CLOSING GENDER GAPS IN THE SOUTHERN CONE

An Untapped Potential for Growth

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IDB

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This book is a collection of studies on gender topics written under the auspices of the IDB Southern Cone Country Department and the Research Department. Under the guidance of project coordinators Veronica Frisancho and Virginia Queijo and academic advisor Libertad Gonzalez, the seven studies included in this volume present novel empirical evidence from the Southern Cone Countries to inform the public debate and ultimately to design better policies.

The editorial team appreciates the contributions of the remarkable researchers whose work appears in the book. We were fortunate to have such a dedicated group of authors. Assembling the book was a lengthy process during which the team benefited from many valuable inputs. We would especially like to thank Fabiano Rodrigues Bastos for his ideas and comments, and Maria Florencia Attademo-Hirt and Eric Parrado for their support throughout the process of producing this volume. We would also like to thank Anne-Marie Urban for participating in the study selection process and Suzanne Duryea for her suggestions and providing some data. The research was enriched by valuable comments and advice from many people during two different workshops organized by the IDB.

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Contents

Introduction

Veronica Frisancho, Libertad González, and Virginia Queijo*

Despite important improvements in recent decades, Latin America and the Caribbean (LAC) still faces challenges regarding gender inequality. Women struggle with explicit and implicit barriers throughout their private and public lives, limiting the achievement of their full potential. Women in the region continue to lag behind men in terms of labor market participation, work hours, and earnings. In addition, relative to men, they dedicate three times as many hours per week to unpaid work activities. Women are also underrepresented in the highest-paid occupations and overrepresented in the informal sector, which is characterized by variable pay and job insecurity.

In this volume, we study gender gaps in the Southern Cone countries which include Argentina, Brazil, Chile, Paraguay, and Uruguay. We assess the importance of gender inequalities and present evidence on their economic consequences, their drivers, and the policy tools that can contribute to mitigating them. Gender gaps in access to public services, human capital accumulation, and the labor market limit overall productivity and economic growth, and policies that mitigate these inequalities have the potential to foster economic development and wellbeing. In our current context, a global pandemic has highlighted and even widened gender gaps, meaning policymakers are in urgent need of a new set of policies that can foster gender parity in the recovery phase. This volume is thus a timely compendium of solid evidence to design policies that can effectively tackle gender disparities in Southern Cone countries.

One of the most important international trends in the labor market in recent decades has been the impressive increase in female labor force participation. Women's employment rates have risen persistently since the mid-20th century, especially among married women and women with children. The gender gap in earnings and wages has also declined considerably, and women have increased their presence in traditionally

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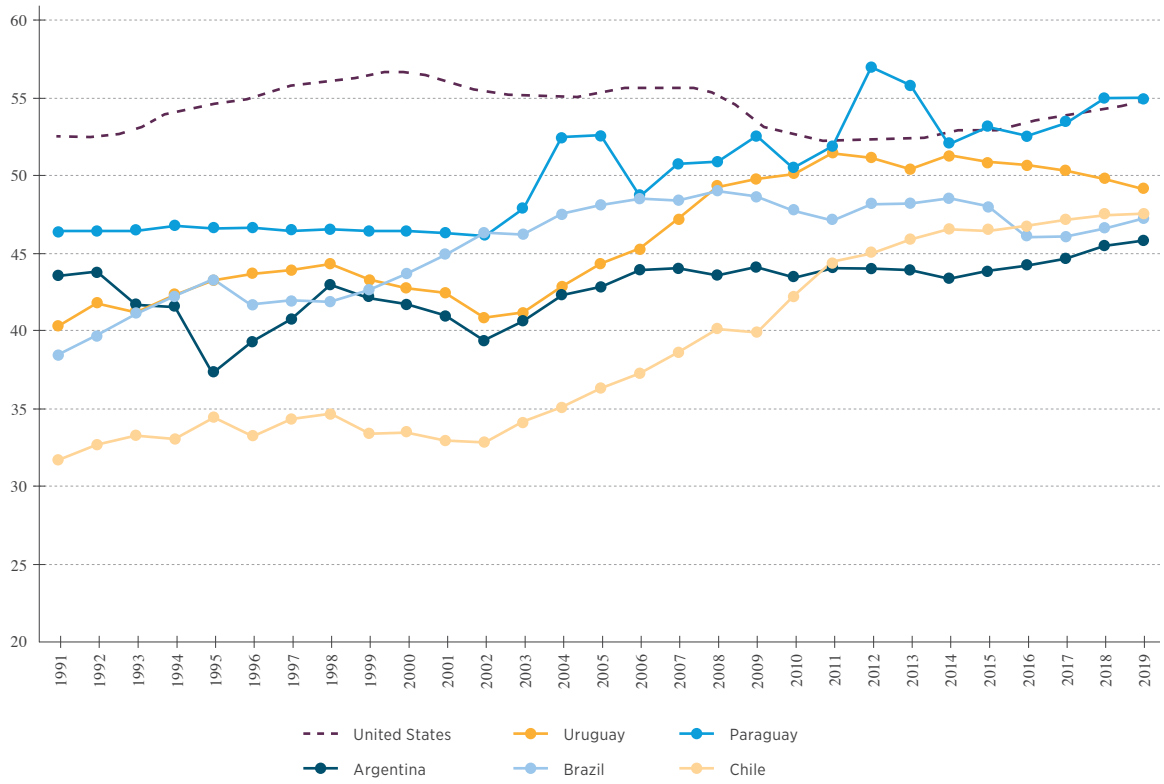
male-dominated occupations. However, in many countries these trends slowed down in the 1990s and 2000s, and important gaps remain. In 2019, the average female employment rate in the Southern Cone was 49 percent, 21 percentage points below that of men (in the United States this gap was 11 percentage points).

