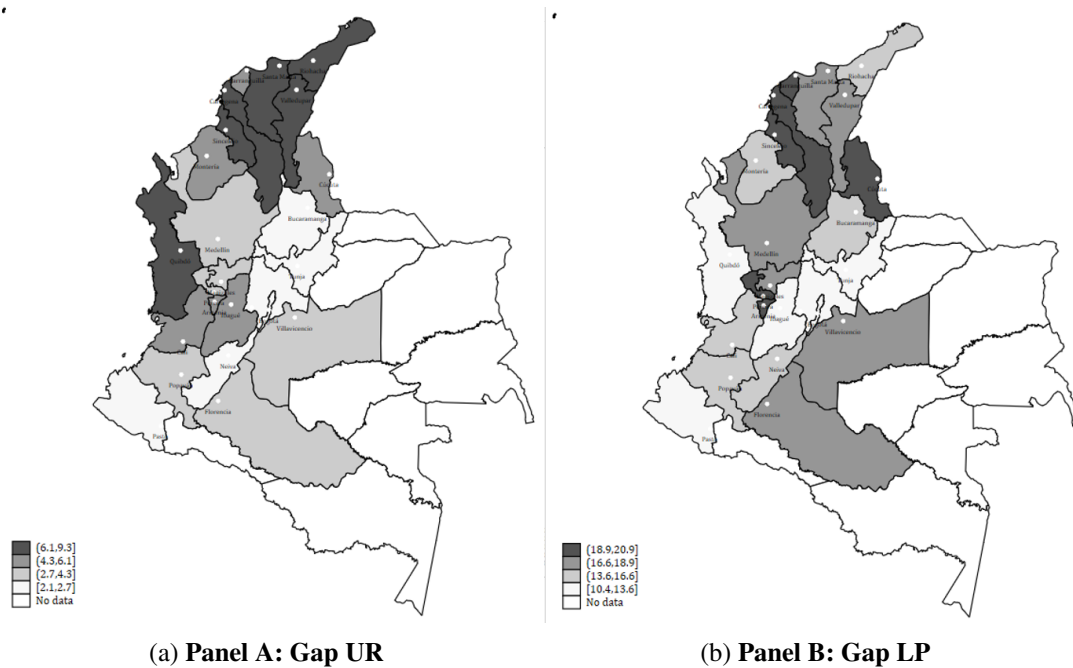


Figura 2: Labor market indicators by gender: Average 2008–2019

Source: Authors' calculations are based on the Great Integrated Household Survey (GEIH).

3. Stochastic Frontier Models (SFM)

Stochastic frontier models are motivated by the theoretical concept that no economic agent (firms or individuals) can exceed an ideal “frontier” (production or wages); in such cases, deviation from the ideal frontier indicates an inefficiency. In general, these models have been used to estimate the inefficiency of firms under their production function. However, this methodology has been applied recently to other similar problems such as the labor market. According to the search model (presented in Appendix A.1), the reservation wage is the necessary wage to induce a worker to accept an offer of employment. We can estimate reservation wage using stochastic frontier models, as proposed by Hoffer and Murphy 1994, who assume that the wage determination process is given by:

$$w_i = X_i\beta + \epsilon_i \quad (1)$$

Where X_i refers to the individual characteristics and $\epsilon_i = \gamma_i + \delta_i$, 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 $w_i - w_i^R = \delta_i$. As long as we can measure δ_i , we can get an estimation of the reservation wage:

$$w_i^R = w_i - \delta_i \quad (2)$$

In a similar framework, Hoffer and Polachek 1985 interpreted δ_i as “ignorance,” defined as the difference between the price an individual would pay with full information and the price he actually pays considering his limited information. Polachek and Yoon 1996 interpreted δ_i as the gap between the reservation wage and the wage that the firm pays. Stochastic frontier models allow us to distinguish between γ_i and δ_i . Where the parameter δ_i is constrained from below, $E(\delta_i) > 0$ gives the decision rule

of accepting an offer. The most common distributions assumed for δ_i are the half-normal truncated at zero; the half-normal truncated at a non-zero point; and the exponential. These distributions allow us to separate the two components of the error term and to estimate the degree by which the actual wage exceeds the reservation wage for each individual. The half-normal model assumes that δ_i is *i.i.d.* $\sim N(0, \sigma_\delta^2)$ and truncated at zero from below. The mean of the conditional distribution is given by:

$$E[(\delta_i|\epsilon_i)] = (\sigma\lambda/1 + \lambda^2)[(\phi(\epsilon_i\lambda/\sigma))/(1 - \Phi(-\epsilon_i\lambda/\sigma)) - (\epsilon_i\lambda/\sigma)] \quad (3)$$

Where φ and Φ are the density and the distribution functions of the standard normal distribution, $\lambda = \frac{\sigma_\delta}{\sigma_\gamma}$ and σ is the standard deviation of the composed error term.¹¹ We use the half-normal distribution and assume that δ_i is defined as the gap between the worker's observed wage and the unobserved reservation wage ($\delta_i = w_i - w_i^R$).¹²

4. Data

The data used in this study were obtained from the Great Integrated Household Survey (GEIH) provided by the DANE, covering the period 2008–2019. The survey is representative of the 23 main cities in Colombia and their metropolitan areas, and includes information on salaried employed individuals. The estimation was performed using data from individuals who reported being occupied as salaried workers during one survey week.¹³ The dependent variable in the stochastic frontier estimation is the natural logarithm of the worker's hourly wage. To predict the reservation wage, individual worker characteristics such as age, education, gender, and occupation were used, along with controls for geographic region and economic sector, in accordance with the search model.

This paper evaluates the heterogeneity of the labor market across cities in Colombia. We consider workers in four distinct groups of cities, categorized based on the 2020 competitiveness ranking developed by the Private Competitiveness Council (CPC). This ranking, in turn, is based on a combination of four sets of indicators (from a total of 103): enabling living conditions, human capital, market efficiency, and innovative ecosystem.¹⁴ The first group includes workers in Bogotá, the capital of the country; the second group encompasses workers in Medellín, Manizales, Bucaramanga, Tunja, Cali, Pereira, and Barranquilla; the third group includes workers in Popayán, Armenia, Cartagena, Neiva, Pasto, Ibagué, Cúcuta, and Santa Marta; the fourth group encompasses workers in Villavicencio, Montería, Sincelejo, Valledupar, Florencia, Quibdó, and Riohacha. Table 1 provides a summary of the descriptive statistics of the variables used in the estimation, both for the overall sample and for each group of cities.

