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Gender wage gap in Brazil: wage-commute trade-off with heterogeneity by sexual orientation

Monografia de Final de Curso

Orientador: Gustavo Gonzaga

Rio de Janeiro, Novembro de 2024



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Declaro que o presente trabalho é de minha autoria e que não recorri, para realizá-lo, a nenhuma forma de ajuda externa, exceto quando autorizado pelo professor tutor.

Rio de Janeiro, Novembro de 2024

As opiniões expressas neste trabalho são de responsabilidade única e exclusiva do autor.

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Abstract

This monograph explores gender differences in wage-commute trade-off. Using household-level data from the 2010 Brazilian Census, we extend the literature on the impact of commute on the gender wage gap to a middle-income country with a large informal sector. Commute relates to job-flexibility, which is more demanded by women as a result of their within-household specialization in house and childcare relative to men. We explore sexual orientation as mechanism for within-household specialization and subsequent willingness to commute. We find women in different sex couples are less likely than average to commute more than 30 minutes, whereas the opposite is true for women in same sex couples. We also expand the literature by quantifying commute compensation differentials: in our preferred specification, women who commute more than 30 minutes earn on average 3 p.p. more than men who commute more than 30 minutes. Heterogeneity analysis show the commute compensation differential is U-shaped on income level and larger for single mothers than for married ones. In sum, this monograph expands knowledge on the commute aspect of job-flexibility and, as consequence, on the remaining gender wage gap.

Keywords

commute; compensation differential; family economics; gender wage gap; informality; job-flexibility; LGBTQ economics; wage inequality

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1 Introduction

While many variables are known to explain the gender wage gap, recent research highlights the importance of within-household decisions. Because women are often attributed more of the domestic and childcare workloads, they have greater demand for job-flexibility on paid work (GOLDIN, 2014). Meanwhile, whenever workers are not perfect substitutes to one another, pay is non-linear on hours of work (GOLDIN, 2014).

Women are most often attributed more of the domestic and childcare loads in the within-household decision-making process - due to comparative advantages, genderconforming social norms or less bargaining power than their spouse. As a consequence, they are more likely than men to need easy, fast access to the home and to childcare facilities at unpredictable times, which explains their greater demand for flexibility. Moreover, this suggests women could choose shorter commutes to work: it both helps them fulfill their aforementioned needs and partially compensates for inflexible work structures - if they need to get away from work, they can come back quicker. Indeed, men in the United States spend on average 15% more time daily commuting to and from work than women. In France, that is 8%¹. This monograph found women in Brazil commute more than 30 minutes to work less often than the average. In the preferred specification, they earn a 3 p.p. commute compensation differential relative to men.

While the evidence of commute compensation differentials on the gender wage gap has expanded, it covers only developed, rich countries. This monograph assesses women's wage-commute trade-off in a middle-income country, with a large informal sector - much larger than France or even the United States -, where housekeeping and childcare services are cheap, but commuting takes relatively long due to insufficient infrastructure and strong economic activity clusters in the city centers. It documents both gender differences in willingness to commute and commute compensation differentials. Therefore, this monograph relates to the line of research that

¹ See table LMF2.6.A at OECD Family Database - LMF2.6: Time spent travelling to and from work

connects job-flexibility to the gender wage gap, specifically through the commute time to work point of view.

Moreover, it relates to research on sexual orientation's effect on labor market outcomes and determinants of within-household specialization: studies have tried to assess why women commute less than men. One hypothesis is gender-conforming social norms impose what roles men and women ought to perform (UNSD, 2018; BERTRAND et al., 2020) and motivate women to take on more of the domestic and caring workloads. Also, these norms diminish women's bargaining power relative to men in the within-household decision-making process.

Sexual orientation is a randomly assigned variable that influences attachment to these norms: mechanically, same sex couples cannot implement gender-specific division of domestic work (BAUER, 2016). As a consequence, spouses in different sex couples specialize more than those in same sex couples - women specialize in domestic work and childcare and men specialize in paid work. This translates to men in same-sex couples commuting shorter on average than men in different-sex couples whereas women in same sex couples commute longer on average than women in different sex couples (OREFFICE; SANSONE, 2023). This monograph found that in Brazil women in different sex couples commute 30 minutes or more less than average while those in same sex couples do it more than average. However, men in same sex couples commute 30 minutes or more less - than average.

The next chapter will review the literature. Chapter three will describe the data and present descriptive statistics. Chapter four presents the empirical strategy on the gender wage gap and on commute compensation differentials with heterogeneities. Chapter five explores the sexual orientation mechanism. The last chapter will conclude.

2 Literature Review

Women systematically earn less than men. This difference has diminished in the last 45 years - the ratio of median annual earnings between women and men working full-time in the United States has gone from 0.56 in 1980, to 0.74 in 2000 to 0.77 in 2010 (GOLDIN, 2014). This convergence is robust to self-selection bias (BLAU et al., 2024). In Brazil, the ratio of hourly wages between women and men was 0.73 in 1995, 0.85 in 2010 and 0.91 in 2021 (URQUIDI et al., 2023). However, this is not the full picture: although that ratio was at 0.898 in 2015 - equivalent to a 10.2% gap - the monthly earnings gap was still at 20.1% (ILO, 2019).

2.1 Schooling, occupations and the motherhood penalty

Women have tightened the gap by catching up with men on labor force participation, paid hours of work and years of study - and in some countries they have even surpassed them (GOLDIN, 2014), including Brazil (URQUIDI et al., 2023). However, they still systematically choose lower-paying careers than men (BERTRAND, 2020; ENGLAND et al., 2002). This is greatly explained by women's under-representation in math-intense STEM careers (GOLDIN, 2014), characterized by high earnings and low within-field gender wage gaps. Nevertheless, in the United States, women born in the 1950 co-hort chose bachelor's degrees with expected mean income 14 p.p. lower than men while those born in the 1960 co-hort chose fields only 6 p.p. lower (BERTRAND, 2018).