Figure 1.1 displays the evolution of female employment rates in the Southern Cone countries since 1990, with the US as a benchmark. Chile had the lowest female employment rate in the 1990s (below 35%), with a pronounced increase since the early 2000s, reaching almost 48% in 2019. Paraguay has the highest female employment rate in the region throughout the period (55% in 2019). Female employment has remained essentially flat in the US since 1990, but at higher initial levels than in all Southern Cone countries. However, all of these countries have reduced the gap relative to the US, with the steepest change observed in Chile and the slowest in Argentina.

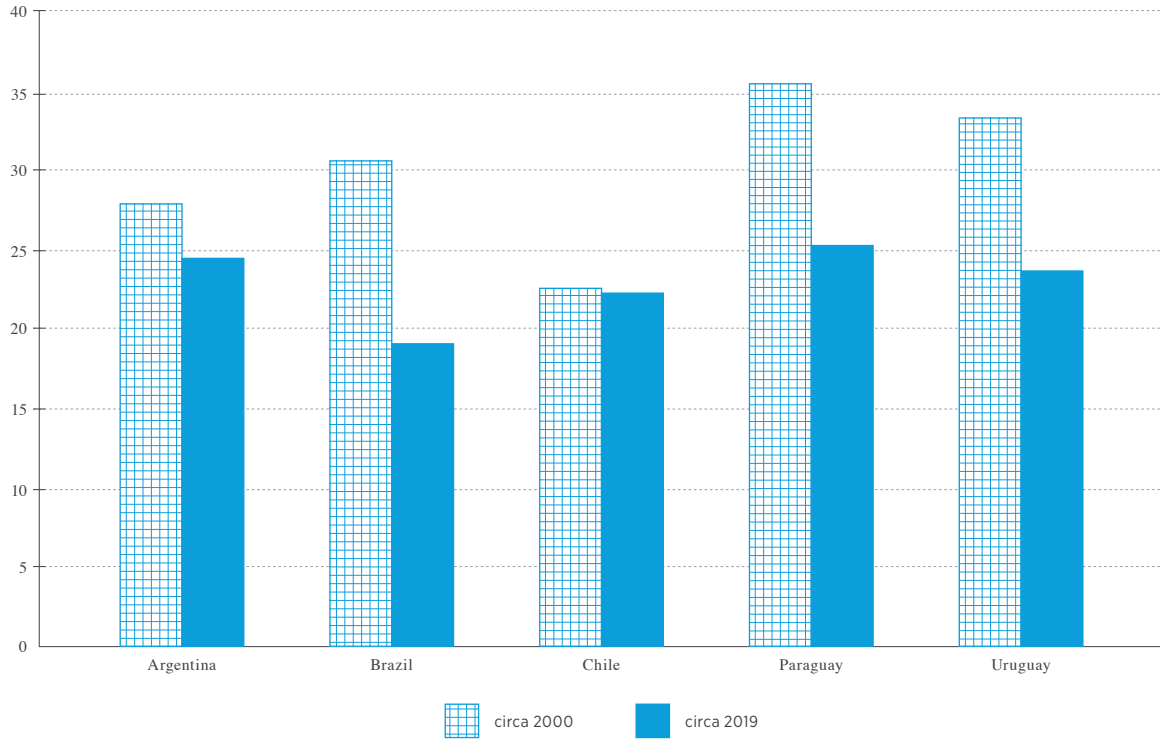
Figure 1.1 Female employment rates, 1991-2019



