THE IMPACT OF COMMUTE TIME ON THE GENDER WAGE GAP: AN EMPIRICAL ANALYSIS

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Abstract

The gender wage gap for the city of Santiago, Chile and its explained and unexplained portions are analysed using the Oaxaca-Blinder decomposition with data from CASEN 2017, the Chilean household survey. A novel feature of the analysis is the inclusion among the explanatory variables of commute time. Wage equations for men and women are estimated using three different methods: ordinary least squares, two-stage least squares and the Heckman selection model. The estimates of the gap vary depending on the method between 0% and 9%. The decomposition of the gap reveals that between 6% and 17% of the gap is unexplained (i.e., due to discrimination). Commute time is found to account for 10% to 47% of the logarithmic wage gap explained by worker characteristics.

Keywords: Gender wage gap; commuting time; Oaxaca-Blinder decomposition; survey data.

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1. Introduction

This article presents an analysis of the gender wage gap in the city of Santiago, Chile. The method employed, originally proposed by Oaxaca (1973) and Blinder (1973), is used to decompose the gap into the portion explained by observable factors and the unexplained portion, the latter also interpreted as the measure of gender discrimination. Among the variables considered as explanatory factors is travel time to work, that is, commute time. This variable and the different valuations of it by men and women may explain a considerable part of the gap (Le Barbanchon et al., 2019). The data used for the analysis were obtained from the 2017 edition of CASEN, Chile's national household survey.

In this application of the Oaxaca-Blinder decomposition, the wage equations are estimated using three different econometric methods: ordinary least squares (OLS), the Heckman selection model (Heckman, 1979) and two-stage least squares (2SLS). The main results of the analysis may be summarized as follows: First, the Santiago wage gap lies between 0% and 9%; second, 5% to 8% of the gap is explained; third, 6% to 17% of the gap is unexplained (i.e., discrimination); and fourth, commute time accounts for 9% to 47% of the gap in the logarithm of wage income explained by worker characteristics.

The gender pay gap has been extensively studied in recent decades for a range of countries using different methodological approaches (Blau & Khan, 2017). Broadly speaking, the literature shows that at the international level the gap has trended downwards, but the rates at which male and female wages are converging are heterogeneous, at least among developed countries (Kunze, 2018). According to the Global Wage Report 2018/19 (ILO, 2018), for 73 countries accounting for approximately 80% of the world's workers, the weighted average raw gender wage gap is about 16%. It varies significantly from country to country, however, in some cases topping 30% while in others the percentage is negative.

A range of factors that might explain the differential has been proposed in the literature. These include human capital levels, workers' occupations, the industry workers are employed in, and even sociological and non-cognitive phenomena (Blau & Khan, 2017; Redmond & McGuinness, 2019). Few studies, however, have explored the role played by commute times even though it is an attribute that differs significantly between men and women. As an example, in the OECD countries women's commutes are on average 33% shorter than men's (Le Barbanchon et al., 2019).

The CASEN survey, the data source for the present study, gathers detailed information on the socio-economic situation of Chilean households and provides the basis for official statistics on Chile's poverty rate and inequality indexes. It is also used by international organisations such as the IMF, the World Bank and ECLAC to derive various different statistical indicators. The survey has been conducted every two or three years since 1990 but only those of 2015 and 2017 contained a question on commute time, allowing it to be included as one of the possible determinants of labour income.

The quantification of that portion of the wage gap that is associated with commuting should constitute an important input to the process of defining mobility policies for improving gender equity and social welfare. The World Economic Forum's Global Gender Gap Report for 2018 (WEF, 2018), though not aimed at formulating public policies for individual countries, emphasises the strong correlation between gender gaps generally (i.e., not only in pay) and economic performance. As Klaus Schwab notes in the preface to the report, "*More than ever, societies cannot afford to lose out on the skills, ideas and perspectives of half of humanity to realize the promise of a more prosperous and human-centric future that well-governed innovation and technology can bring*."