The child penalty or motherhood penalty also explains the gender wage gap. The birth of the first child is a non-event for the father, but an immediate, negative and persistent shock on the mother's earnings (BERTRAND, 2020). Women both reduce their labor supply - in the intensive and extensive margins - and receive lower hourly wages. In Europe, the average annual earning losses 5-10 years after the first child's birth range from 20% in Denmark to 60% in Germany (KLEVEN et al., 2019). As the gender wage gap decreased, the child penalty's importance to explain it has increased (KLEVEN et al., 2019).

Evidence shows women face penalties based on employers' expectations of future motherhood (BRONSON; THOURSIE, 2019; HOYOS et al., 2010). In Sweden, a significant gender gap in promotions appears early in the life cycle, reversing after age 40 - when women's fertility declines. Women are affected regardless of eventually becoming mothers, implying the penalty stems from employer biases rather than women's actual parenthood plans (BRONSON; THOURSIE, 2019).

2.2 Flexibility and commute

Job-flexibility is defined by the number, precision, and predictability of hours and control over one's schedule. In occupations where employees are not perfect substitutes, employers disproportionately reward long and precise hours worked. Since women demand more job-flexibility than men, it is an important variable in explaining the remaining of the gender wage gap (GOLDIN, 2014). A longer commute to work corresponds to less flexibility. Women trade-off wages for amenities such as job-flexibility more than men (WISWALL; ZAFAR, 2017). In this context, this monograph explores commute compensation differentials by gender in Brazil.

Women in France have on average 4% lower reservation wages and 14% lower maximum acceptable commutes than men. Both gaps relative to men increase with marriage and parenthood (BARBANCHON et al., 2021). Men in the United States commute on average 4 minutes more than women in 2008-2019 (OREFFICE; SAN-SONE, 2023). This gap has grown from 2 minutes in 2005 (CRANE, 2007). In the United Kingdom, the median gap in 2018 was 5 minutes (ONS, 2019). In Belgium, it was 4 minutes (ALBANESE et al., 2022). All these gaps are significant relative to the average time spent daily on different activities (RUSSELL et al., 2007). This monograph adds to the literature by exploring a middle-income country - with a larger informal sector - rather than a high-income one.

This monograph will investigate commute compensation differentials from the perspective of labor supply. Although, the hiring rate decreases as the distance between firm and worker residence increases, it is not at a significantly faster rate for women, so employers do not discriminate against women for living further away (BARBANCHON et al., 2021). Still, positions' job-inflexibility may drive women to be more likely to look for part-time work (BARBANCHON et al., 2021), selfemployment or work in the informal sector, specially after becoming mothers (MAT-TAR, 2018).

2.3 The role of sexual orientation

Women indeed trade-off wage and commute, but it can be due to individual preferences or household decision constraints (BARBANCHON et al., 2021). Exploring heterogeneity by sexual orientation in the wage-commute trade-off clarifies it is the latter (OREFFICE; SANSONE, 2023). Women in same-sex couples commute on average 2.5 minutes longer than those in different-sex couples, while the average gap between men and women is 4 minutes. Considering the trade-off between wages and total time dedicated to work, women in same sex couples work on average 3 hours a week more than those in different sex couples (OREFFICE; SANSONE, 2023).

The gap among women suggests the wage-commute trade-off is driven not by gendered biological differences, but by some factor differing by sexual orientation, such as gender-conforming social norms (OREFFICE; SANSONE, 2023; BERTRAND et al., 2020). They are "the perception of how men and women should behave in society" (UNSD, 2018) and are not only descriptive, but also prescriptive, motivating individuals to conform to gender expectations (BERTRAND et al., 2020). Other findings support this explanation: while gender-conforming social norms are stronger among older generations, the gender commute gap is crescent by age cohort (BARBANCHON et al., 2021; OREFFICE; SANSONE, 2023).

Still, there are alternative explanations to women's specialization in domestic work and childcare: variables other than gender-conforming social norms - such as earnings, education and age - diminish women's bargaining power relative to their husband, affecting within-household decision-making (FENGDAN et al., 2016; FRIEDBERG; WEBB, 2006). In addition, women's comparative advantage in that type of work is another possible explanation (BECKER, 1985). Nonetheless, more recent literature refutes this model (SIMINSKI; YETSENGA, 2022). In fact, evidence suggests women's comparative advantage in home production has contributed to narrow the gender wage gap in the rise of the Service Economy (NGAI; PETRON-GOLO, 2017). What is certain is within-household specialization matters: women's fall in employment as they become mothers is worse where non-market activities are more unequally distributed between spouses (MEDEIROS, 2022)

2.4 Evidence on Brazil

In Brazil, women sort into lower-paying firms. Their jobs have better amenities, specially at large firms. For high-ranking employees, employers offer high pay to men and high amenities to women (MORCHIO; MOSER, 2024). The Blinder-Oaxaca decomposition (BLINDER, 1973; OAXACA, 1973) implies education, experience, occupation and urbanity contributed to close the gap between 1995 and 2021 (URQUIDI et al., 2023). However, occupation's contribution for the earnings gap is still positive (GONZAGA; CAVALCANTI, 2022): the higher the occupation's average income is, the greater is its gender pay gap (BARROS et al., 1997). Also, women are underrepresented in high-paying occupations (BARROS et al., 1997) - men choose STEM tertiary degrees more often than women (MARCHIONNI et al., 2019).

In contrast, age, marital status and the presence of minors in the household were variables that increased the gender disparity (URQUIDI et al., 2023). Moreover, women are over-represented in informal jobs (GONZAGA; CAVALCANTI, 2022). In a context with scarce part-time work opportunities (MATTAR, 2018), informal positions offer more flexible work arrangements compared to formal positions. After becoming mothers, women move to the informal sector, leaving behind benefits and social security coverage of formal jobs (MATTAR, 2018). In particular, this effect is driven by switching to self-employment, which is even more flexible than working as an informal employee (MEDEIROS, 2022). Mothers are also more likely to work part-time or in the public sector - where work is more flexible and amenities are more generous than in the private sector - and less likely to become managers (MEDEIROS, 2022). Finally, income heterogeneity matters: the motherhood penalty is weaker for wealthy women in the top 10% of wages distribution (MEDEIROS, 2022).