¹¹The truncated normal model assumes that: δ_i is *i.i.d.* $N(\mu, \sigma_\delta^2)$ where $\mu \neq 0$ and the distribution are truncated at zero from below; this distribution contains an additional parameter μ to be estimated. To obtain the mean of the conditional distribution, the expression $\epsilon_i\lambda/\sigma$ is now $\mu^* = \epsilon_i\lambda/\sigma + \mu/\sigma\lambda$.

¹²The estimation process maximizes the log-likelihood function of a stochastic frontier model, and the variance-covariance matrix (VCE) is calculated as the inverse of the negative Hessian matrix. Although the standard errors of the estimators are interpreted as a lower bound of their variance with this method, it benefits from the properties of asymptotic convergence. Using the cluster method to calculate standard errors could potentially underestimate them and lack robustness to the model specification. Therefore, we opted for the method based on the observed information matrix (VCE) and the standard errors were not clustered, as is traditional in the estimation of stochastic frontier analysis when assuming a normal distribution.

¹³This definition includes all salaried employees in Colombia's main 23 cities who are private workers, public workers, domestic workers, and daily workers.

¹⁴Among the variables we used to build the CPC by city are: indices on fiscal autonomy, capacity of savings, homicides and robbery rates, efficiency of the judicial system; basic services such as energy, water, gas, transportation cost, connectivity; education coverage (primary, secondary and undergraduate), test of quality of education (e.g. Saber 11, Saber 5, and Saber Pro), quality of teachers, investment in education; coverage of the health system, infant and maternity mortality rates; investment in public health, deforestation rates, firms with quality certification ISO14001, natural disasters rate, banalization rates, formality rates, unemployment rates, facility to register a property; investment on research, patents, quality of research, and firms' density (for more details on this index, see <https://www.compitem.com.co/indice-de-competitividad-de-ciudades/>).

Tabla 1: *Descriptive statistics: 2008–2019*

Variables	Total Sample	Group 1	Group 2	Group 3	Group 4
Worker's hourly wage (Colombian pesos of 2018)	5,055	5682	5,128	4,920	4,860
Household income excluding worker's wage (Colombian pesos of 2018)	6,783	8,403	7,092	6,218	6,398
Age	33.6	32.5	33.4	34.2	33.6
Years present employer	10.1	7.3	9.5	11.1	11.0
Children under 14 years	0.9	0.8	0.8	0.9	1.1
Sex (male=1)	47.8	49.0	49.1	47.5	45.5
Head household (yes=1)	29.0	29.1	28.3	29.5	29.6
Marital status (married=1)	54.6	51.7	52.4	56.2	57.7
Education					
Secondary	52.4	54.3	54.2	50.8	50.5
Technical	21.6	20.7	22.9	21.9	19.4
College	16.3	15.0	14.3	17.1	19.3
Graduate level	7.3	7.4	6.3	7.9	8.3
Economic sector					
Agricultural	0.8	0.4	0.9	0.9	0.5
Mining	0.6	0.5	0.2	0.7	1.1
Manufacturing	13.3	16.5	19.2	9.8	5.9
Electricity, gas, water	1.4	0.6	1.2	1.7	1.7
Construction	3.6	3.2	3.9	3.4	3.7
Commerce, hotel, restaurants	26.6	23.2	25.5	28.2	27.8
Transport, storage, communications	6.7	9.0	6.9	6.9	5.3
Financial intermediation	3.6	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

Note: The median is shown for the income variables and the average for the rest of the variables.

Source: Authors' calculations are based on the Great Integrated Household Survey (GEIH).

During the period 2008–2019, in the whole sample, the salaried worker received a median wage per hour of \$5,055 (Colombian pesos of 2018)¹⁵ the median age was 33.6 years and 47.8 % of workers were male. In terms of education, we find that 52.4 % had secondary education, 21.6 % had a technical education, and more than 16.3 % had a higher education. Regarding sectors, most salaried workers were operating in the manufacturing sector (13.3 %); commerce, hotel, and restaurants (26.6 %); and the public services sector (35.3 %). By groups of cities, we find important differences. For example, Group 1 presents a median wage per hour higher than the whole sample (\$5,682); Group 2 which presents a median wage per hour of \$5,128; Group 3 presents a median of \$4,920; and the median for Group 4 is \$4,860. The lowest median wage per hour, in Group 4, is not surprising when we consider that this group received the lowest classification in the competitive index and the highest levels of poverty and inequality (Arango LE, 2019)

¹⁵To deflate wages, we use the CPI of each city as suggested by Murillo-Huertas et al. 2020 and Weinand and von Auer 2020.

5. Results

5.1. Stochastic wage frontier

Our estimation of the stochastic wage frontier was conducted using the half-normal distribution for individuals who participated in the GEIH survey between 2008 and 2019 and reported being salaried workers¹⁶ The results of the estimated wage function are presented in Table B1 of the Appendix (Equation 1). As in traditional wage function estimations, the coefficients of age and age squared indicate that earnings increase with age, but at a declining rate; this result is similar to results obtained using length of experience with the current employer. Additionally, characteristics such as being male, head of household, or married were found to increase wage earnings. In terms of education, secondary education resulted in 11.6 % higher wage earnings compared to primary education, and higher education was associated with 70 % or more higher earnings compared to primary education. As reported in the literature, we find a positive and significant relationship between actual wages and a worker's net household income, excluding individual income.

We also find differences in wage earnings across economic sectors. Individuals who worked in sectors such as mining, manufacturing, electricity, financial intermediation, and the public sector received higher wages compared to those in the agricultural sector; those who worked in construction, trade, transport, and communication received a lower wage (compared to the agricultural sector). As we noted in the descriptive section, geographic differences are significant; to better understand regional differences, we control for the regions defined by DANE: Atlantic, Eastern, Central, Pacific, and Bogotá (the capital). In the next section, we delve deeper into these differences by exploring the reservation wages for cities, which classify based on their level of competitiveness and development (as per the CPC index).