The remainder of this paper is divided into five sections. Section 2 reviews the relevant literature, identifying previous contributions and elements that have been incorporated into the present discussion and methodological development. Section 3 describes the data while Section 4 develops our approach. Section 5 sets the results and Section 6 presents our conclusions.

2. Literature review

The problem of gender pay gaps has been extensively studied for many countries using different approaches and data sources. A recent survey of part of the literature on the topic is found in Blau & Khan (2017). Many different aspects of the issue have been analysed, including wage gap trends, international comparisons and explanatory factors.

Various studies seeking to explain the wag gap have applied the methodological framework developed by Oaxaca (1973) and Blinder (1973), which is built around the estimation of wage equations. Kunze (2008) reviews works that employ this approach.

In most countries, the observed gap has declined since the 1970s as female labour force participation rates and education levels have increased, attaining levels in some countries above those recorded for men. Yet the differential persists, though it varies significantly between countries (Kunze, 2018; Weichselbaumer & Winter-Ebmer, 2005; Blau & Khan, 1995).

Redmond & McGuinness (2019) find that while the gap has fallen over time in Europe, the unexplained portion has increased. More recent studies have thus focussed on evaluating previously ignored observable characteristics that explain the gap such as differences in male and female competitiveness (Niederle & Vesterlund, 2007; Manning & Saidi, 2010), self-confidence (Reuben et al., 2017), negotiating skills (Babcock & Laschever, 2003), personality (Nyhus & Pons, 2012) and the gender composition of managerial or supervisory positions (Abendroth et al., 2017; Quintana-Garcia & Elvira, 2017).

Goldin (2014), however, believes that true equality is not achieved by strengthening men's and women's bargaining skills or their desire to compete. Rather, the gap can be reduced or eliminated through labour market changes, especially those that increase flexibility of working hours or reduce disproportionate rewards for working long hours or particular hours. This suggests that commute times would be expected to play an important role in determining gender pay differentials.

Studies of differences between men and women in commuting patterns go back several decades. Their results suggest that women tend to have shorter commutes than men both in time and distance (Ericksen, 1977; Madden, 1981; Hanson & Johnston, 1985; Fagnani, 1987; MacDonald 1999). According to this literature, these differences are explained by women's role in the home that must be coordinated with the demands of their job, and their lower wage rates that do not justify longer trips to work. More recent research has explored other aspects related to gender differences in transport, such as subjective well-being (Sweet and Kanaroglou, 2016) or attitudes towards risk and insurance (Lucas et al., 2017).

In the theoretical framework of equalizing differences developed by Rosen (1986), commute time would be a work attribute for which people would be willing to pay. Indeed, empirical studies typically find a positive relationship between commute time and wages (Madden, 1985; Zax, 1991; Fu & Ross, 2013; French et al., 2020). Generally speaking, it is difficult to identify compensatory wage differentials from labour market equilibria for a number of reasons. First, databases often lack information on certain key employer and employee characteristics; second, the data contain measurement errors; and third, there are frictions in the labour market (Hwang et al., 1998; Lang & Majumdar, 2004; Bonhomme & Jolivet, 2009; Ruppert et al., 2009). To get around these problems, recent studies have used experimental data to estimate workers' valuations of different job attributes (Maestas et al., 2018; Mas & Pallais, 2017). However, this literature does not typically focus on gender wage differentials. An exception is the recent study by Le Barbanchon et al. (2019), which makes use of French public service data to estimate the impact of commute time on the gender pay gap.

In the case of Chile, a number of studies have estimated the gap and how it breaks down, but none have considered the effect on it of commute times. Paredes and Rivero (1994) examine the gap for the city of Santiago over the period 1958-1990. Their main finding is the relationship between the gap and the business cycle. Using CASEN survey data, Herrera and Razmilic (2018) find that in every Chilean city, women have shorter commute times than men. The difference is particularly marked when women have partners and children, a phenomenon the authors interpret as a possible reflection of an asymmetrical distribution of responsibilities in the home. Also based on the CASEN survey, Fuentes et al. (2005) estimate wage equations for the years 1990 through 2003, correcting for selection bias. They find that the unexplained gap fell from 58.5% to 27.5% over the 13-year period. In particular, they note that correcting for bias significantly alters their estimates. In a paper taking a similar approach, Fuentes and Vergara (2018) estimate that the unexplained gap in Chile declined from 38% in 1990 to 18.5% in 2006, since when it has remained stable through 2017 at levels of about 20%.