3 Data

The data used in this project is the individuals (pessoas) dataset from the 2010 Brazilian Census micro-data. The micro-data is composed of four datasets that cover the households, the individuals, immigration and mortality. IBGE (Instituto Brasileiro de Geografia e Estatística) has run this survey every decade since 1970. This monograph uses the 2010 data rather than the 2022 data because the latter was not yet available at the time. The data is a cross-section sample meant to represent the Brazilian population. Therefore, all calculations must include the sample weight associated to each household. This information is provided by IBGE. The data was processed through Data Zoom's Stata package.

Each observation corresponds to an individual. In the following analysis, only heads of households and their spouses ages 18-64 are included, as in OREFFICE; SANSONE (2023). They amount to a total of 8872894 observations.

3.1 Descriptive Statistics

Table 1 shows demographic variables' means and standard deviations in the sample. Participation rate and occupation rate are defined as the proportion of people of working age - older than 14 - who are economically active and who are occupied, respectively. Since everyone in the sample is older than 14, these are the proportions of economically active and of occupied people in the sample. Moreover, the unemployment rate is the proportion of economically active individuals who are not occupied.

The table shows that men and women in same-sex couples have a different profile than the rest of the sample. They are on average younger, more likely to be economically active (except men with children), but more likely to be unemployed (except women without children), more likely to be in an urban context, less likely to be non-white (except women with children) and more likely to have finished at least high school than their single and different-sex couple respective counterparts. Furthermore, every category is less likely to have finished high school if they have children than if they do not. Single and different-sex couple women are less likely to be economically active or to be occupied. Particularly, different-sex couple women with children have the lowest participation and occupation rates.

Table 2 shows work-related variables' means and standard deviations, conditional on individuals being occupied. It reveals further differences of men and women in same-sex couples relative to the rest of the sample. Both make more than their respective single and different-sex couple counterparts. Also, they are more likely to have more than one job. Moreover, men in same-sex couples work on average less hours a week than their counterparts, while women in same-sex couples work on average more hours than their counterparts. This is relevant for further analysis in this monograph as wage-commute trade-off is likely part of a wage-total time at work trade-off, where total time at work is hours worked plus commute time.

Finally, table 3 shows the proportion of individuals in each group who fit into each commute time category. Calculating the deviation by group from the average proportion of each commute time category shows how they are different from one another - for this purpose, they were all given the same weight to build figures 1 and 2. Figure 2 splits the data by gender and relationship status. In the appendix, table A.2.1 presents the table used to build figure 2. Figure A.2.1 shows the deviation from commute by gender, relationship status and parenthood status.

Figure 1 shows women are less likely than men to have commutes over 30 minutes. Figure 2 shows individuals in same sex couples are more likely than average to commute between 30 and 120 minutes and that women in different sex couples are more likely than average to commute up to 30 minutes - driving the result for women in general shown in figure 1. Figure A.2.1 shows that this effect is more intense for women in different sex couples with children than without.



Figure 1 – Gender differences in commute time (Women - Men per category)

Variable	Men					Women						
	sin	gle	different	sex couple	same se	x couple	sin	gle	different	sex couple	same se	x couple
	no kids	kids	no kids	kids	no kids	kids	no kids	kids	no kids	kids	no kids	kids
sample proportion	4.82%	0.97%	8.44%	32.34%	0.05%	0.003%	3.42%	7.36%	9.09%	33.46%	0.04%	0.02%
age	40.09	47.92	41.65	41.55	35.01	37.50	44.69	41.24	38.88	38.09	34.09	34.50
	12.77	9.96	13.54	10.56	9.33	10.33	13.97	9.04	10.73	9.81	8.86	8.56
participation rate	81.6%	79.3%	84.9%	89.0%	90.7%	80.9%	64.9%	66.7%	61.4%	58.2%	87.8%	81.6%
	0.39	0.41	0.36	0.31	0.29	0.39	0.48	0.47	0.49	0.49	0.33	0.39
occupation rate	77.7%	76.5%	82.5%	86.4%	86.6%	76.2%	60.6%	61.4%	57.0%	53.5%	81.2%	73.1%
	0.42	0.42	0.38	0.34	0.34	0.43	0.49	0.49	0.50	0.50	0.39	0.44
unemployment rate	4.74%	3.48%	2.90%	2.91%	4.54%	5.79%	6.51%	7.86%	7.14%	8.09%	7.58%	10.31%
	0.21	0.18	0.17	0.17	0.21	0.23	0.25	0.27	0.26	0.27	0.26	0.30
urban	85.50%	85.97%	85.23%	83.74%	96.82%	91.01%	94.50%	92.58%	85.13%	83.69%	98.03%	96.42%
	0.35	0.35	0.35	0.37	0.18	0.29	0.23	0.26	0.36	0.37	0.14	0.19
non-white	52.17%	55.17%	46.55%	51.72%	39.90%	44.51%	44.69%	54.37%	44.15%	50.43%	42.40%	50.10%
	0.50	0.50	0.50	0.50	0.49	0.50	0.50	0.50	0.50	0.50	0.49	0.50
finished at least high school	40.80%	27.64%	40.56%	33.04%	73.21%	51.98%	51.78%	33.35%	45.06%	37.12%	67.27%	46.23%
	0.49	0.45	0.49	0.47	0.44	0.50	0.50	0.47	0.50	0.48	0.47	0.50
spouse's income			1335.66	1184.16	3219.72	2291.84			2007.60	1899.05	1975.57	1696.85
			2548.14	2818.96	5731.20	3338.68			4753.98	5226.61	2659.41	3363.09