5.2. Reservation wages

5.2.1 All urban areas

Reservation wages for salaried individuals are calculated from Equation (2) using the estimated parameter $\hat{\delta}_i$ from the stochastic frontier estimation.¹⁷ Figure 3 shows the frequency distribution of the actual and reservation wage salary in real terms at 2018 prices. Here we see that the reservation wage distribution is concentrated to the left of the wage distribution, with a median reservation wage per hour of \$3,737 (2008 Colombian prices), compared to the median wage of \$5,055. In relative terms, the reservation wage represents 74.2 % of the median actual wage. Our results are similar to those of other authors such as Hofler and Murphy 1994 for the US (around 80 % of the average wage) and Villa 2006 for 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 2 shows the reservation wage estimation at the tenth percentile (Q1), fiftieth percentile (Q3), and ninetieth percentile (Q5).¹⁸ It is worth mentioning that the ratio between the reservation wage

¹⁶As a robustness check, we estimate the stochastic frontier with alternative distributions, such as the half-normal truncated at a non-zero point and the exponential distribution. However, the estimation using the truncated distribution did not converge. The results for the exponential distribution are shown in Table B1 in the Appendix, along with the results of the estimation using the half-normal distribution.

¹⁷It is important to note that standard errors are calculated for the parameters (β), which are included in the table of stochastic frontier estimates (Appendix B). In turn, reservation wages are a variable obtained from the estimation of the frontier ($w_i^R = w_i - \hat{\delta}_i$).

¹⁸Based on the efficiency measures obtained from the estimation of the stochastic frontier function, we calculated reservation wages for each individual. The presentation of results by quantiles is done ex-post to the estimation and the calculation

and the observed wage increases with the quantile distribution, going from 61.9 % in Q1 to 81.9 % 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 (Hofler RA, 1994). These results remain across other dimensions such as level of education, economic sector, age, and gender. Table 2 also presents the reservation wage estimations using quantiles for the socioeconomic characteristics previously mentioned.

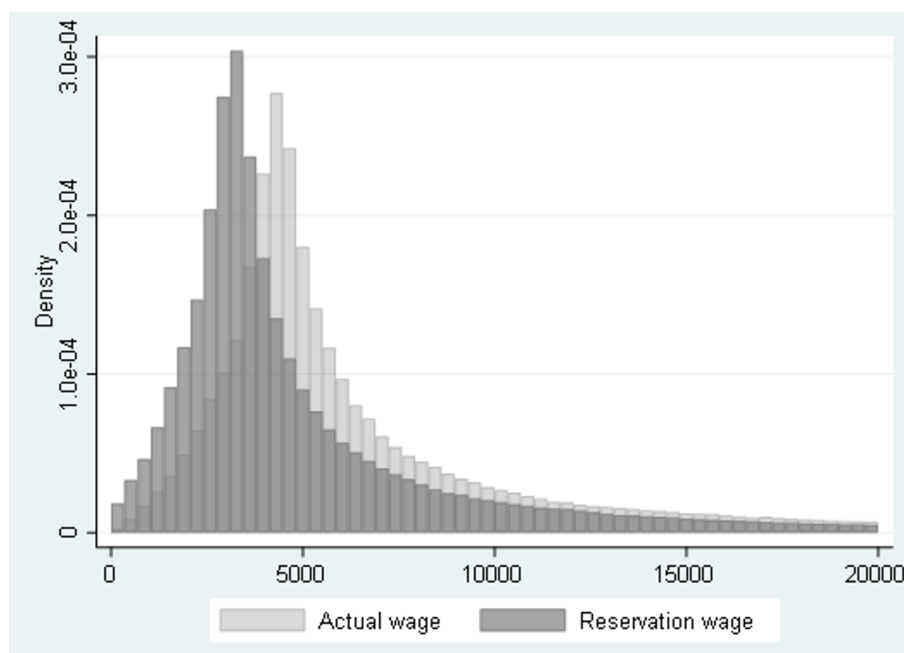


Figura 3: *Frequency histograms of actual and reservation wage*

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

Following Hofler and Murphy 1994, we also check if our results are consistent with those predicted by the search theory. As presented Appendix A.1 (in Equation (4)), 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 labor market, and/or the opportunity cost of work versus leisure. Thus, different demographic groups might have different discount factors and therefore different reservation wages. For example, medium-age workers who are more attached to the labor market will set higher reservation wages than younger groups who weakly attached to the labor force or have not yet decided their career path. Similarly, women have different preferences as well as different opportunity cost of work than men, which reflects their lower reservation wage compared to men (Dennett J, 2013; Hofler RA, 1994; Kluge J, 2014). In the next section, we discuss this gender gap in more detail within the reservation wage.

In Table 2, we see that the reservation wage increases with age across all quantiles. Thus, individuals younger than 25 year have a lower reservation wage than older individuals. The difference in the reservation wage by age also increases with the quantile. 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 began working at an

of reservation wages. Specifically, the data is organized by quantiles considering different socioeconomic variables for individuals. This approach allows us to evaluate the behavior of reservation wages not only by quantiles but also in consideration of individuals' socioeconomic conditions.

early age.

Tabla 2: Reservation wages by quintiles (Constant pesos of 2018)

	Q1 ^{1/}		Q3 ^{2/}		Q5 ^{3/}	
	Reservation wage	% wage	Reservation wage	% wage	Reservation wage	% wage
Total sample Sex:	1,865.6	61.9	3,737.4	74.2	12,249.9	81.9
Male	1,964.5	61.9	3,809.1	74.0	12,496.5	82.1
Female	1,772.8	61.9	3,678.6	74.3	12,040.7	81.8
Education:						
Primary/no educ.	980.9	59.6	2,714.6	74.7	4,806.0	82.0
Secondary	1,542.7	63.0	3,227.2	74.6	6,148.5	81.7
Technical	2,267.7	64.2	3,840.9	74.1	8,435.4	81.9
College	2,790.7	59.1	7,386.2	73.4	18,267.5	83.1
Graduate	5,904.8	59.5	14,632.7	73.0	30,395.3	82.2
Age:						
< 25	1,286.0	61.2	3,072.4	74.7	5,514.5	81.3
26-35	2,032.1	62.9	3,756.0	74.4	9,682.4	81.7
36-45	2,195.7	61.6	4,233.7	73.5	13,896.1	81.9
46-55	2,330.9	61.2	5,107.5	73.3	19,182.1	82.6
56-65	2,559.6	61.7	8,534.9	74.6	23,791.7	83.8
Net household income:						
≤ \$3000	1,416.6	62.3	3,317.2	75.4	8,073.5	82.6
\$3001-\$5000	1,779.1	62.8	3,403.9	74.3	7,856.4	81.4
\$5001-\$7000	1,859.7	62.4	3,642.1	74.3	9,117.4	81.5
≥ \$7001	2,095.1	61.3	4,326.5	73.7	15,821.3	82.1

Source: Authors' calculations. Percentile 10^{1/}, Percentile 50^{2/}, Percentile 90^{3/}

Other important elements that determine the reservation wage are individual characteristics such as level of education, and economic sectors that reflect the different job offers received by each individual. Individuals with a high level of education may present higher wage offers, which would imply higher reservation wages than those with low education or non-education as suggested by Hoffer and Murphy 1994. We find that this is the case for all individuals at all quantiles. As has been found in the literature, individuals who live in households with higher net labor income (excluding that worker's income) are more likely to be able to wait and search for high-paying jobs; therefore, those individuals should have higher reserve salaries (ES, 2003). Indeed, as can be seen in the case of Colombia, reservation wages increase with net family income. This increase is greater for the highest quintiles (Table 2). Similar results are found in the literature that considers individuals' wealth (Bloemen HG, 2001).

