Gender Wage Gap and Firm Market Power in Chile

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Abstract

The main aim of this work is to explain the Chilean gender wage gap using a dynamic monopsony model to estimate labor supply elasticities at the firm level. To the best of our knowledge, our study is the first to measure monopsony power at the firm level using voluntary separations and the first to apply this methodology to estimate such elasticities for a middle-income country. Our results suggest that elasticities of labor supply to firms are rather small, which implies that firms have market power. We also found that Chilean men earn approximately 19% more than women as a result of the difference in labor supply elasticities by gender, ceteris paribus. Furthermore, we found that the magnitude of between-firm differences in elasticities are more than twice the magnitude of within-firm differences, suggesting that the gender wage gap is driven more by structural factors that generate gender sorting to firms. Finally, we found that elasticities for a high-income country (United States) are 63% and 100% higher than those obtained for a middle-income country for men and women, respectively, suggesting higher labor market frictions in middle-income countries for men and even higher for women.

Keywords: Gender Pay Gap, Dynamic Monopsony, Elasticity of Labor Supply, Worker Mobility, Chile
JEL Classification: J16, J18, J42, J62, J71

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1 Introduction

Chile is a small open economy that has experienced sustained and rapid economic growth, with an increasing trend in household incomes and falling poverty rates for most of the last four decades (Contreras, 2003; Armendáriz and Larraín, 2017). Nevertheless, Chile is one of the most unequal countries in the world (Weber, 2017). In particular, according to the 2018 report of the United Nations Development Program, although important advances in human development continue to be made in Chile, *the problem of gender inequality still prevails in the country.* Indeed, while Chile occupies the 44^{th} position worldwide on the Human Development Index, it still falters in terms of gender equality, occupying the 72^{nd} position on this dimension.

Furthermore, Chile has one of the lowest rates of female labor participation in the LATAM region (Contreras et al 2011) and a large gender wage gap (Acosta et al. 2007). Regarding this latter issue, the OECD Education at a Glance 2018 report revealed that in 2015, Chilean women who completed university received 65 percent of the salary earned by men with the same level of education, which falls considerably lower than the average of 74 percent across the OECD countries (OECD, 2018). This finding highlights Chile as the country with the highest gender pay gap, one of the lowest levels of GDP per capita and one of the worst-performing educational systems in the OECD. Because of this and as suggested by previous literature reports (e.g., Montero and Rau 2015), Chile is an interesting case to study: it is a developing economy that shares similarities with developed countries in terms of labor market institutions (e.g., unemployment insurance, minimum wage and active labor market programs) but has not completed the transition to economic development (e.g., a significant share of its labor market is informal work, high wage inequality, and low quality of education, among others).

We focus on the gender wage gap, as it is quite relevant to increasing female labor force participation, which is in turn an important driver (and outcome) of economic growth and development (Mammen and Paxson, 2000; Gaddis and Klasen, 2014). The gender pay gap has been studied for decades in economics (see, for example, Altonji and Blank 1999, Bertrand 2011 and Blau and Kahn 2017 for surveys), mainly–but not exclusively–because women's diminished economic power has detrimental effects on society as a whole, affecting pensions, health, poverty and fiscal policy, among others (e.g., European Commission 2013). As pointed out by the ECLAC (2016), while Chile has shown some progress in recent years in closing the gender wage gap, it has narrowed more slowly for well-educated women than for others, and the slow pace of change hampers the development and progress towards gender equality.

While there is a vast body of literature that studies the wage gaps between men and women in Chile, all studies considered perfectly competitive labor markets (Bravo, Sanhueza and Urzúa, 2008a y 2008c; Gill, 1992; Gill and Montenegro, 2002; Montenegro, 2001; Paredes, 1982; Paredes and Riveros, 1994; Perticara and Bueno, 2009), assuming a perfectly elastic labor supply (Becker, 1971). This competitive approach assumes that two workers with the same characteristics doing the same job at the same firm must be paid the same wage. If they are not, the residual difference must be due to discrimination. Becker pointed out that competitive forces should reduce or eliminate discrimination in the long run because the least discriminatory firms would have lower costs of production and should drive more discriminatory firms out of the market.

Studies related to monopsony models in the labor market have questioned Becker's approach because of the existence of frictions in the labor market (Robinson, 1933; Madden, 1973; and Black, 1995). It is important to clarify that modern labor economics, which uses monopsony models, does not assume monopsony power in the classical sense of a single employer, *a la* Robinson (Robinson, 1933). The new monopsony literature (Manning 2003) emphasizes that monopsony power may arise even if there are many firms competing for workers. These models yield upward-sloping firm-level labor supply curves (even without concentration on the demand side) due to search frictions, heterogeneous preferences among workers and mobility costs. Therefore, as noted by Webber (2016), in the new monopsony literature, the word "monopsony" is a synonymous with monopsonistic competition, imperfect competition, finite labor supply elasticity, an upward-sloping labor supply curve to the firm and basically any departure from perfect competition.

This literature suggests that the monopsonistic framework could explain how discriminatory gender wage differences arise and persist if firms wield greater monopsony power over female workers than male workers. For this to hold, women's supply of labor to the firm must be less wage elastic than men's. Women's lower labor supply elasticity may be due to a variety of factors, such as the following:

1. Family locational decisions (Cooke et al. 2009, Benson 2014 and Webber 2016): in general, the male is the primarily breadwinner. Therefore, a family may make locational decisions based primarily on the husband's job prospects. This situation forces the wife to search for a job only in a local labor market centered around her husband's place of employment.