Table 1 – Demographic variables' means and standard deviations

Variable			N	ſen			Women					
	sin	gle	different	sex couple	same se	x couple	sin	gle	different	sex couple	same sez	x couple
	no kids	kids	no kids	kids	no kids	kids	no kids	kids	no kids	kids	no kids	kids
informality rate	43.0%	45.6%	36.3%	38.3%	30.1%	25.2%	39.3%	47.0%	38.9%	45.9%	36.6%	49.3%
	0.50	0.50	0.48	0.49	0.46	0.43	0.49	0.50	0.49	0.50	0.48	0.50
total monthly earnings	1,747.87	1,756.82	1,747.92	$1,\!655.42$	$3,\!147.87$	2,034.80	1,589.49	1,101.09	1,222.03	1,063.41	1,933.90	1,567.79
	5,021.61	5,829.79	4,195.43	4,562.24	$5,\!598.06$	3,016.98	$3,\!619.94$	2,231.58	2,484.83	2,634.45	2,857.92	3,151.80
main job monthly earnings	1,700.94	1,736.32	1,733.72	$1,\!640.98$	$2,\!890.76$	$1,\!840.13$	1,532.36	1,072.17	$1,\!247.11$	1,098.46	$1,\!805.14$	$1,\!456.00$
	4,544.61	5,743.33	4,023.58	3,924.22	4,947.83	2,441.70	3,515.83	2,089.85	2,451.81	2,630.50	2,650.48	3,000.94
main job hourly earnings	11.66	11.74	11.39	10.63	19.37	12.20	11.81	8.44	9.37	8.64	12.48	10.38
	49.30	36.28	39.64	45.88	45.45	14.10	41.27	24.62	26.07	39.70	19.57	22.04
weekly hours of work	41.88	42.16	42.97	43.46	40.72	39.51	38.06	37.76	38.19	36.90	40.14	40.97
	14.78	15.45	14.48	14.82	14.41	17.03	15.33	15.77	14.91	15.37	14.90	16.38
more than one job	6.44%	5.77%	5.12%	4.93%	12.20%	11.41%	8.21%	7.31%	5.16%	4.98%	10.94%	8.88%
	0.25	0.23	0.22	0.22	0.33	0.32	0.27	0.26	0.22	0.22	0.31	0.28

Table 2 – Variables' means and standard deviations conditional on being occupied

Note: Average month length 4.345 weeks

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Table 3 –	Commute	time	ın	minutes

				Men				V	Vomen			
	single different sex		t sex couple	same se	x couple	sin	gle	different	t sex couple	same sex couple		
	no kids	kids	no kids	kids	no kids	kids	no kids	kids	no kids	kids	no kids	kids
0 to 5	14.61%	13.18%	13.17%	12.28%	9.39%	14.73%	12.56%	11.88%	14.71%	16.01%	9.79%	10.28%
6 to 30	52.07%	51.63%	52.29%	51.37%	48.43%	47.23%	51.60%	51.13%	53.24%	53.99%	48.95%	47.43%
31 to 60	23.13%	23.88%	23.05%	23.91%	27.48%	22.89%	23.66%	23.92%	21.47%	20.40%	24.87%	25.97%
61 to 120	8.61%	9.47%	9.53%	10.23%	13.02%	11.89%	10.41%	11.06%	9.12%	8.20%	14.42%	14.05%
over 120	1.57%	1.83%	1.96%	2.22%	1.68%	3.26%	1.76%	2.00%	1.46%	1.39%	1.98%	2.27%



Figure 2 – Deviation from commute categories' means by gender and relationship status

4 Empirical Strategy

4.1 Gender wage gap

First, this monograph assesses the gender wage gap in Brazil in 2010. In table 4 specification (1) presents the uncontrolled gender wage gap: women made on average 16.3% less than men per hour of work. Columns (2) and (3) control for individuals' characteristics, while (4) and (6) also control for labor market characteristics (AL-TONJI; BLANK, 1999).

According to (2), women make 30.7% less than men on average, per hour of work. The gap grows between (1) and (2) as schooling is included because women in Brazil are more educated than men (URQUIDI et al., 2023). Results are nearly identical between columns (2) and (3), meaning controlling for schooling is sufficient when it comes to individuals' characteristics. Specification (4) controls for UF, urban and informal, while (6) also considers sector. As there is a 3.3 p.p. difference between them, sector can be considered an important variable to explain the gender wage gap in Brazil. The gap diminishes because women choose, on average, lower-paying occupations than men.

Finally, columns (5) and (7) interact gender with informality, revealing women in the informal sector make more than men in the informal sector. Perhaps that happens because in informal positions, workers have more flexibility. The difference in the gaps highlights how important this effect may be: according to (5), women in the formal sector make 26.2% less than men on average, whereas those in the informal sector make 7% more.

Upon analyzing these regression results, the controls chosen for regressions in the following sections are schooling, age, non-white, UF, urban and informal. Although important to explain the gap, the sector variable will be excluded because it is endogenous to job-flexibility.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Woman	-0.163***	-0.307***	-0.300***	-0.296***	-0.321***	-0.263***	-0.293***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Informal				-0.231***	-0.262***	-0.191***	-0.231***
				(0.000)	(0.000)	(0.000)	(0.000)
Woman x Informal					0.070^{***}		0.092^{***}
					(0.000)		(0.000)
Observations	5611584	5611584	5611577	5611577	5611577	5611577	5611577
Adjusted R^2	0.007	0.263	0.291	0.359	0.359	0.383	0.383
Schooling		Х	Х	Х	Х	Х	Х
Other indiv. controls			Х	Х	Х	Х	Х
Labor market controls				Х	Х	Х	Х
CNAE activity						Х	Х

Table 4 – Gender gap on hourly earnings on the main job (dependent variable: In of main job hourly earnings)

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

Note: The first two digits of the CNAE Activity Codes were used

4.2 Commute compensation differential

This monograph will show women in Brazil trade-off wages for shorter commutes. In order to check whether that trade-off exists, first it should be established that if women commuted longer, they would have, on average, greater wages. This would not be true if, on average, offered wages went down the further from home people went. Because we only have realized labor market outcomes, we can only find a positive correlation between wages and commuting time, as in OREFFICE; SANSONE (2023). Therefore, we cannot infer that if people looked for a job further away, they would earn more. However, to the best of our knowledge, none of the literature presents causal inference. All of the evidence is based on correlation (MANNING, 2003; BARBANCHON et al., 2021; ALBANESE et al., 2022; PETRONGOLO; RONCHI, 2020).