5.2.2 Exploring differences by gender

In this section, we examine the difference in the reservation wage between male and female urban workers, considering individual characteristics such as education, age, and the number of children under 14 years old in the household. Table 3 presents the reservation wage gap (the difference in the reservation wage between men and women) by various levels of education.¹⁹ Our findings show that males have higher reservation wages compared to females at all education levels. Additionally, the gender reservation wage gap increases with higher educational level and throughout the distribution. The largest increase in reservation wages is observed when individuals (both men and women) progress from college to graduate-level education. The second column presents the gender gap as a proportion of the reservation wage estimated for each educational group. In this case, we see that the proportional gender gap is wider in the first quantile for those with primary or no education and is smaller for those with post-graduate education. Nonetheless, we still observed for the last quintile that the proportional wage gap increases with the level of education.

¹⁹Differences are statistically significant in all cases. T-tests are available upon request from the authors.

The gender reservation wage gap found in our analysis could be driven by a variety of factors, including differences in career choices and promotions, risk preferences (women tend to be more risk-averse), or gender biases in the labor market.²⁰ The lower reservation wages of women compared to men might also be influenced by government policies such as the earlier retirement age for women (age 57, compared to men's age of 65), which can lead them to reduce their reservation wage to secure a job and receive future government payments. According to Barber and Odean 2001, the reservation wage gap may reflect differences in personality traits and preferences between men and women. Furthermore, as highlighted by Eckel and Grossman 2008, gender differences in reservation wages may result from various factors, including a person's education level, age, and number of children in the household.

The reservation wage gap by age reveals a positive gap for those in the first quantile but a negative gap for individuals in the Q3 and Q5 quantiles for ages below 25 and over 56. This means that for these ages, women have a higher reservation wage than men, but the gap becomes positive for those between 26 and 55 years old. We examine the relationship among these results, women's fertility age, and the presence of children in their households later in this paper.

To further understand the gender reservation wage gaps, we estimated the reservation wage for women and men while controlling for the presence of children, which is often cited in the literature as a contributing factor to the differences between men and women's reservation wages. Children raise the opportunity cost of accepting a job (Brown S, 2011; R, 1973), and studies such as Brown et al. 2011 show that children significantly raise the reservation wage for women more than for men. Caliendo, Lee, and Mahlstedt 2021 further explain that these differences in reservation wages between men and women may be due to differences in expectations that change over time and are exacerbated 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" (p. 20).

Results in Table 3 show that the gender reservation wage gap is small and even negative for individuals without children, especially for young women under 25 years old and those between 26 and 35 years old. However, when there are children in the household, the gender reservation wage gap becomes positive and increases with the number of children. These results remain consistent across all points in the distribution and at different ages.

²⁰For instance, Bosquet, Combes and García-Peñalosa 2019 found for French academic economists that women have fewer promotions, mainly because they seek fewer promotions. Hospido, Laeven and Lamo 2022 studied gender differences in career promotions using data from the European Central Bank (ECB) and found that women are less likely to be promoted to a higher salary band. This result can be partly explained by the presence of children in a woman's life.

Tabla 3: Gender reservation wage gap, considering socioeconomic characteristics (Colombian pesos of 2018)

	Q1 ^{1/}		Q3 ^{2/}		Q5 ^{3/}	
	Gender gap	% RW	Gender gap	% RW	Gender gap	% RW
Education:						
Primary/no educ.	273.3	27.9	363.0	13.4	808.7	16.8
Secondary	333.1	21.6	172.7	5.4	1125.9	18.3
Technical	195.1	8.6	496.8	12.9	2194.2	26.0
College	115.4	4.1	1160.6	15.7	3353.4	18.4
Graduate	648.0	11.0	1578.4	10.8	9263.2	30.5
Age:						
< 25	11.1	0.9	-17.3	-0.6	-4.7	-0.1
26-35	239.1	11.8	94.7	2.5	-182.4	-1.9
36-45	296.2	13.5	425.8	10.1	911.1	6.6
46-55	179.2	7.7	586.7	11.5	1711.7	8.9
56-65	34.7	1.4	-22.7	-0.3	2598.5	10.9
> 66	-109.3	-5.8	1701.1	27.5	8555.6	30.3
# Children:						
Without children	36.3	1.9	-38.6	-1.0	-557.3	-4.0
1 child	200.3	10.6	167.6	4.5	844.0	7.4
2 children	348.4	19.2	270.5	7.3	1440.0	12.7
> 2 children	431.1	29.9	229.9	7.0	1272.0	16.1
Without children:						
Primary/no educ.	75.4	7.3	196.5	7.1	702.5	14.0
Secondary	217.6	13.8	114.9	3.5	861.6	13.4
Technical	111.4	4.9	349.0	9.1	1535.0	17.8
College	105.5	3.8	982.1	13.3	2977.4	15.8
Graduate	521.0	8.6	1064.0	7.1	9064.4	29.8
With 1 child:						
Primary/no educ.	314.1	31.4	357.6	13.0	785.3	16.3
Secondary	332.5	21.2	178.5	5.5	1167.9	19.2
Technical	198.4	8.7	568.3	14.8	2343.0	28.3
College	119.9	4.3	1288.5	17.7	3740.4	21.2
Graduate	608.5	10.6	1836.6	13.0	7679.6	26.4
With > 2 Children:						
Primary/no educ.	308.6	35.0	593.0	23.5	1019.0	22.4
Secondary	495.4	38.3	327.7	10.7	1165.8	22.3
Technical	547.6	27.2	615.1	16.9	3400.0	44.1
College	102.0	3.9	1221.2	17.1	3442.9	20.2
Graduate	1251.4	22.6	2047.1	14.7	7452.5	25.9
Without children:						
< 25	-85.3	-6.0	-71.0	-2.2	-254.5	-4.2
26-35	12.7	0.6	-211.6	-5.2	-1089.0	-9.6
36-45	244.0	11.5	436.6	10.8	1035.9	7.8
46-55	123.1	5.2	437.7	8.5	1221.1	6.4
56-65	11.2	0.4	-146.5	-1.6	3437.4	14.0
With 1 child:						
< 25	-19.6	-1.6	-17.7	-0.6	-8.4	-0.2
26-35	210.7	10.1	100.2	2.7	-261.9	-2.8
36-45	264.5	11.7	467.0	10.9	958.3	6.9
46-55	194.3	8.3	537.8	10.3	1619.5	8.4
56-65	34.3	1.4	93.6	1.2	1764.8	8.0
With > 2 Children:						
< 25	144.9	15.1	191.5	7.2	222.7	5.1
26-35	448.1	29.1	174.9	5.3	657.6	10.2
36-45	614.7	32.8	329.1	8.7	-8.1	-0.1
46-55	495.9	26.2	988.0	25.2	3354.6	21.9
56-65	219.3	11.4	677.8	14.3	210.0	1.1