2. Workers' preferences (Bonin et al. 2007, Albanesi and Olivetti 2009, Brown et al. 2011): It has been found that women may place greater importance on nonwage benefits offered by employers (e.g., flexible work schedules or other family-friendly practices that limit the number of jobs that are suitable) than do men.

3. Lower bargaining power (Croson and Gneezy 2009, Card et al. 2016, Cruz and Rau 2017): Previous studies have found that men's and women's average propensity to negotiate differs, with women being

much less likely to do so. Women's lower propensity to negotiate could reflect social factors, including women being socialized to feel that they are being pushy or overbearing (unfeminine) if they negotiate.

4. Psychological attributes (Mueller and Plug 2006 , Borghans et al. 2014, Brown and Taylor 2014): The previous literature has found that men place a higher value on money, have higher self-esteem, are less risk averse, are more competitive, are more self-confident and disagreeable, and believe that they control their own fate to a greater extent than do women. As suggested by Blau and Kahn (2017), in equilibrium, we expect such traits to be related to wages, and if men and women differ in psychological attributes, then those differences will contribute to explaining the gender pay gap.

5. Sorting (Card et al. 2016, Cruz and Rau 2017): some studies have suggested that women are less likely to be hired at high-paying firms than men. In this case, we should observe a wage gap due to employment sorting.

Because of these factors, women may have fewer outside options than men, making their labor supply to the firm more inelastic. Furthermore, as suggested by previous literature, the factors presented above may have heterogeneous effects. For example, as Cattan (2014) pointed out, some psychological attributes such as self-confidence may be rewarded differently among executives than among clerical workers and between men and woman. In this way, it is important to include the possibility of heterogeneous effects in the model, something that it is not common in this literature.

The implications of monopsony models were originally studied by Manning (2003), who formalized a method for identifying the labor supply elasticity facing the firm from job-to-job transitions. Models using this approach are known as dynamic monopsony models because they emphasize the dynamic nature of the monopsonistic market.

Due to data constraints, only recently have studies started considering the impact that imperfect competition in the labor market may have on the gender wage gap. Most of these studies have focused at the market level, finding that male elasticity is higher than female elasticity and that this difference can explain around one-third of the gender wage gap. Until now, the only existing evidence at the firm level has come from the United States, although that study did not use voluntary separations. The use of voluntary separations (i.e., quits) is crucial because labor markets may appear to be less monopsonistic when the reason for separation is not identified, suggesting an upward bias of the elasticity measures in the previous literature (see Sánchez et al, 2019) [1]. Furthermore, it can be argued that market imperfections (i.e., search frictions, mobility costs,

[1] In a related paper, we found that labor supply elasticities increased by roughly 18% when all separations (i.e., without identifying their source) were used instead of voluntary separations (i.e., quits).

etc) are more prevalent in middle- and low-income countries than than in the United States due to higher poverty rates, greater difficulty in starting businesses, poorer information technologies and transportation infrastructure, fewer education opportunities, and lower unionization rates (e.g., Jackson and Jabbie 2019). Additionally, empirical studies have noted that larger, more informal sectors and more widespread discrimination in many middle- and low-income countries are particularly harmful to female equality and mobility (Chioda 2011;World Bank 2012).

Hence, our work aims at calculating and comparing labor supply elasticities at the firm level by gender using voluntary separations (i.e., quits) for a middle-income country with those obtained for a high-income country, examining indirectly the prevalence of labor market frictions in both cases. Furthermore, our main idea is to estimate how much of the gender wage gap can be explained by the exercise of market power by Chilean firms.

We used the Chilean Unemployment Administrative Database. This is a panel database that considers information about individuals who were employed in the private sector (as dependent workers) since October 2002 and decided to affiliate with this system, as well as those individuals who were not working at that time but who found a dependent job in the private sector after that date. By February 2016, the number of affiliated individuals reached 8.8 million (i.e., the vast majority of the dependent workers in Chile, as suggested by the Superintendecia de Pensiones and Instituto Nacional de Estadísticas). The mentioned data set includes all the required variables, allowing us to study the dynamics of the labor market by firm because we can identify the employee and employer in each time period, as well as wages, separations and the cause of each separation, among others.

This paper is structured as follows. Section 2 presents a literature review focused on previous works analyzing the Chilean gender wage gap and on dynamic monopsony models. Section 3 puts forward a theoretical model that highlights the importance of the labor supply elasticity in the gender wage gap. Section 4 presents our empirical strategy. Section 5 describes the data and provides summary statistics of the key variables necessary to estimate our models. Section 6 presents the main results of our work, and Section 7 includes concluding remarks and a discussion of avenues for future research.