There is theoretical eclecticism when it comes to treating the gender wage gap. Different models are used depending on exactly what question needs answering. This monograph looks at the issue from the perspective of labor supply. The basic regression model used is:

$ln(Wage)_i = \beta_0 + \beta_1 Commute_i + \beta_2 Woman_i + \beta_3 Commute_i \times Woman_i + \mathbf{X}_{\mathbf{i}}\alpha$

Where *Wage* is hourly wages on the main job, X is the vector of controls selected in section 4.1 and *Commute_i* takes various forms. In table 5's specification (1) it is a *categorical* variable for all five commute categories: 0-5 minutes, 6-30 minutes, 31-60 minutes, 61-120 minutes, 121+ minutes. In (2), we simplify it to 0-30 minutes, 31-60 minutes, 61+ minutes. In (3), it becomes a *binary* variable for traveling more than 5 minutes. In (4), it is for traveling more than 30 minutes and in (5), for traveling more than an hour. The parameter of interest is β_3 . Only occupied individuals are included.

Table 5 shows that across specifications, women have positive commute compensation differentials relative to men. Also, these compensation differentials grow with commute time. Women receive 2.3 p.p. more than men for commuting more than 5 minutes, 3 p.p. for more than half an hour and 4.1 p.p. for more than an hour. Although informative, the more granular specifications do not offer different insights than the simpler ones. Therefore, in the following sections, commute specification (4) with two categories - 0-30 min, 31+ minutes - will be used. This makes for a 60-40 ratio split of the sample - the closest to 50-50 possible. Also it was important to incorporate 121+ min into another category to mitigate self-selection biases.

	(1)	(2)	(3)	(4)	(5)
Woman	-0.299***	-0.288***	-0.298***	-0.288***	-0.283***
	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)
6-30 min	-0.026***				
	(0.002)				
31-60 min	-0.004*	0.018^{***}			
	(0.002)	(0.001)			
61 to 120 min	-0.028***				
	(0.002)				
$121 + \min$	0.003				
	(0.004)				
Woman x 6-30 min	0.013***				
	(0.002)	0 000****			
Woman x 31-60 min	0.032^{***}	0.022^{+++}			
W	(0.003)	(0.002)			
woman x 61-120 min	$(0.050^{-0.01})$				
Woman y 191 - min	(0.003)				
woman x 121+ mm	$(0.005)^{-1}$				
$6 \pm \min$	(0.000)		-0.021***		
0 11111			(0.021)		
$31 + \min$			(0.002)	0 011***	
01 11111				(0.001)	
$61 + \min$		-0.001		(0.001)	-0.007***
		(0.002)			(0.002)
Woman x $6+\min$		()	0.023***		()
			(0.002)		
Woman x $31 + \min$			× ,	0.030***	
				(0.002)	
Woman x $61 + \min$		0.046^{***}			0.041^{***}
		(0.002)			(0.002)
Observations	4113243	4113243	4113243	4113243	4113243
Adjusted \mathbb{R}^2	0.359	0.359	0.359	0.359	0.359

Table 5 – Gender & commute effects on hourly earnings (dependent variable: ln of main job hourly earnings)

. p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

Controls: schooling, age, non-white, UF, urban and informal

4.3 Heterogeneity by income level

This section analyzes how commute compensation differentials vary by income level. In Brazil, housekeeping and childcare services are inexpensive, which is significant because public childcare for children under six is insufficient (ANAZAWA et al., 2020). This affordability means that a relatively large share of the population can hire these services, effectively buying the flexibility women often need. Therefore, in households with high enough earnings, women would not specialize in household tasks relative to men. As a consequence, their compensation differential should be the same as men's.

Table 6 presents table 5's specification (4) results by income quartile. Figure 3 presents a LOESS non-parametrical smoothed line of OLS estimates for *Woman* x 31+ min parameter by income percentile. It confirms what table 6 suggests: the commute compensation differential for women relative to men is positive at first, then it indeed decreases to zero and afterwards it increases again as households become richer. Figures B.1.1 and B.1.2 in appendix B.1 show this result is robust to different commute specifications. Still, these results should be interpreted with caution as they yield from realized labor-market outcomes.

The smoothed line is statistically equal to zero from the 35th to the 62nd percentile, where households earn between 2 and 4 minimum wages. This is consistent with the aforementioned theoretical reasoning. However, it does not explain the rising positive trend after the 60th percentile. This increase might occur because, in higher-income households, the opportunity cost of commuting is greater. Although commuting takes time away from leisure or other income-generating activities from everyone, this opportunity cost is higher for high-income household if these activities are more valuable to them, relative to more time dedicated to work. Within high-income households, this cost may be higher for women due to their preferences.