Source: Authors' calculations. Percentile 10^{1/}, Percentile 50^{2/}, Percentile 90^{3/}

These results contrast with the findings of Brown et al. 2011 in the UK and Brown et al. 2022 in Italy, which observed a lack of affordable childcare services and only 15 % of children having access to government-funded nurseries (Istat 2014). In Colombia, however, the coverage of public childcare services is high and more affordable compared to these developed countries. For example, the national public policy De Cero a Siempre [From Birth to Forever] was implemented in 2011, offering free education for children under 5 years old, with priority given to low-income households. According to Bernal 2014, approximately 53 % of children between 0 to 5 years old have access to childcare services, making

Colombia one of the Latin American countries with the highest coverage in the region.

This difference in access to childcare services between countries may explain the variations in the gender reservation wage gap between different countries. While the presence of children raises the opportunity cost of accepting a job for both men and women, it also increases the value of employment due to the larger income needs of the family, which seems to be a significant effect in low-income countries like Colombia. In this case, the effect on the reservation wage is determined by the interplay between these two forces. As a result, in Colombia, the presence of children stimulates the incentives to work, leading to a reduction in the reservation wage to find a job, especially for women. Analysis with more details the presence of children, at age and education (see continuation Table 3), we can observe that the presence of children increases the gender reservation wage at all levels of education and ages. This result does not consider the age of the children or the availability of informal childcare in the household, which could help to explain these result (as noted by (Brown S, 2022)).

Other factors that could explain the gender reservation wage gap in Colombia are the commuting time and timetable flexibility of the job. Although we cannot analyze these aspects in our study, Brown et al. 2022 found that increased commuting time and a lack of working time flexibility amplify the gender reservation wage gap in all regions and across the entire income distribution. This can be attributed to women's preference for shorter commutes and more flexible working hours (de La Rica S, 2008). These findings are consistent with the results reported by Arango, Castellani, and Lora 2016, who found that women may prioritize a flexible work schedule even if it means accepting a lower wage.

We conducted a robustness check using Colombia's Great Integrated Household Survey (DANE) to calculate the self-reported reservation wages of the unemployed individuals for the period 2009–2019. The results are presented in Table C1 in the Appendix. Our analysis of this sub-sample revealed similar outcomes to our previous findings. The reservation wage was found to be higher for men compared to women and to increase with the level of education and age. Additionally, individuals with children reported a lower reservation wage compared to those without children. Furthermore, we compared the distribution of the self-reported reservation wage ratio from unemployed workers with the distribution of the reservation wage ratio of employed workers estimated using the stochastic frontier method (Figure C1 in the Appendix). Our results align with those reported by Mui and Schoefer 2021 as we observed similar distributions in both sub-samples, with a median of 0.88 in the case of self-reported reservation wage of unemployed workers and a median of 0.74 in the for the stochastic frontier approach (SFA).²¹ However, one advantage of the stochastic frontier approach is its larger sample size, as noted by Leppin 2014.

5.2.3 Differences by cities

To explore the geographical differences across the country we looked at cities in four main groups, considering the classification of cities in the 2020 CPC index. The first group comprises the most developed cities and the last group encompasses the least developed cities. Table 4 displays the reservation wages for each city group and across different quantiles. As expected, the reservation wage increases with the level of development and productivity of the cities, and across all quantiles except for the fifth quantile, in which the reservation wage in Group 4 is higher than that in Groups 2 and 3. This result can be attributed to the lower quality of life in the last group of cities, which compensates professionals and skilled workers with a higher wage.

We also find that the reservation wage of males is always higher than the reservation wage of females across all groups of cities and quantiles. Thus, the gender reservation wage gap is always positive across all quantiles. In proportional terms (gender reservation gap divided by the reservation wage),

²¹Notice that by construction the reservation wage ratio of SFA cannot be higher than 1. Even though we still have a distribution with higher tails for the case of unemployed workers, this is explained by the sample size of each sub-sample.

and excluding the first group, we find that the gender gap decreases with the income distribution and the productivity of cities. Other characteristics that can affect the gender reservation wage gap across cities are the travel-to-work and no set work time preferences that we are not considering herein. For example, Brown et al. 2022 found for the case of Italy that being willing to commute anywhere in Italy explains 18 % of the gender reservation wage gap, and no set work time explains around 7 %. In the case of Colombia, there is little commuting time in small cities; however, cities such as Bogotá do indicate evidence of important commuting across municipalities (see (DA, 2004)). For example, Arango, Castellani, and Lora 2016 present evidence for the case of Bogotá, suggesting the importance of commuting time on female participation: “the reduction of commuting time, that bring an increase on the access to the sources of employment on 50 %, will imply an increase in the female labor force participation rate from 51 % to 64 %” (Ch. 8, p. 260). Arango et al. 2016 also find that women’s preferences for a flexible time job explain their long-term period of unemployment search (Ch. 3, p. 92), which affects their reservation wages. Moreover, the less-developed cities have a strong cultural tradition in which household chores are women’s responsibility and men are dedicated to labor market activities.