2 Literature Review

The literature on the Chilean gender wage gap started with Paredes (1982) and Paredes and Riveros (1994), who estimated for the first time the average gender wage gap for Chile, finding values ranging between 20%

and 30%, depending on the controls and specifications used. Montenegro (2001) and Gill and Montenegro (2002) used the standard “Mincerian” wage equation and estimated it separately by gender using the quantile regression method and also broke down the total wage gap into an explained term (due to differences in endowments) and a residual (or unexplained term) using the Oaxaca decomposition. The results showed that there are systematic differences in the returns to education and experience by gender along the conditional wage distribution and that the unexplained wage differential is higher in the upper quantiles of the conditional wage distribution. Perticará and Astudillo (2008) also used quantile regressions to evaluate the gender wage gap, taking into account the potential endogeneity of the education variable and controlling for effective work experience. The characteristic effect is found to be small and statistically insignificant up to approximately the 50th quantile (median), where it becomes positive (favorable to women) and grows monotonically up to 12% in the 90th percentile. They did not find a glass-ceiling effect in the Chilean labor market once they controlled for the endogeneity potential of the education variable.[2]

Ñopo (2007) used a decomposition approach that stresses the need for comparisons inside the common support for the distributions of observable characteristics of individuals. The results suggested that there are noticeable gender wage gaps in Chile favoring males, which are measured at around 25 percent of average female wages, and that these gaps are higher at the highest percentiles of the wage distribution among those with higher educational attainment. Contrary to Perticará and Astudillo (2008), this work showed some evidence of a glass-ceiling effect in Chilean labor markets such that for some occupations and particular combinations of observable characteristics, there are highly paid males but not females.

Bravo, Sanhueza and Urzúa (2008) presented an analysis of the gender differences in the Chilean labor market, which formally dealt with the selection of the individuals into schooling levels and its consequences on gender gaps. Their results showed that there exist statistically significant gender differences that critically depend on the schooling level of the individuals considered in the analysis. Finally, Perticara and Bueno (2009) studied the existing wage gaps by gender controlling for effective work experience and its time duration. They argued that even when there are still wage differences between men and women, the introduction of controls for effective work experience and the instrument for the selection of work experience in Chile are key factors.

In this work, we want to extend the previous literature by measuring the Chilean gender wage gap using a dynamic monopsony model, estimating labor supply elasticities at the firm level. Manning (2003) estimated labor supply elasticities for two American and two British data sets: the Panel Study of Income Dynamics

[2] A "ceiling" or "glass ceiling" effect is said to exist when the unexplained component of the wage gap is proportionally larger in the upper deciles of income.

and National Longitudinal Study of Youth from the United States and the Labour Force Survey and British Household Panel Study from the United Kingdom. Labor supply elasticities are quite low for all four data sets (ranging from 0.7 to 1.4), but he does not find differences by gender. Because Manning used data sets based on supply-side individual- or household-level surveys, he was not able to control adequately for firm-specific determinants of transition behavior.

Due to data constraints, only recently have studies considered the impact that imperfect competition in the labor market may have on the gender wage gap. A special issue of the Journal of Labor Economics (2010) presented several studies on dynamic monopsony in labor markets. However, there have been only two studies that have analyzed the gender wage gap with monopsonistic labor markets. They are Ransom and Oaxaca (2010) and Hirsh et al. (2010); the former used data from one regional grocery retailer in the United States, and the latter used German panel data.

Ransom and Oaxaca (2010) made use of one of the implications of monopsony models, which is the fact that under certain conditions, the labor supply curve might be calculated by the wage separation elasticity (these authors recognized that it was more appropriate to use the wage–quit elasticity, but they did not have that information.) Ransom and Oaxaca exploited the differences in wages and separations between job titles in a firm. Furthermore, they did not control for firm-specific controls (as in Manning 2003) and implicitly treated wages of workers as exogenous; they claimed that employers had no control over wages because wages for each job title are fixed by bargaining. The authors found differences between the labor supply elasticity of males and females, with the latter being smaller than the former (i.e., 2.5 for men and 1.6 for women). Ransom and Oaxaca (2010) relied on a specification in the spirit of Burdett and Mortensen's (1998) equilibrium search model with wage posting, where, among others, transitions to and from nonemployment are wage inelastic; therefore, one firm's wage-related hire is another firm's wage-related quit.

Unlike the study by Ransom and Oaxaca (2010), Hirsch et al. (2010) allowed for wage-elastic transitions to and from nonemployment and controlled for firm characteristics. They made use of the German-linked employer-employee data set LIAB for the years 2000–2002. Their estimated elasticities ranged from 1.9 to 3.7, depending on specification, with women's elasticity always lower than men's. Their results suggested that new monopsony models imply that firms have substantial monopsony power given that the estimated elasticities are rather small in size. Furthermore, although they did not directly test the difference between men's and women's elasticities, they calculated that it should explain roughly one-third of the observed gender pay gap, a result similar to that found by Ransom and Oaxaca (2010). It is important to note that this result cannot be directly tested in the data used in these studies but rather is theoretically implied by the difference in gender-specific elasticities at the market level.

So far, all the empirical studies have calculated the elasticity at the market level. Webber (2015) extended the theoretical and empirical model to the firm level using thousands of firms in several industries for the United States rather than one firm, as used by Ransom and Oaxaca (2010). He found support in the data for dynamic monopsony models. Webber (2016) extended his previous work by breaking down elasticity by gender. He estimated for the United States the male and female labor supply elasticity by firm and used this information to study the gender pay gap. In both of his studies, Webber used separations (due to data constraints, he could not identify quits versus layoffs) and found substantial search frictions in the United States labor market, with females facing a higher level of frictions than males. He also found that males faced a labor supply elasticity 0.15 points higher than that for females (i.e., 1.09 versus 0.94), which leads to 3.3 percent lower earnings for women.