The present article aims to contribute to the gender wage gap literature by incorporating commute time into the wage equations. This was made possible for Chile by the inclusion of the commute time question in the 2015 and 2017 CASEN surveys. The estimate of the unexplained gender wage gap resulting from the addition of this factor is lower than that reported in either Fuentes et al. (2005) or Fuentes & Vergara (2018), who as already noted, also used CASEN survey data. This difference in the results is due to the incorporation of commute time as well as other factors to the list of explanatory variables.

3. Data

As already noted, the data for this study was obtained from the 2017 CASEN survey. The survey sample design is probabilistic and stratified by population and place both for urban and rural areas of the country. For purposes of the present analysis, however, the data are confined to those for the city of Santiago, which encompasses 31.3% of Chile's total population, all classified as urban. Furthermore, only full-time workers from 18 to retirement age, which in Chile is 65 for men and 60 for women, are included.

The variables incorporated in our econometric models are hourly income, schooling (years), potential experience (years), commute time (minutes), and binaries indicating the presence of a partner, the presence of dependent children, and union membership. Potential experience is calculated as age less years of education minus 6. To avoid the influence of outliers, income levels above CLP$ 500,000 are excluded.[2] The sample means and standard deviations of the variables for both men and women are set forth in Table 1. As can be seen, without controlling for personal characteristics or participation, men's income average 21.4% higher than women's, though the large size of the standard deviation should be noted. Commute times for women are shorter than those for men.

Table 1. Descriptive Sample Statistics

Variable	Men	Women
Income	4,958	4,084
	(9,572)	(4,525)
Schooling	13.460	13.961
	(3.626)	(3.332)
Experience	20.415	19.207
	(13.495)	(12.101)
Time	48.145	45.196
	(32.049)	(30.375)
Partner	0.619	0.490
	(0.486)	(0.500)
Children	0.659	0.690
	(0.474)	(0.462)
Union	0.109	0.121

[2] In 2017, US$ 1 was equal to CLP$ 650.

	(0.311)	(0.326)
No. of Obs.	4,955	3,912

Standard deviations in parentheses.

4. Method

To implement the methodology developed by Oaxaca (1973) and Blinder (1973) for decomposing the gender pay gap, wage equations are estimated (Mincer, 1974) for each population group, or men and women in the present case. It is assumed that the equation for men represents a non-discriminatory relationship between worker characteristics and wage rates. The equations are as follows:

$$\ln Y_M = X_M \beta_M + u_M \tag{1}$$

$$\ln Y_F = X_F \beta_F + u_F \tag{2}$$

where the subindexes M and F indicate men and women, respectively. The dependent variable Y in both cases is the logarithm of the wage rate and the explanatory variables X include schooling, potential experience and its square, commute time and the dichotomous variables representing the presence of a partner, the presence of children, and union membership. With the exception of commute time, the particular focus of the present analysis, these explanatory variables are the same ones typically found in other wage gap studies.

The wage gap is defined as the difference between the average wage rates of men and women:

$$Gap = \overline{\ln Y_M} - \overline{\ln Y_F} \tag{3}$$

Once the β parameters in Equations (1) and (2) have been estimated, predictions of the average wage rates for men and women are obtained as follows:

$$\overline{\ln Y_M} = \overline{X}_M \hat{\beta} \tag{4}$$

$$\overline{\ln Y_F} = \overline{X}_F \hat{\beta} \tag{5}$$

Equation (3) can then be rewritten as

$$Gap = \left(\overline{X}_M - \overline{X}_F \right) \hat{\beta}_M + \overline{X}_F \left(\hat{\beta}_F - \hat{\beta}_M \right) \tag{6}$$

The first term on the right-hand side of Equation (6) is the explained portion of the gap, which is related to the differences in men's and women's characteristics evaluated by the non-discriminatory Equation (1). The second term on the right-hand side of Equation (6) expresses the unexplained portion of the gap. The latter can also be calculated as a residual so the aggregate decomposition can be obtained without

estimating the parameters for the equation corresponding to the group exposed to discrimination (in this case, the wage equation for women). However, to measure the contribution to the unexplained gap of each explanatory variable, their coefficients do need to be estimated.