Tabla 4: *Reservation wages by group of cities, considering socioeconomic characteristics (Colombian pesos of 2018)*

	Q1 ^{1/}	Q3 ^{2/}	Q5 ^{3/}
Reservation wage			
Total sample:	1,865.60	3,737.40	12,250.00
Group 1	2,242.40	4,199.20	14,600.00
Group 2	2,071.60	3,807.40	11,573.70
Group 3	1,765.90	3,614.70	11,824.40
Group 4	1,587.60	3,604.00	13,137.60
By Sex:			
<i>Gender reservation wage gap</i>			
Group 1	56.50	227.50	1,110.10
Group 2	123.30	110.10	111.30
Group 3	169.80	98.60	385.40
Group 4	271.10	150.70	1,043.90
<i>Gender gap divided by reservation wage</i>			
Group 1	2.5 %	5.4 %	7.6 %
Group 2	6.0 %	2.9 %	1.0 %
Group 3	9.6 %	2.7 %	3.3 %
Group 4	17.1 %	4.2 %	7.9 %

Source: Authors’ calculations. Percentile 10^{1/}, Percentile 50^{2/}, Percentile 90^{3/}

Finally, we explore the reservation wage across cities considering the different levels of education. As expected, reservation wages increase with education across all cities, but it is high in the cities with the highest productivity (see Table A3 in the Appendix). However, these results are not the same when comparing the reservation wage of those with technical and higher education in the cities of Group 4. In this case, these individuals have a higher reservation wage than individuals in cities that are more developed, such as those in Group 3. A possible explanation for these results is that the lower quality of life in cities of Group 4 increases the reservation wage of workers, especially those who can easily find a job offer in a more developed city. In this case, professionals and qualified workers are willing to accept a job only if they receive a higher wage, which outweighs the additional cost of not having good healthcare and education systems, among other amenities.

5.3. Relationship between reservation wage and labor supply

Following Mui and Shofer 2021, we use the ratio of reservation wage and wage as a non-parametric approximation of the aggregate labor supply curve. Figure 4 shows the aggregate labor participation by different characteristics such as level of education, net family income, and age. In general, we find that

for the aggregate (Panel A), more than 80 % of workers are willing to work for a reservation wage of 0.8 of their current wage. However, the labor supply changes with the level of education. In effect, those with college and graduate education are more willing to participate at a reservation wage of 0.7 of their current wage, compared to those with lower education (see Panel B). Similar results are found by age, where older workers (46–55) are more willing to participate at a reservation wage of 0.7 than young workers (less than 25 years old). Finally, those with higher incomes are more willing to participate than those with lower net family income.

6. Final remarks and policy implications

This paper provides evidence for a positive correlation between education and reservation wage. Individuals with higher levels of education, such as college or graduate degrees, tend to have higher reservation wages than those with lower levels of education or no education. Additionally, we find that reservation wage is positively related to both tenure and net labor income of the household. This means that individuals living in households with higher net labor income (excluding that worker's income) are more likely to hold out for a better job offer. Supporting the search theory, we found that middle-aged workers who are more invested in the labor market tend to set higher reservation wages than younger workers who are less attached to the labor force and have not yet chosen a career path. Similarly, we observed that women who have weaker ties to the labor market typically have lower reservation wages than men.

Our study also examines the gender gap in reservation wages. We found that, similar to the results of Brown et al. 2022 in Italy, men have higher reservation wages than women. This gender gap in reservation wages exists across all regions and percentiles of the wage distribution, with a larger gap at the lower end of the wage distribution. Furthermore, when we controlled for education level, we found that the gender reservation wage gap increases with higher educational level and throughout the distribution. These differences may stem from variations in preferences, personality traits such as risk aversion, and other factors, as suggested by Barber and Odean 2001 and Eckel and Grossman 2008. Additionally, other studies suggest that the gender gap in reservation wages may also be related to differences in the value assigned to time spent on family-related activities (Caliendo M, 2021, 2017), particularly in Colombia where the division of household duties tends to be traditional. According to Urdinola and Tovar 2018, Colombian women spend an average of 2 more hours per day than men on caring activities, especially during their twenties, which decreases to 1 hour around their forties but remains positive until the age of 75.

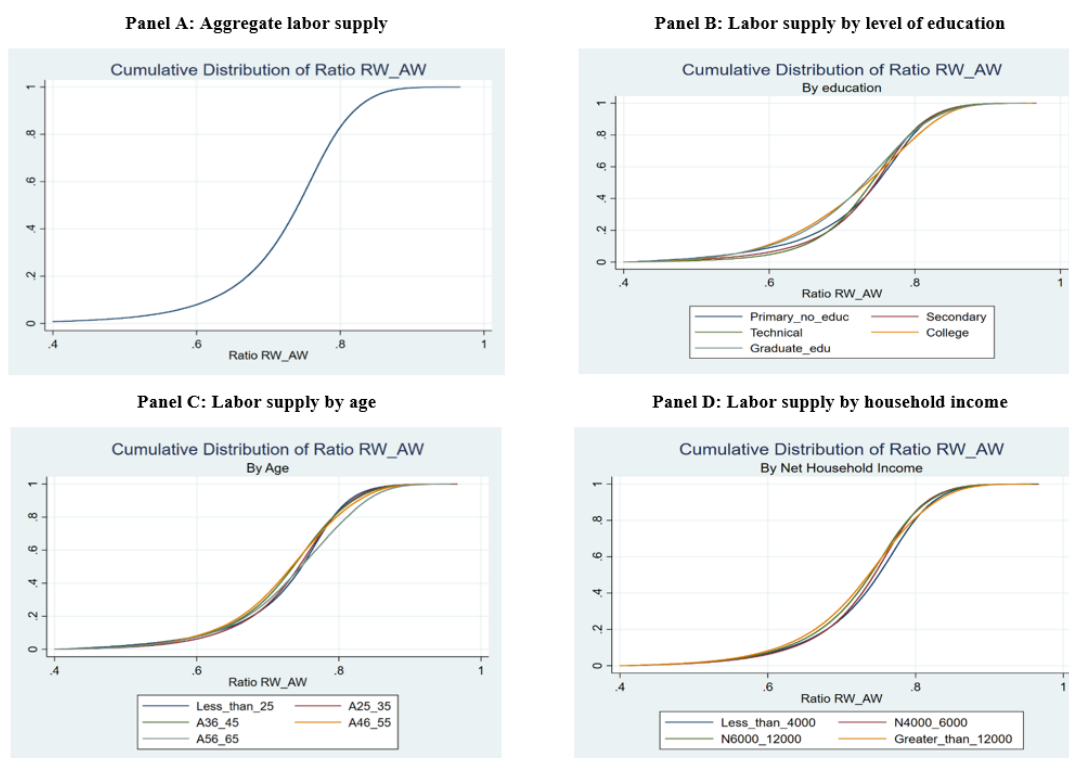


Figure 4: Aggregate labor participation supply

Sources: GEIH, Authors' calculations.