Unfortunately, the current literature does not differentiate voluntary from involuntary separations (i.e., quits from layoffs). As Vick (2017) suggested, this definition is crucial because worker movements toward better offers drive the dynamics of the monopsony model. He pointed out that including layoffs in the data (as in Ransom and Oaxaca (2010), Hirsh et al. (2010), and Webber (2015) and (2016)) may confuse estimates based on worker movements. Therefore, knowing the reason for job separations is critical, as elasticity estimates based on hazard models of quits vs. layoffs yield very different wage coefficients. In particular, Vick found that elasticities using separations move in a different direction from quit elasticities. This fact suggests that failing to distinguish between the two potentially biases elasticity estimates and may fail to capture gender differences in worker separation decisions. In this way, Vick found a labor elasticity of supply at the market level of 1.6-2.2 for men and 1.2-1.5 for women when quits were taken into account.

Finally, Sánchez et al. (2019) extended Webber's analysis by including the reason for separation. These authors found that estimations of labor supply elasticities increased by roughly 18% when all separations (i.e., without identifying their source) were used instead of voluntary separations (i.e., quits). Therefore, in this study, we will not return to the discussion of separations versus quits; we will directly use quits.

3 Theoretical Model

The starting point of our analysis is a Cobb-Douglas production function, featuring constant returns to scale and heterogeneous labor inputs:

$$Q_{jt} = A_{jt} K_{jt}^{\gamma} L_{jt}^{1-\gamma} \tag{1}$$

For simplicity, we assume the firm's capital stock (i.e. non-labor inputs summarized by K) is fixed so that we can effectively ignore the role of capital (i.e. non labor inputs) in the model and write the production function as $Q(L[E_m, E_f])$. Where L is a composite of male and female employment (E_m, E_f). Therefore, to see how a firm's labor supply elasticity affects the wage it pays, consider a profit maximizing firm that faces the following objective function:

$$Max\ \pi_{w_M, w_F} = pQ(E_m, E_f) - w_m E_m(w_m) - w_f E_f(w_f) \tag{2}$$

where p is the price of the output produced according to the production function Q, w_m and w_f are wages for male and female workers respectively which determine the male and female labor supplied to the firm (E_m and E_f) respectively. Taking the first order conditions:

$$\frac{\partial \pi}{\partial w_m} = p\frac{\partial Q(E_m, E_f)}{\partial E_m} * \frac{\partial E_m}{\partial w_m} - E_m(w_m)\frac{\partial E_m}{\partial w_m} = 0 \tag{3}$$

$$\frac{\partial \pi}{\partial w_f} = p\frac{\partial Q(E_m, E_f)}{\partial E_f} * \frac{\partial E_f}{\partial w_f} - E_f(w_f)\frac{\partial E_f}{\partial w_f} = 0 \tag{4}$$

and defining $\varepsilon_m = \frac{w_m}{E_m}\frac{\partial E_m}{\partial w_m}$ and $\varepsilon_f = \frac{w_f}{E_f}\frac{\partial E_f}{\partial w_f}$ as labor supply elasticities of male and female workers respectively, these equations can be writen as:

$$p\frac{\partial Q(E_m, E_f)}{\partial E_m} = w_m\left(1 + \frac{1}{\varepsilon_m}\right)$$

$$p\frac{\partial Q(E_m, E_f)}{\partial E_f} = w_f\left(1 + \frac{1}{\varepsilon_f}\right)$$

reorganizing terms we obtain:

$$w_m = \frac{p\frac{\partial Q(E_m, E_f)}{\partial E_m}}{\left(1 + \frac{1}{\varepsilon_m}\right)} \tag{5}$$

$$w_f = \frac{p\frac{\partial Q(E_m, E_f)}{\partial E_f}}{\left(1 + \frac{1}{\varepsilon_f}\right)} \tag{6}$$

From equations(5) and (6), we can derive the standard result of perfect competition ($\varepsilon = \infty$), in which wages will be equal to the marginal product of labor.

Finally, it is possible to see that for two workers with the same marginal product of labor (i.e. $\frac{\partial Q(E_m,E_f)}{\partial E_f} = \frac{\partial Q(E_m,E_f)}{\partial E_m}$), we can obtain the gender wage gap (ratio of female to male wages) as follows:

$$\frac{w_f}{w_m} = \frac{\left(1 + \frac{1}{\varepsilon_m}\right)}{\left(1 + \frac{1}{\varepsilon_f}\right)} \tag{7}$$

From equation (7), it transpires that a gender wage gap will be generated by differences in female and male firm labor supply elasticities.

4 Empirical Strategy

4.1 Estimating the Elasticity of Labor Supply

In order to estimate the labor supply elasticity to the firm we followed Manning (2003) and used a simple model of an economy with search frictions. This model is in turn based on Burdett and Mortensen's (1998) seminal paper. These authors developed a model of an economy with on the job search in which employers post wages based on their competitor's behavior, In this model, workers will switch jobs if they receive a higher wage elsewhere. For simplicity, we do not consider non pecuniary benefits in the model.

Assume that there are M_t equally productive workers, where productivity is given by p and each worker gains utility b from leisure. Furthermore, assume that there are M_e constant returns to scale firms, which are infinitesimally small when compared to the entire economy. A firm set wages w to maximize steady state profits $\pi = (p - w)N(w)$ where $N(w)$ is the labor supply to the firm. Let's also define $F(w)$ as the cdf of wage offers observed in the economy and $f(w)$ the corresponding pdf. All workers within a firm must be paid the same wage. In this model, employed workers will accept a wage offer w' if it is greater than their current wage w and nonemployed workers will accept w' if $w' > b$.