Table 6 – Gender & commute effects on hourly earnings by income quartile (dependent variable: ln of main job hourly earnings)

	(1)	(2)	(3)	(4)
Woman	-0.125^{***}	-0.216^{***}	-0.319^{***}	-0.440***
$31+\min$	(0.001)	(0.000)	(0.000)	(0.001)
	0.019^{***}	0.052^{***}	0.046^{***}	0.020^{***}
Woman x 31+ min	(0.001)	(0.000)	(0.001)	(0.001)
	0.046^{***}	- 0.004^{***}	0.017^{***}	0.044^{***}
	(0.001)	(0.001)	(0.001)	(0.001)
Sample	1st quartile	2nd quartile	3rd quartile	4th quartile
Observations	1016770	1084588	998780	1012095
Adjusted R^2	0.180	0.104	0.152	0.263

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

Controls: schooling, age, non-white, UF, urban and informal

4.4 Heterogeneity by informality status

Women are more likely to be self-employed or work in the informal sector, specially after becoming mothers (MATTAR, 2018). As that may happen because informal work is more flexible and commute relates to job-flexibility, heterogeneity by informality status is worthy of investigation. Figure 4 shows people in informal work are less likely to commute over 30 minutes than those in formal positions. It also shows this effect is more intense for men. Moreover, table 7 shows they have larger commute compensation differentials than those in formal positions, specially women.





Table 7 – Gender & commute effects on hourly earnings by informality status (dependent variable: ln of main job hourly earnings)

	(1)	(2)
Woman	-0.307***	-0.267***
	(0.001)	(0.002)
$31+\min$	-0.002*	0.038***
	(0.001)	(0.002)
Woman x $31 + \min$	0.028***	0.058***
	(0.002)	(0.003)
Sample	Formal	Informal
Observations	2617585	1495658
Adjusted R^2	0.332	0.267

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

Controls: schooling, age, non-white, UF, urban and informal

4.5 Heterogeneity by family structure

This section explores how commute compensation differentials vary by family structure for women and men: single or married, childless or not. In tables 8 and 9, table 5's specification (4) is run on single individuals and married individuals samples, respectively. Then, parenthood is included in the specification to show how those who have children under 6 or who have any children differ from those who do not. For married individuals, the spouse's earnings influence the individual's working decisions, so it is added as a control.

Table 8 –	Gender, parenthood & commu	te effects on hour	ly earnings f	for single in
	dividuals (dependent variable:	ln of main job ho	ourly earning	$\mathbf{s})$

	(1)	(2)	(3)
Woman	-0.420***	-0.412***	-0.356***
	(0.002)	(0.002)	(0.003)
Kids		0.027 +	0.059^{***}
		(0.015)	(0.005)
Woman x Kids		-0.088***	-0.140***
		(0.016)	(0.005)
$31+\min$	-0.028***	-0.027***	-0.023***
	(0.003)	(0.003)	(0.003)
Woman x $31 + \min$	0.072^{***}	0.068^{***}	0.061^{***}
	(0.004)	(0.004)	(0.005)
Kids x $31 + \min$		-0.046+	-0.032***
		(0.024)	(0.008)
Woman x Kids x $31 + \min$		0.075^{**}	0.042^{***}
		(0.025)	(0.009)
		Small kids	Any kids
Observations	673276	673276	673276
Adjusted R^2	0.458	0.458	0.459

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

Controls: schooling, age, non-white, UF, urban and informal

	(1)	(2)	(3)
Woman	-0.492***	-0.497***	-0.445***
	(0.001)	(0.001)	(0.002)
Kids		-0.001	0.017^{***}
		(0.001)	(0.001)
Woman x Kids		0.020^{***}	-0.060***
		(0.002)	(0.002)
$31+\min$	-0.021***	-0.019***	-0.009***
	(0.001)	(0.001)	(0.002)
Woman x $31 + \min$	0.077^{***}	0.073^{***}	0.075^{***}
	(0.002)	(0.002)	(0.003)
Kids x $31 + \min$		-0.006**	-0.015***
		(0.002)	(0.002)
Woman x Kids x $31 + \min$		0.014^{***}	0.002
		(0.004)	(0.004)
		Small kids	Any kids
Observations	3373996	3373996	3373996
Adjusted R^2	0.475	0.475	0.475
+ n < 0.1 * n < 0.05 * * n	~ ~ 0.01 **	$\frac{1}{2}$ $\frac{1}$	

Table 9 – Gender, parenthood & commute effects on hourly earnings for married individuals (dependent variable: ln of main job hourly earnings)

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001 Controls: schooling, age, non-white, UF, urban, informal and spouse's earnings

Figure 5 compares estimates for commute compensation differentials presented across the different specifications in tables 8 and 9. It shows single mothers have larger compensating differentials than married ones.

There are a few possible explanations for why single mothers' compensation differential is larger than married mothers'. First, single mothers value their time not dedicated to work more. Joining that to the flexibility issue: single mothers demand more flexibility because they are more often the only ones looking after their children. Therefore, they need to be paid even more than people who have help to commute further.

Second, self-selection bias may be affecting married women's estimate. As table 1 shows, the ones in different sex couples, who make up the immense majority of this group, have the lowest participation rates of all. Maybe the ones who self-select out of the labor market demand such high commute compensation differentials that they cannot find a job. Therefore, the result would be biased downwards.



Figure 5 – Estimates for commute compensation differential parameters by family structure with 95% confidence intervals

5 Mechanism

OREFFICE; SANSONE (2023) find sizable differences in the within-couple commute gap between same sex couples and differences drive the gender commute gap and its subsequent effect on the gender wage gap. Rather, it is something that differs between women in different sex couples and same sex couples that explains the gender commuting gap. They argue that it is conformity to gender norms: in different sex couple households, women more often than men are attributed to housework and childcare in the household decision-making process. These are tasks that require more time to be spent at home and fast and urgent access to childcare facilities, for instance. People attributed to these tasks are more likely to choose a flexible job with short commute. In contrast, in same sex couple households the task distribution ought to be more egalitarian (BADGETT et al., 2021), since there are not both a man and a woman to perform their traditional gender roles.