Moreover, when considering the presence of children, we found that children reduce the reservation wage for both men and women in Colombia. In contrast, in the UK and Italy, the presence of children tends to increase the reservation wage, especially for women. We interpret these findings as reflecting the varying costs of childcare services in these countries. In the UK and Italy, affordable public childcare services are lacking, while in Colombia, recent public policies provide free assistance for children under 5 years old and allow women to lower their reservation wages and participate in the labor market. Additionally, in developing countries, the presence of children in a household may increase the value of being employed, reducing also the women's reservation wage. The positive gender reservation wage gap, particularly in the presence of children, may also reflect job characteristics such as flexible working hours, part-time jobs, and short commuting times, which are preferred by individuals with children, particularly women, even if the jobs pay less (Arango LE, 2016; de La Rica S, 2008). Other studies do explore other reasons for the self-selection of women into low-paid occupations with low costs of career interruption, such as social discrimination by employers who may view women as less willing to work extra hours or more likely to require interruptions (e.g. maternity leave) during their working tenure (SW, 1981; Uribe AMT, 2019).

We also analyzed the reservation wage of workers in different cities across Colombia. As mentioned, we categorized the 23 main cities into four groups based on their level of development, with the first group (Group 1) consisting of the most developed cities and the last group (Group 4) comprising the least developed ones. Our findings show that the reservation wage generally increases with the level of development and productivity of the cities. However, we also observed that qualified workers in low-quality cities tend to have higher reservation wages compared to those in median-quality cities. This result could be because skilled workers may only consider taking jobs in low-quality cities if they receive higher wages that compensate for the lack of access to quality healthcare, education, and other amenities. Similar results were reported by Brown et al. 2022 in their study comparing the North and South regions of Italy. They found that in the South, where the level of development is low and the

unemployment rate is high compared to the North, women tend to be segregated into low-paying jobs with less responsibility compared to men. These findings highlight the need for policies and programs aimed at promoting gender equality and reducing barriers for women's access to better-paying jobs, especially in regions with lower levels of development and high levels of unemployment. These efforts can help close the gender reservation wage gap and promote more equitable and inclusive economic growth.

Following the approach of Mui and Shofer [2021](#), we use the ratio of the reservation wage to the wage as a non-parametric approximation of the aggregate labor supply curve. Our results indicate that, in aggregate, more than 80 % of workers are willing to work at a reservation wage equal to 80 % of their current wage. However, the labor supply differs based on factors such as level of education, age, and family income. For instance, workers with college or graduate-level education are more willing to participate at a reservation wage of 70 % of their current wage, compared to workers with lower levels of education. Older workers (46–55) are also more willing to participate at a reservation wage of 70 % compared to younger workers (under 25). Additionally, workers with higher family income are more likely to participate at a reservation wage of 70 % compared to those with lower family income.

Our study highlights the need for public policies that address the gender gaps in reservation wages, particularly in less-developed cities where cultural traditions may play a significant role. To address this issue, socialization efforts could be implemented to emphasize the importance of women and men spending equal time on family-related activities such as childcare. One effective policy that can help change the culture of gender division of labor is the extension of paternity leave to be equal to maternity leave. Countries such as Germany, Sweden, and Poland have already implemented similar policies with positive outcomes. Such policies can help change social attitudes towards childcare and home-related activities, which can lead to a more equitable distribution of labor. Additionally, public campaigns highlighting the importance of men's role in children's education could help shift cultural divisions of labor. As shown by Uribe, Vargas, and Bustamante [2019](#), these types of initiatives can lead to positive changes in cultural norms and improve gender equality in the workforce. Therefore, to promote a more inclusive and equitable society, it is essential to prioritize and invest in public policies that address gender gaps in reservation wages.

An important policy to consider, especially for women with children, is increasing incentives for employers to offer part-time jobs with flexible working hours (e.g. teleworking). Although there has been an increase in job offers with the possibility of working from home, because of the pandemic, the number of people working from home is still relatively low. In addition, research shows that short commuting time is a job characteristic preferred by women ([Brown S, 2022](#)) a result that highlights the need for policies that increase public transportation options and reduce the time women spend moving between home and work. Changes of this kind would allow women to accept better job offers located in at a distance without sacrificing pay for a nearby job offer. Furthermore, there is a need for more provision of kindergartens. Although the national government public policy "De Cero a Siempre" provides access to childcare services for children between 0 to 5 years old, there is still a lack of public institutions and the quality of these kindergartens can be improved ([Arango LE, 2016](#)).

Finally, our research has some limitations due to data availability. Like some other authors, we were unable to consider the inactive labor force, which could provide interesting insights into the heterogeneity of reservation wages. Additionally, in Colombia, women often move directly from inactivity to informal jobs, which we did not consider as our study focuses solely on formal workers. This area remains an important topic for future research, subject to the availability of relevant data.

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A. Appendix

A.1. Appendix A. 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; what we observe is the wage itself. In this section, we introduce the definition of reservation wage according to the job search model. 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:

$$E \sum_{t=0}^{\infty} \beta^t x_t \quad (4)$$

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 $x = b$; w being 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 consisting of 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. The Belmman equations that represent this problem are given by:

$$W(w) = w + \beta W(w) \quad (5)$$

$$U = b + \beta \int_0^{\infty} \max\{U, W(w)\} dF(w) \quad (6)$$

Where $W(w)$ represents the payoff of accepting a job offer and remaining there forever, and U represents the payoff of searching for a job offer that can be accepted or rejected. The reservation wage (w^R) is defined as the value for which $W(w^R) = U$ is satisfied.²² 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. Using these two equations and integrating by parts we have the following:

$$w^R = b + \frac{\beta}{1 - \beta} \int_{w^R}^{\infty} [1 - F(w)] dw \quad (7)$$

This result implies that the reservation wage depends on the value of leisure or unemployment insurance (b) and the expected gain of receiving a wage offer, which depends on the distribution of job offers and the discount factor β . Empirically we do not observe the reservation wage, but we can use information on wages and individual characteristics to estimate it. Hoffler and Murphy 1994 propose stochastic frontier methodology to estimate the reservation wage.

²²Given that $W(w)$ is a strictly increasing function, then there is a unique value for w^R .