Wage offers are drawn randomly from the distribution $F(w)$, and arrive to all workers at rate λ. Assume also an exogeneous job destruction rate (δ) and that all workers leave the job market at rate (δ) to be replaced in nonemployment by an equivalent number of workers. Denote $R(w)$ and $s(w)$ as the recruitment flow and separation rate functions of a firm that pays a wage w respectively:

$$R(w) = R^N + \lambda \int_0^W f(x)N(x)dx \tag{8}$$

$$s(w) = \delta + \lambda(1 - F(w)) \tag{9}$$

where R^N are the recruits from nonemployment. Burdett and Mortensen (1998) and Manning (2003) showed that, wage dispersion is an equilibrium outcome in this model, even when workers are equally productive, as long as one assumes that the arrival rate of job offers is positive but finite. In perfect competition the arrival rate tends to infinity and the wage will be the marginal product of labor. On the other hand, if λ tends to zero, the wage will be the reservation wage b.

As Manning (2003) showed, it is possible to formulate the supply of labor to a firm with the following equation:

$$N_t(w) = N_{t-1}(w)\left[1 - s_{t-1}(w)\right] + R_{t-1}(w) \tag{10}$$

which can be read as follows: the labor supply today is equal to the fraction of workers from last period who stay with the firm plus the new recruits. Assuming a steady state we can rewrite equation (10) as:

$$N(w) = \frac{R(w)}{s(w)} \tag{11}$$

taking the natural log of each side, multiplying by w and differentiating we can write the labor supply elasticity at time t as a function of the long run elasticities of recuitment and separations[3]:

$$\varepsilon_N = \varepsilon_R - \varepsilon_S$$

It is possible to further decompose these elasticities. Following Manning (2003), we can split recruitment flow from unemployment versus recruitment flow from other firms and separation rate to unemployment versus separation rate to other employment:

$$\varepsilon_N = \theta^R \varepsilon_R^E + (1 - \theta^R)\varepsilon_R^N - \theta^S \varepsilon_S^E - (1 - \theta^S)\varepsilon_S^N \tag{12}$$

where ε_R^E is the elasticity of recruitment of workers from employment, ε_R^N is the elasticity of recruitment of workers from nonemployment, ε_S^E is the elasticity of separation of workers to employment, ε_S^N is the

[3]It actually should be quits but due to data constraints almost all empirical evidence uses separations. This difference is crucial as Vick (2017) showed that results differ significantly when using one versus the other. To be consistent literature, we keep separations in our notation of the description of the model. However, we will use both of them in our empirical section to show the misleading results obtained when separations are used instead of quits.

elasticity of separation of workers to nonemployment. θ^R and θ^S are the share of recruits from employment and the share of separations to employment respectively.

As discussed in the literature, the two separations elasticities can be estimated easily with duration models (described below). However, recruitment elasticities are harder to obtain (see details in Manning 2003, chapter 4). Therefore, it is handy to express recruitment elasticities as functions of estimable quantities such as (see derivation in Manning (2003) chapter 4):

$$\varepsilon_R^E = \frac{-\theta^S \varepsilon_S^E}{\theta^R} \tag{13}$$

$$\varepsilon_R^N = \varepsilon_R^E - \frac{w\theta'^R(w)}{\theta^R(w)\left[1-\theta^R(w)\right]} \tag{14}$$

This is derived from the definition of the share of total recruits which come from employment: $\left(\theta^R = \frac{R^E}{R^E+R^N}\right)$, where R^E and R^N are the recruits from employment and nonemployment respectively. Taking the natural log of each side and differentiating yields equations (13) and (14). As presented in Webber (2016), the second term of the right hand side of equation (14) can be thought of as the bargaining premium that an employee receives from searching while currently employed.

To conclude, the labor supply elasticity to the firm can be written as a function of both separation elasticities, the premium to searching while employed and the calculated shares of separations and recruits to/from employment.

4.1.1 Estimation of the Elasticity of labor supply to the firm

In order to estimate the labor supply elasticity to the firm by gender, we follow Webber (2016). This author used an augmented gender by firm level implementation of the methodology proposed in Manning (2003). To estimate the labor supply elasticity to the firm we need several elements. First, the elasticities of separation to employment (ε_S^E) and nonemployment (ε_S^N) respectively Second, the premium to searching while employed $\left(\frac{w\theta'^R(w)}{\theta^R(w)\left[1-\theta^R(w)\right]}\right)$. Third, the recruitment and separation share for each firm (θ^S and θ^R). Each of the following models is run separately by gender for every firm in the sample, where the unit of observation is an employment spell.

We start with the estimation of the elasticity of separation to nonemployment (ε_S^N). To do this we use a Cox proportional hazard model given by:

$$\lambda(t \mid \beta^{N,\ sep}\ \log(earnings)_i + X_i\gamma^{N,\ sep}) = \lambda_0(t)e^{(\beta^{N,\ sep}\ \log(earnings)_i + X_i\gamma^{N,\ sep})} \tag{15}$$

where $\lambda()$ is the hazard function; λ_0 is the baseline hazard; t is the length of empoyment; $\log(earnings)$ is the natural log of individual i's earnings and X is a vector of explanatory variables. Workers who transition to a new employer or who are with the same employer at the end of the data series are considered to have a censored employment spell. β represents the estimate of the elasticity of separation to nonemployment.