To estimate Equations (1) and (2) we use three different econometric approaches: ordinary least squares (OLS), the Heckman selection model and two-stage least squares (2SLS).

For the participation equation in the Heckman model we use schooling, age, size of household and two dichotomous variables for householder and presence of children, respectively. The model is estimated using full-information maximum likelihood. Observations for persons not in the labour force and therefore not accounted for in Table 1 must also be included. The resulting coefficients for the participation equation are set out in Table 2.

Table 2. Participation Equation Estimates

Dep. Var.: Participation	Male	Female
Schooling	0.05***	0.102***
	(0.005)	(0.005)
Age	0.004**	0.01***
	(0.002)	(0.002)
Partner	0.567***	-0.024
	(0.046)	(0.036)
Householder	0.465***	0.655***
	(0.046)	(0.04)
Persons	-0.008	-0.04***
	(0.01)	(0.009)
Children	0.478***	0.184***
	(0.047)	(0.043)
Const.	-0.815***	-1.783***
	(0.105)	(0.101)
No. of Obs.	6,867	7,462
Selected	4,955	3,912
Non-Selected	1,912	3,550

Standard errors in parentheses.

Since commute time in a wage equation may be a source of endogeneity, we also estimate Equations (1) and (2) using 2SLS, with dichotomous instrumental variables for district of residence, industry of employment (to the first digit of the industrial classification) and occupation (to the first digit of the occupational classification).

5. Results

The parameter estimates for Equations (1) and (2) obtained using OLS, Heckman and 2SLS are displayed in Table 3. As can be seen, with all three methods commute time is negative, which is consistent with the fact that average wages are relatively low in the outer districts of the city where the lower income population is concentrated. In absolute terms, the marginal effect of commute time on wages is greater for men than for women. Also notable is that the effect of commute time is considerably stronger for both genders in the 2SLS estimates relative to those generated using OLS or Heckman. Under the latter two methods, an additional 30 minutes of commute time is associated with a wage that is 5% lower for men and 2.7% lower for women whereas with 2SLS, the corresponding figures are 36.6% and 25.8%, respectively.

Table 3. Wage Equation Estimates

Dep. Var.	OLS		Heckman		2SLS	
Ln(Income)	Male	Female	Male	Female	Male	Female
Comm. Time	-0.0016***	-0.0009***	-0.0015***	-0.0009***	-0.0122***	-0.0086***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0009)	(0.0009)
Schooling	0.1441***	0.1479***	0.1367***	0.1275***	0.1283***	0.1372***
	(0.0032)	(0.0036)	(0.003)	(0.0044)	(0.0034)	(0.0037)
Experience	0.0198***	0.0195***	0.0189***	0.0155***	0.0199***	0.0184***
	(0.0027)	(0.0031)	(0.0026)	(0.0032)	(0.003)	(0.0034)
$(\text{Experience})^2$	-0.0002***	-0.0002**	-0.0002***	-0.0001**	-0.0002***	-0.0002**
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Partner	0.1672***	0.0864***	0.0886***	0.1194***	0.1333***	0.0641***
	(0.0199)	(0.0192)	(0.0233)	(0.0201)	(0.0237)	(0.0207)
Children	0.0047	-0.048**	-0.0543**	-0.077***	0.0637**	-0.0257
	(0.0233)	(0.0239)	(0.0248)	(0.0251)	(0.0268)	(0.0261)
Union	-0.0068	-0.0452*	-0.0118	-0.0532*	0.0075	-0.0594**
	(0.0255)	(0.0247)	(0.0277)	(0.028)	(0.0316)	(0.0303)
Const.	5.815***	5.686***	6.113***	6.215***	6.528***	6.189***
	(0.051)	(0.063)	(0.062)	(0.094)	(0.082)	(0.086)
R Sqr.	0.4205	0.4022	-	-	0.2428	0.3039
No. Obs.	4955	3912	4955†	3912†	4955	3912

Standard errors in parentheses. ** indicates significance at the 5% level and *** at the 1% level.