Following OREFFICE; SANSONE (2023), this monograph will check whether conformity to gender norms is a mechanism that explains the results on wagecommute trade-off by women in Brazil. The data is from the 2010 Census. However, same sex couples' marriage only became legal in Brazil between 2011 - when the Supreme Court ruled it legal - and 2013 - when registry offices were forbidden to deny same sex couples their marriage paperwork. Therefore, people in same sex couples likely misreported their relationship, making them indistinguishable from roommates of the same sex in the database. Indeed, between the 2010 and the 2022 censuses, the number of same sex couple households grew from 0.1% at 59.957 to 0.54% at 391.080 (IBGE, 2024). This is a measurement error that biases the estimates. Still, arguably, the ones who did declare their true relationship are more likely to be less conforming to gender norms. Therefore, the identification does work: the same sex couple variable is in fact a proxy for low conformity to gender norms - the actual mechanism variable -, which is measured without error.

	(1)	(2)	(3)
SSC	0.151***	0.164***	0.161***
	(0.014)	(0.015)	(0.017)
Kids		0.052^{***}	0.003 +
		(0.002)	(0.002)
SSC x Kids		-0.024	-0.030
		(0.051)	(0.032)
$31 + \min$	0.048^{***}	0.049^{***}	0.072^{***}
	(0.001)	(0.002)	(0.003)
Kids x $31 + \min$		-0.003	-0.032***
		(0.003)	(0.003)
$SSC \ge 31 + \min$	0.016	0.017	0.002
	(0.022)	(0.023)	(0.026)
SSC x Kids x $31 + \min$		-0.025	-0.002
		(0.079)	(0.049)
		Small kids	Any kids
Observations	1291006	1291006	1291006
Adjusted \mathbb{R}^2	0.367	0.368	0.368
+ n < 0.1 * n < 0.05	k = k = k = 0.01	*** n < 00	01

Table 10 – Gender, parenthood & commute effects on hourly earnings for women (dependent variable: ln of main job hourly earnings)

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001 Controls: schooling, age, non-white, UF, urban, informal and spouse's earnings Table 10 compares women in same sex couples to those in different sex couples, conditional on being occupied. It reveals the commute compensation differential part of the mechanism is not true. Since parameters $SSC \ge 31 + min$ and $SSC \ge Kids \ge 31 + min$ are statistically insignificant in all specifications, we find women in same sex couples have the same commute compensation differentials as women in different sex couples.

However, the mechanism can work through willingness to commute further rather than compensation differentials. Indeed, figure 2 shows women in same sex couples commute 31+ minutes more than the sample average whereas women in different sex couples commute 31+ minutes less than average - both conditional on being employed. In order to further investigate the mechanism, we should consider withinhousehold decisions: the spouses may each specialize either in domestic work and childcare or in paid work (OREFFICE; SANSONE, 2023).

This will require further research. So far, the average absolute commute gap by group hints a direction. Although statistically indiscernible, the means suggest different sex couples specialize more than the others, specially if they have children. The low granularity of the data attenuates the commute gaps - spouses commuting 5 and 6 minutes are indiscernible from spouses commuting 0 and 30 minutes.

Table 11 –	Absolute	commute gap	o mean and	l standard	deviation b	oy famil	y structur
		01				•/	

	DSC		SSC - v	SSC - women		SSC - men	
	no kids	kids	no kids	no kids kids		kids	
	0.471	0.488	0.466	0.437	0.444	0.450	
	0.710	0.721	0.715	0.702	0.708	0.819	
Observations	341116	1239189	1298	561	1603	75	

Table 12 compares men and women in same sex couples. Parameter *Woman* x 31 + min is positive and statistically significant at 5% in all specifications. This does not invalidate the mechanism. Rather, it is a stylized fact showing even among whom gender norms are supposedly weaker, women demand a larger commute compensation differential than men. However, it does show gender differences in commute compensation differentials are driven by something other than within-household specialization motivated by gender-conforming social norms. Possibly, it is women's comparative advantage in domestic work and childcare (BECKER, 1985) - further investigation on it is necessary.

	(1)	(2)	(3)
Woman	-0.282***	-0.290***	-0.289***
	(0.027)	(0.027)	(0.029)
Kids		-0.165	-0.121
		(0.161)	(0.089)
Woman x Kids		0.227	0.123
		(0.174)	(0.098)
$31 + \min$	-0.053+	-0.054+	-0.048
	(0.030)	(0.030)	(0.031)
Woman x $31 + \min$	0.133**	0.136**	0.141**
	(0.041)	(0.042)	(0.045)
Kids x $31 + \min$		-0.015	-0.154
		(0.297)	(0.146)
Woman x Kids x $31 + \min$		-0.005	
		(0.314)	
		Small kids	Any kids
Observations	6161	6161	6161
Adjusted R^2	0.431	0.431	0.431

Table 12 – Gender & commute effects on hourly earnings for individuals in SSCs (dependent variable ln of main job hourly earnings)

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001 Controls: schooling, age, non-white, UF, urban, informal and spouse's earnings

6 Conclusion

This monograph investigates how commute time to work variable affects the gender wage gap in Brazil. It delves into two channels: commute compensation differentials and willingness to commute. Women have 3 p.p. compensation differentials relative to men for commuting more than 30 minutes. The ones in different sex couples travel that far less often than average - specially if they have children.

The literature suggests this is a consequence of women's greater demand for jobflexibility, which is the result of within-household decisions that attribute to women more housework and childcare. In order to assess that, sexual orientation is explored as a mechanism to weaker gender social norms, which result in more egalitarian share of household tasks between spouses. This translates into lower within-household specialization and greater willingness to commute. Indeed, women in same sex couples commute more than 30 minutes more often than average. However, their commute compensation differentials are the same as women in different sex couples'. Further investigation into within-household specialization will shed light onto this mechanism. Still, women in same sex couples present positive commute compensation differentials relative to men in same sex couples. This suggests something else is at play other than within-household specialization motivated by gender-conforming social norms.

As any work that uses realized labor market outcomes, this monograph faces selfselection bias limitations. Self-selection biases arise whenever an "unmeasured factor affecting employment also affect wages given employment" (BLAU et al., 2024). Therefore, the results obtained with the sample - representative of the working population - are biased relative to the true parameters for the working-age population.