The estimation of the elasticity of separation to employment (ε_S^E) follows an analogous setting:

$$\lambda(t \mid \beta^{E,\ sep}\ \log(earnings)_i + X_i\gamma^{E,\ sep}) = \lambda_0(t)e^{(\beta^{E,\ sep}\ \log(earnings)_i + X_i\gamma^{E,\ sep})} \tag{16}$$

with the only difference being that the sample is restricted to those workers who do not have a job transition to nonemployment.

To estimate the premium to searching while employed $\left(\frac{w\theta^R(w)}{\theta^R(w)\left[1-\theta^R(w)\right]}\right)$ we follow Manning (2003) who shows that this is equivalent to the coefficient on log earnings when estimating the following logistic regression:

$$P_{rec} = \frac{e^{(\beta^{E,\ rec}\ \log(earnings)_i + X_i\gamma^{E,\ rec})}}{1 + e^{(\beta^{E,\ rec}\ \log(earnings)_i + X_i\gamma^{E,\ rec})}} \tag{17}$$

where the dependent variable takes a value of 1 if a worker was recruited from employment and 0 if they where recruited from nonemployment. This coefficient is also interacted with time dummies on order to allow for time variation.

5 Data and Summary Statistics

To estimate the labor supply elasticity of the firm by gender, we use Chile's full administrative Unemployment Insurance ("Seguro de Cesantía", in Spanish) database provided by the Unemployment Fund Administrator. By law, the Unemployment Fund Administrator is required to collect, on a monthly basis, all contributions to unemployment individual accounts for each labor relation. To obtain our final dataset, we removed all spells that spanned fewer than 3 months, because the data do not contain information as to when during the month an individual was hired/separated. Therefore, the entries for the first and last month of any employment spell will almost certainly underestimate an individual's monthly earnings (unless the individual was hired on the first day or left employment on the last day of a month). While this procedure certainly eliminates short (and likely low-wage) jobs, it also prevents us from systematically underestimating monthly wages.[4] We furthermore removed job spells that fell in the top and bottom 1 % of earnings observations. We also limited our analysis to firms with at least 100 total employment spells of any length over the lifespan of the firm, and 25 separations or hirings. Finally, we also excluded firms in the agricultural sector.

Our dataset spans from January 2010 to December 2017 and includes individual and employer characteristics such as age, age squared, education, gender, tenure, tenure squared, region, time of affliation to the insurance, monthly taxable income, the reason and date of separation, industry, date of hiring, type of contract and geographical location, among others.

The variable education has several missing observations in the Unemployment Insurance dataset which is why we complemented it with administrative information from the Ministry of Education. In this way, we can recover the missing information of the education variable. In **Table 1** we present the descriptive statistics of our database, we observe that male workers are slightly older and less educated than female workers. Furthermore, male workers receive 34.4% higher wages than female workers and also have shorter employment spells than female workers (17.7 months versus 20.4 months on average).

After making these restrictions, we are left with a sample of all workers for whom we can estimate a gender-specific labor-supply elasticity. This sample is made up of 6,866,636 employment spells, belonging to 3,212,361 unique individuals, who work at 7,357 separate firms.

6 Results

6.1 Labor Supply Elasticity by Firm and Gender

Table 2 list the average (weighted by employment) firm level elasticities using voluntary separations broken down by gender. It can be seen that labor supply elasticities are 0.49 for men and 0.38 for women. Using the main result of our theretical model, given by equation (7), we can work out the empirical value of the gender wage gap, which in this case implies that men should earn approximately 19% more than women as a result of the difference in labor supply elasticities *ceteris paribus.* It transpires that labor supply elasticities are rather small, which suggests that firms still do retain relevant market power.These results cannot be directly compared with the existing literature, since we are the first to estimate labor supply elasticities at the firm level using voluntary separations. However, we conduct an indirect comparison below.

[4] Results do not change in a significant way with this assumption.

6.2 Comparing Labor Supply Elasticities: Developed versus Developing Countries

Webber (2016) reported labor supply elasticities at the firm level for the United States using separations but without identifying the reason of termination. As suggested by Sánchez et al. (2019) not identifying the reason for termination increases labor supply elasticities by roughly 18%. Therefore, if we conduct a simple exercise and decrease Webber's elasticities by 18% we should be able to say something about the degree of competition of a developed versus a developing labor market. We present both results in **Table 3** and results suggest that even after adjusting U.S. elasticities, they are still higher than those estimated for Chile. This fact suggests that the United States has a more competitive labor market. In particular, for men United States elasticities are 63% higher than the Chilean equivalent while for women the difference is more than 100%. This comparison is interesting because the chilean labor market has important differences compared with the United States labor market. For example, the Chilean labor market has a higher level of informality (30%) than the United States labor market (20%)[5], lower levels of average education (10.3 years versus 13.4 years)[6], greater difficulty associated with starting a business (56^{th} versus $8^{\mathbf{th}}$ in Doing Business Ranking 2019), less investment in transport infrastructure (34% of Chilean GDP and 42% of United States GDP)[7] and an overall higher rigidity of the labor market (e.g. higher severance payments, higher unionization rate, among others)[8] which highlights important differences between developed versus developing labor markets.

6.3 Distribution of Labor Supply Elasticity by Firm and Gender

Now we turn to analyze the differences between and within firm percentile elasticity distribution. The results are presented in **Table 2** for voluntary separations. Columns 2, 3 and 4 list results for the 25^{th}, 50^{th} and 75^{th} percentiles of the distribution of estimated firm level labor supply elasticities. It can be noted that the result presented in column 1 is larger than those presented in columns 2 and 3 which implies that the mean is higher than the median. This finding is consistent with the right skewed distribution of estimated elasticities.