(†) Number of participants

The negative sign on the commute time estimate should not be interpreted as a willingness to pay for living further from one's place of work, a conclusion that would be counter-intuitive. Although one would expect workers to be willing to accept a lower wage in exchange for a shorter commute, the wage equation coefficients are a reduced form of various factors that determine the relationship between wages and commute times, among which is the lower cost of housing in the outer districts.

As for schooling and experience, the effects are similar for men and women and with all three estimation methods. The effect of living with a partner is positive but varies with the estimation method, being greater for men using OLS and 2SLS but greater for women when participation is controlled for using Heckman. The Heckman method also produces the largest negative effects on women for having children. Lastly, union membership is not significant for men but the effect is marginally negative and in the vicinity of 5% for women under all three methods.

Table 4. Wage Gap Decomposition

Wage Gap	OLS	Heckman	2SLS
Total Gap	0.091*** (0.016)	0.008 (0.032)	0.091*** (0.019)
Explained	-0.045*** (0.011)	-0.051*** (0.01)	-0.077*** (0.014)
Comm. Time	-0.005*** (0.001)	-0.005*** (0.001)	-0.036*** (0.009)
Comm./Explained	0.105	0.089	0.470
Unexplained	0.136*** (0.013)	0.059* (0.031)	0.167*** (0.015)
Comm. Time	-0.032* (0.018)	-0.03* (0.018)	-0.162*** (0.061)
Comm./Unexplained	-0.235	-0.514	-0.967

Standard errors in parentheses. * indicates significance at the 10% level and *** at the 1% level.

The decomposition of the wage gap given by Equation (6) is shown in Table 4, indicating the explained and unexplained portions associated with commute time. As may be observed, the total gap is 9.1% under both OLS and 2SLS but not significantly different from zero when participation is controlled for using Heckman. In keeping with other studies, the explained portion was negative, a result consistent with women workers' greater average human capital. However, the unexplained portion ranges between 6% to 17%, offsetting or more than offsetting the portion explained.

Regarding commute time, the coefficients account for 9% to 10% of the explained difference in the log wage gap using OLS or Heckman and 47% using 2SLS. As for the unexplained portion, the commute time coefficients represent 23.5% of the log wage difference under OLS, 51.4% under Heckman and 96.7% under 2SLS.

6. Discussion and Conclusions

An analysis was presented of the gender wage gap for the city of Santiago, Chile, using the Oaxaca-Blinder decomposition. Special emphasis was given to the inclusion of commute time as a key factor in determining both the explained and unexplained portions of the gap. The coefficients of the wage equations for men and women under the decomposition methodology were estimated using three different methods: ordinary least squares, two-stage least squares and the Heckman selection model.

According to the estimates, the gap ranged between 0% and 9%. The unexplained portion, interpreted as a measure of discrimination affecting women, varied from 6% to 17% depending on the estimation method. Commute time accounted for 10% to 47% of the difference in the logarithm of wage income explained by worker characteristics, and 23.5% to 96.7% of the difference not so explained.

The significant variations in the results depending on the estimation method is consistent with the findings of the previous literature. Nevertheless, all three methods showed that commute time accounts for a significant part of the wage gap, whether it be explained by worker characteristics or other, unexplained attributes.

These results for commute time introduce a new dimension into the factors considered in the design of public policies aimed at reducing the unexplained portion of the gender wage gap. Traditional policies have centred on aspects of the workplace, neglecting to take into account the different valuations of commute time by men and women and the complex decisions involved in the choice of residence location of diversely constituted households.

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