Reproduction package is available in annex. The data used in this monograph is publicly available on IBGE's website. It can be processed with Data Zoom's Stata package.

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A Data

A.1 Construction of variables

Alphabetically-ordered list of selected variables:

- Age: is a *categorical* variable. Categories are: 18 & 19, 20-24, 25-29, 30-34, 35-39, 40-44, 45-49, 50-54, 55-59, 60-64.
- Commute: is a *categorical* variable that measures how many minutes it usually takes to get to the main job from home. The categories are: 0-5 minutes, 6-30 minutes, 31-60 minutes, 61-120 minutes, over 121 minutes. They are meaningfully ordered and represent differently sized intervals. As the first category is 0 to 5 minutes, people who work from home are not separately identified. However, they should represent a small part of the workforce: 1% in 2008-2013 Italy (PIGINI; STAFFOLANI, 2019).
- Earnings: is a *numerical* variable, equal to the total monthly amount of Brazilian Reais (R\$) earned by the individual from their jobs.
- Has any kids: is a *binary* variable. It equals 1 for the household head or their spouse if there are any individuals in the household regardless of their age labeled as children of the household head, of the spouse or of both.
- Has small kids: is a *binary* variable. It indicates whether there are children under six years old in the household - regardless of their parents being the both the household chief and their partner or only one of them.
- Informal: is a *binary* variable. It equals 1 if the individual's work is informal. Informal work is defined here as a modified version of the informality definition used by IBGE (2022). Its definition is: private sector and domestic workers without a signed work card (Carteira de Trabalho e Previdência Social - CTPS), self-employed workers and employers who do not contribute to social security and unpaid family workers (Trabalhadores Familiares Auxiliares - TFA). Here,

employers are not considered, as in LUCCHESI, (2020). Moreover, it would be ideal to also identify informality in the public sector - public sector workers without a signed work card. However, the data does not allow for such identification as "public sector worker" and "unsigned work card" are mutually exclusive categories.

- Job sub-type: is a *categorical* variable. The categories are: Domestic workers with a signed work card, domestic workers without a signed work card, other employees with a signed work card, military & public servants, other employees without a signed work card. It is used to build the *Informal* variable.
- Main earnings: is a *numerical* variable, equal to the amount of Brazilian Reais (R\$) earned monthly by the individual in their main job.
- Married: is a *binary* variable. It equals 1 if the individual lives with a spouse - regardless of being officially married or not. Household positions are defined relative to the household head. Therefore, spouses are explicitly identified.
- Non-white: is a *binary* variable. it equals 1 if the individual is neither white nor yellow. Individuals with undeclared race are assigned NA.
- Same-sex couple: is a *binary* variable. It equals 1 if the individual lives with a same-sex spouse regardless of being officially married or not.
- Schooling: is a *categorical* variable. The categories are: from no instruction to 8 years of schooling, from 9 years to 11 years, 12 to 15 years and 16 years or more. It is impossible to retrieve the exact number of years of schooling from the available data.
- UF: is a *categorical* variable. The categories are the 27 units of the Brazilian federation the 26 states plus the Federal District.
- Woman: is a *binary* variable. It equals 1 if the individual is female.

A.2 Descriptive Statistics





Table A.2.1 – Deviation to commute categories' means by group (in percentage points)

	S	Single Different sex couple		Same sex couple		
Commute time (min)	Men	Women	Men	Women	Men	Women
0 to 5	2.01	-0.27	0.09	3.33	-2.73	-2.44
6 to 30	1.07	0.36	0.63	2.90	-2.55	-2.41
31 to 60	-0.73	-0.15	-0.26	-3.34	3.28	1.19
61 to 120	-2.14	-0.05	-0.81	-2.48	2.07	3.41
121+	-0.20	0.10	0.34	-0.41	-0.07	0.24

B Empirical strategy

B.1 Heterogeneity by income level

Figures B.1.1 and B.1.2 are robustness checks to figure 3. Regardless of commute specification, the U-shape of the smoothed line holds. While the declining slope is more steep than the ascending slope in the 31+ min specifications, that effect is even more pronounced in the 61+ min specification, whereas both parts have very similar slopes in the 6+ min specification. Also, the curves levels are consistent with table 5: compensation differentials are larger

Figure B.1.1 – LOESS smoothed curve for Woman x 6+ min OLS estimates with 95% confidence interval



Figure B.1.2 – LOESS smoothed curve for Woman x 61+ min OLS estimates with 95% confidence interval



C Mechanism

Table C.1 compares men in different sex couples to men in same sex couples. It shows men in same sex couples have smaller commute compensation differentials than men in different sex couples. This result further undermines the compensation differential part of the mechanism: if men in different sex couples were more specialized in paid work, they would have lower commute compensation differentials. Furthermore, the willingness to commute part of the mechanism does not hold for men either. Figure 2 shows men in same sex couples are more likely than average to commute more than 30 minutes to work while men in different sex couples are not.

Table C.1 – Gender, parenthood & commute effects on hourly earnings for men (dependent variable: ln of main job hourly earnings)

	(1)	(2)	(3)
SSC	0.088***	0.093***	0.101***
	(0.016)	(0.016)	(0.016)
Kids		0.007***	0.011***
		(0.002)	(0.002)
SSC x Kids		-0.187	-0.116
		(0.133)	(0.073)
$31+\min$	0.015^{***}	0.018^{***}	0.026^{***}
	(0.001)	(0.001)	(0.002)
Kids x $31 + \min$		-0.007**	-0.013***
		(0.002)	(0.003)
$SSC \ge 31 + \min$	-0.098***	-0.101***	-0.104***
	(0.025)	(0.025)	(0.025)
SSC x Kids x $31 + \min$		-0.085	-0.133
		(0.246)	(0.121)
		Small kids	Any kids
Observations	2082990	2082990	2082990
Adjusted \mathbb{R}^2	0.386	0.386	0.386

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001 Controls: schooling, age, non-white, UF, urban, informal and spouse's earnings