A second interesting result is that differences across firms percentiles in the elasticity gap are larger than differences within firm percentiles. For example, a larger within elasticity gap difference appears in

[5] Chile: Instituto Nacional de Estadísticas. U.S.A.: Federal Reserve Bank of Saint Louis: https://www.stlouisfed.org/on-the-economy/2017/april/informal-labor-market

[6] Source: Human Development Reports. http://hdr.undp.org/en/indicators/103006

[7] OECD: https://data.oecd.org/transport/infrastructure-investment.htm

[8] In the OECD index (2013), where 0 is soft and 5 is strict, Chile has a score of 2.5 for individual dismissal while the U.S. has 0.5. Source: https://www.oecd.org/employment/emp/oecdindicatorsofemploymentprotection.htm
https://www1.compareyourcountry.org/employment-protection-legislation/en/0/176/datatable//CHL+USA
Unionization rate in Chile 2018 (20%) and in the U.S. (10.5%). Source: for Chile, Consejo Superior Laboral. For the U.S., https://www.bls.gov/news.release/pdf/union2.pdf

the 75^{th} percentile; 0.92 and 1.09 for men and women respectively (a difference of 0.17). This difference is much smaller than the 0.92 and the 1.09 obtained between the 75^{th}-25^{th} percentile for men and women respectively.

6.4 Between and Within Firm Differences

We conducted complementary analysis to further investigate between versus within firm differences in gender-specific elasticities. We used a sample of firms that only included individuals who worked at firms where we were able to estimate both, a male and a female labor-supply elasticity. This sample contains 3,387,908 employment spells, belonging to 1,742,547 unique individuals, who work at 2,374 separate firms.

In the upper panel of **Table 4** we calculate the difference among these gender-specific elasticities suggesting, in our prefered model (full model time varying), that, on average, male elasticities between firms are 0.07 higher than female elasticities. In the second panel of **Table 4** we present within firm differences which are calculated by taking the difference between male and female elasticities for each firm and then taking the average of the differences across firms. The results of our preferred model (full model time varying) suggest that, on average, male elasticities are **0.03** higher than female elasticities within firms. This finding suggests that between firm differences are more than twice the magnitude of within firm differences (in our prefered model). In other words, between firm differences in elasticities are more important than within firm differences in elasticities.

6.5 Characterizing the Firm

As noted above, there are significant differences in the magnitudes of labor supply elasticities along its distribution. Furthermore, the elasticity gap reverses at the top part of the elasticity distribution. Therefore, in order to gain insights into the characteristics of firms appearing at the lowest and highest parts of the elasticity distribution, we present in **Table 5** a characterization of firms in the lower 25^{th} and the upper 75^{th} percentile of the labor supply elasticity distribution. For men and women, firms with low labor supply elasticities (those under the 25^{th} percentile) pay lower wages than firms with high elasticity (those higher the 75^{th} percentile). Furthermore, firms with low labor supply elasticity have slightly older workers than firms with high elasticity. Finally, workers in firms with low labor supply elasticity have shorter job spells and lower education levels than those working in firms with high labor supply elasticity.

7 Concluding Remarks

We analyzed the gender wage gap using a dynamic monopsony model and estimated labor supply elasticities at the firm level for Chile. We additionally contributed to the literature by estimating for the first time labor supply elasticities using voluntary separations (i.e., quits). We find that Chilean men earn approximately 19% more than women as a result of the difference in labor supply elasticities, *ceteris paribus*. Our results also suggest that labor supply elasticities are rather small, which implies that firms have relevant market power. Furthermore, we find that firms with low labor supply elasticities have less educated workers, pay lower wages and have shorter employment spells than firms with high labor supply elasticities.

We also investigated *between-* versus *within-firm* differences in gender-specific elasticities. Our results suggest that, on average, male elasticities are higher than female elasticities within a firm, which suggests that the magnitude of between-firm differences are more than twice the magnitude of within-firm differences (in our preferred model). In other words, between-firm differences in elasticities are more important than within-firm differences in elasticities. This result is relevant because regulations targeted at firms might be able to help address the gender gap. However, it appears that the gender wage gap is driven more by structural factors that generate gender sorting to firms (e.g., education). This result is in line with Card et al. (2016) and Cruz and Rau (2017). These authors, analyzing Portuguese and Chilean data, respectively, used different approaches and found that most of the wage gap was explained by sorting and that bargaining power within firms played a comparatively smaller role. Our results call for public policies that focus on early determinants of the gender sorting by firms. Moreover, we think that our results should be taken into account when designing policies to decrease the gender wage gap, especially in developing countries.

Finally, we compared Chilean labor supply elasticities with United States adjusted labor supply elasticities (e.g., adjusting Webber's results by 18%). The results suggest a much less competitive labor market for the middle-income country (Chile) than for the high-income country (United States). This type of analysis should be replicated in other middle-income and lower-income countries in order to gain a more in-depth understanding of the gender wage gap in labor markets with different characteristics.