A.2. Appendix B

Tabla 5: B1. Estimated parameters of the wage function from stochastic frontier estimation. Dependent variable: actual hourly wage

Variables	Half-normal	Exponential
Worker's household income net of worker's own income	0.1180*** (0.00003)	0.1164*** (0.00003)
Age	0.0285*** (0.00002)	0.0262*** (0.00001)
Square of age	-0.0003*** (0.00000)	-0.0002*** (0.00000)
Years working with the present employer	0.0043*** (0.00000)	0.0042*** (0.00000)
Square of the number of years with the present employer	-0.0000*** (0.00000)	-0.0000*** (0.00000)
Head of the household (yes=1)	0.1173*** (0.00006)	0.1145*** (0.00006)
Marital status (married=1)	0.0747*** (0.00005)	0.0733*** (0.00005)
Number of children under 14 years of age	-0.0153*** (0.00003)	-0.0146*** (0.00002)
Sex (male=1)	0.0941*** (0.00005)	0.0936*** (0.00005)
Secondary education (yes=1)	0.1166*** (0.00015)	0.1090*** (0.00015)
Technical education (yes=1)	0.2684*** (0.00016)	0.2591*** (0.00016)
Higher education (yes=1)	0.6989*** (0.00017)	0.6987*** (0.00017)
Postgraduate education (yes=1)	1.1766*** (0.00019)	1.1821*** (0.00018)
Mining sector (yes=1)	0.5091*** (0.00046)	0.5180*** (0.00045)
Manufacturing sector (yes=1)	-0.0339*** (0.00029)	-0.0355*** (0.00028)
Electricity, gas, and water (yes=1)	0.1261*** (0.00037)	0.1213*** (0.00035)
Construction sector (yes=1)	-0.0944*** (0.00031)	-0.0909*** (0.00029)
Commerce, hotel, and restaurant sector (yes=1)	-0.1348*** (0.00029)	-0.1338*** (0.00028)
Transport, storage, and communications (yes=1)	-0.0725*** (0.00029)	-0.0712*** (0.00028)
Financial intermediation sector (yes=1)	0.1876*** (0.00031)	0.1847*** (0.00029)
Real estate activities sector (yes=1)	-0.0563*** (0.00029)	-0.0587*** (0.00028)
Public services (yes=1)	-0.0352*** (0.00029)	-0.0344*** (0.00027)
Atlantic region (yes=1)	-0.1352*** (0.00008)	-0.1374*** (0.00008)
Eastern region (yes=1)	-0.1033*** (0.00009)	-0.1069*** (0.00009)

Standard errors in parentheses. *** $p < 0,01$, ** $p < 0,05$, * $p < 0,1$. Estimations are control by time effects.

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

Tabla 6: B1. (cont 'd) Estimated parameters of the wage function from stochastic frontier estimation.
Dependent variable: actual hourly wage

Central region (yes=1)	-0.0416*** (0.00010)	-0.0419*** (0.00009)
Pacific region (yes=1)	-0.0583*** (0.00008)	-0.0579*** (0.00008)
Constant	-1.3494*** (0.00068)	-1.3912*** (0.00065)
Year of survey	Yes	Yes
Month of survey	Yes	Yes
$Ln\sigma_v^2$	-1.7454*** (0.00013)	-1.7693*** (0.00010)
$Ln\sigma_u^2$	-1.6719*** (0.00033)	-2.7745*** (0.00028)
Observations	786,374	786,374

Standard errors in parentheses. *** $p < 0,01$, ** $p < 0,05$, * $p < 0,1$. Estimations are control by time effects.
Source: Authors' calculations based on Great Integrated Household Survey (GEIH).

A.3. Appendix C

Tabla 7: C1. Hourly median reservation wages for unemployed workers 2007–2019 (Colombian 2018 pesos)

Characteristics	Reservation wage	%
Total sample	3,342	0.88
Sex		
Male	3,356	0.84
Female	3,332	0.93
Education		
Primary/no educ	3,282	1.05
Secondary	3,333	0.88
Technical	3,368	0.77
College	6,066	0.78
Graduate	10,119	0.66
Age		
< 25	3,314	0.96
26–35	3,352	0.81
36–45	3,356	0.82
46–55	3,351	0.88
56–65	3,349	1.01
With children < 14 years		
No	3,352	0.86
Yes	3,333	0.88

Source: Authors’ calculations are based on the Great Integrated Household Survey (GEIH) question to unemployed workers about the salary at which they are willing to work.

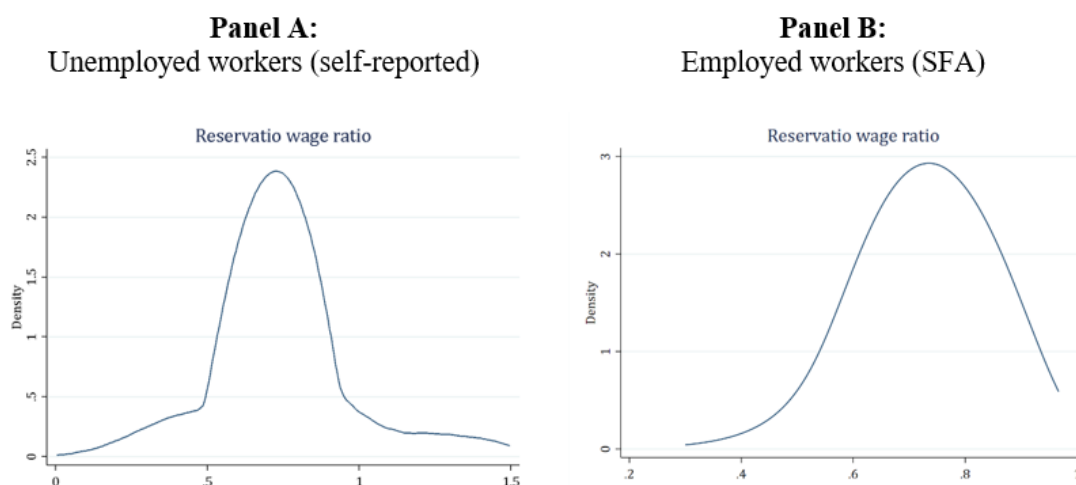


Figura 5: C1. Histogram of estimated reservation wage ratio

Note: The mean (median) for distribution is 0.84 (0.88) in Panel A and 0.72 (0.74) in Panel B. By construction the reservation wage ratio of the SFA cannot be higher than 1. **Source:** Authors’ calculations.