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Appendix

Table 1

Descriptive Statistics

	Male		Female	
Variable	Mean	Std. Dev.	Mean	Std. Dev.
Unit of Observation: Employment Spell	(1)	(2)	(3)	(4)
Age (Years)	35.2	11.6	34.6	10.5
High School	0.29	0.46	0.23	0.44
High School Diploma	0.57	0.49	0.61	0.49
Some College	0.05	0.23	0.05	0.22
College Degree+	0.08	0.27	0.10	0.29
Spell Duration	17.7	24.4	20.4	26.5
Log(wages)	2.97	0.60	2.67	0.56
Wages (UF)	23.6	16.2	17.4	13.5
Observations	4,467,641		2,398,995	

Note: Summary statistics by gender of our final sample from the "Seguro de Cesantía" administrative records complemented with the administrative records from the Ministry of Education.

Table 2

Estimated Firm-level Labor Supply Elasticities and their Distribution

Model	Mean	25^{th}	50^{th}	75^{th}
	(1)	(2)	(3)	(4)
Male Elasticities				
Earnings only	0.96	0.42	0.80	1.42
No education controls	0.52	0.13	0.43	0.91
Full model	0.48	0.07	0.39	0.85
Full model time varying	0.49	0.00	0.39	0.92
Female Elasticities				
Earnings only	0.97	0.32	0.97	1.55
No education controls	0.41	0.00	0.37	0.98
Full model	0.38	0.00	0.34	0.97
Full model time varying	0.38	0.00	0.37	1.09

Three separate regressions, corresponding to equations (15)–(17), were estimated separately by gender for each firm in the data that met the conditions described in the Data section. The coefficients on log earnings in each regression were combined, weighted by the share of recruits and separations to employment to obtain the estimate of the labor supply elasticity to the firm. The first row of each panel represents estimates from equations where the only regressor in each model is log earnings. Second row also includes: age; age-squared; tenure, tenure squared, region, type of contract, number of employees working at the firm and industry indicator variables. Third row includes all previous controls plus indicator variables for education level. Year effects are included in all models. The first three rows report only the long-run elasticities, while the fourth row describes the elasticities when a steady-state is not assumed, and they are allowed to vary over time (i.e. the short run elasticity of Manning (2003)).The first column reports the firm labor-supply elasticity calculated with separations (i.e. voluntary and involuntary separations) while the fifth reports the same but using voluntary separations only (i.e. quits).

Table 3

Comparing Developed versus Developing Labor Supply Elasticities

Model	Chile	U.S.
	(1)	(2)
Male Elasticities		
Full model time varying	0.49	0.80
Female Elasticities		
Full model time varying	0.38	0.77

Three separate regressions, corresponding to equations (15)–(17), were estimated separately by gender for each firm in the data that met the conditions described in the Data section. The coefficients on log earnings in each regression were combined, weighted by the share of recruits and separations to employment to obtain the estimate of the labor supply elasticity to the firm. We present the full model time varying results only. Results for other specifications are available upon request. The full model time varying describes the elasticity when a steady-state is not assumed, and they are allowed to vary over time (i.e. the short run elasticity of Manning (2003)). Both columns report the firm labor-supply elasticity calculated using voluntary separations only (i.e. quits). U.S. elasticities are adjusted by 18% as suggested by Sánchez et al. (2019). Both columns represent the elasticity at the mean of the distribution for the full model time varying. Control variables include: log earnings; age; age-squared; tenure, tenure squared, region, type of contract, number of employees working at the firm and industry indicator variables; indicator variables for education level and year effects.

Table 4

Differences in labor Supply Elasticities (Between and within firms)

	Mean
Differences Between Firms	
Earnings only	-0.07
No education controls	0.09
Full model	0.06
Full model time varying	0.07
Differences Within Firms	
Earnings only	-0.04
No education controls	0.01
Full model	0.03
Full model time varying	0.03

Note: Between firms differences among men and woman are obtained using firms that only includes individuals who work at firms where we were able to estimate both a male and female labor-supply elasticity. We take the average male elasticity between firms and substract the average female elasticity between firms. Within firms differences are obtained by taking the difference between male and female elasticities for each firm and then taking the average of the differences across firms. The sample includes workers who work at firms where we can identify both a male and female elasticity. This sample has 3,387,908 employment spells, belonging to 1,742,547 unique individuals, who work at 2,374 separate firms.

Table 5

Characterization of Firms by Elasticity Percentile

	Full Model Time Varying	
Model	25^{th}	75^{th}
	(1)	(2)
Male Elasticities		
Age	34.32	34.22
<High School	0.28	0.26
High school diploma	0.58	0.59
Some college	0.06	0.06
College degree +	0.08	0.09
spell	14.07	18.87
Log(wage)	2.88	3.02
Female Elasticities		
Age	34.83	34.34
<High School	0.26	0.20
High school diploma	0.60	0.61
Some college	0.05	0.07
College degree +	0.10	0.12
spell	16.26	19.29
Log(wage)	2.56	2.84

Three separate regressions, corresponding to equations (15)–(17), were estimated separately by gender for each firm in the data that met the conditions described in the Data section. The coefficients on log earnings in each regression were combined, weighted by the share of recruits and separations to employment to obtain the estimate of the labor supply elasticity to the firm. We present the full model time varying results only. Results for other specifications are available upon request. Control variables include: log earnings; age; age-squared; tenure, tenure squared, region, type of contract, number of employees working at the firm and industry indicator variables; indicator variables for education level and year effects. The full model time varying describes the elasticity when a steady-state is not assumed, and they are allowed to vary over time (i.e. the short run elasticity of Manning (2003)). Both columns report the 25^{th} and the 75^{th} percentile of the labor-supply elasticity distribution calculated using voluntary separations only (i.e. quits).