Notes: *Percentage of the adult female population that is employed. World Bank's DataBank database of Gender Statistics (*Employment to population ratio, 15+, female (%). modeled ILO estimate*). The original data source is the International Labour Organization's ILOSTAT database. The ILO generates these modeled estimates to improve consistency and comparability across countries. These estimates are based on data from national labor force surveys and household surveys, supplemented by official estimates and censuses for a small subset of countries.*

Figure 1.2 shows estimates of the gender gap in earnings across the five southern countries, showcasing heterogeneous progress in the subregion. In 2000, Chile had the smallest gender gap in earnings, while Paraguay exhibited the highest. Between 2000 and 2019, the gender wage gap fell in most countries but at a different rate. By 2019, the earnings gap was fairly similar in the five countries, ranging from 19 to 25 percent.

Figure 1.2 Gender gap in monthly earnings



Source: *IDB Harmonized Household Surveys from Latin America and the Caribbean.*
Note: *Gender gap in monthly earnings, unadjusted for worker characteristics. Estimates correspond to the difference between the average earnings of men and women, expressed as a percentage of the average earnings of men. Circa 2000 indicates the 2000 household survey except in the case of Brazil and Paraguay where the 2001 survey was used. Circa 2019 indicates the 2019 household survey, except in the case of Chile where the 2017 survey was used. Sample includes individuals with positive earnings and positive hours in primary job.*

This volume collects seven studies on a variety of topics related to labor market gender disparities in the Southern Cone. While some studies dig into the sources of gender gaps in the labor market, looking at the education system and daily mobility patterns, others analyze the economic consequences of gender inequalities, such as their impact on aggregate productivity, and the gendered impacts of different policies or phenomena such as globalization.

The volume starts by quantifying the aggregate costs experienced by the economies of the Southern Cone as a result of gender gaps in the labor market. In **Chapter 2**, David Cuberes, Florencia Saravia, and Marc Teignier assess gender (and ethnic) gaps both in earnings and labor market participation in Southern Cone countries. When some groups (such as women) face barriers to work in certain occupations, talent is not efficiently allocated, reducing aggregate efficiency and total output. The authors use the framework proposed by Hsieh et al. (2019) to estimate the potential gains in aggregate output that would be obtained by relaxing the occupational barriers faced by women and ethnic minorities. Their analysis reveals that eliminating occupational barriers such as wage discrimination, human capital accumulation gaps, and gender-biased social norms yields considerable aggregate output gains in Southern Cone countries, ranging from 4% to more than 15%, depending on the country. In the case of Brazil, if one also removes barriers faced by various ethnic groups, the gains could reach up to 30 percent of GDP.

This result stresses the importance of policies that promote women's labor market participation and access to high-skill occupations, as well as the need to tackle human capital accumulation gaps early on. Recent work has shown two stylized facts: (i) the traditional female disadvantage in years of schooling has disappeared and turned into an advantage in most countries, but (ii) there are large differences in the fields of specialization chosen by males and females at the tertiary level, with females disproportionately entering lower-paying fields. The next chapters thus focus on gender gaps in financial literacy and math-oriented STEM fields.

In **Chapter 3**, José Espinoza-Delgado and Jacques Silber study gender gaps in financial literacy in selected countries. There is evidence that individuals who are less financially literate use more costly forms of borrowing, have smaller consumption growth, tend to use informal sources of borrowing, have worse retirement plans, are less likely to invest in stocks, and get a lower return on their investments when they participate in financial markets. The authors propose an aggregate measure of financial literacy that combines the answers to multiple detailed survey questions to make comparisons across Argentina, Chile, and Paraguay. They find gender gaps in financial literacy in all three countries, although these are relatively small (under 10%). They decompose the effects to understand the role of various potential determinants of financial literacy and find that differences across men and women are only partly driven by observable characteristics such as education and income.

Chapter 4 considers the role of gender gaps in the choice of college major. Using data from Chile, Josefa Aguirre, Juan Matta, and Ana Maria Montoya study the labor market returns to pursuing high-earnings fields such as technology and engineering (TE) for men and women. They find that enrollment in TE as opposed to humanities, arts or social science only increases men's earnings and employment, but the same is not true for women who choose TE fields. The authors argue that this is not a consequence of gender differences in preferences for job attributes, but rather that women in TE may be subject to more labor market discrimination relative to women in other fields. Their results suggest that policies to effectively address gender gaps should go beyond incentivizing more women into TE fields, as they may struggle in the labor market later on when trying to succeed in male-dominated fields.

In **Chapter 5**, Aguirre, Matta, and Montoya consider other factors that may affect labor market outcomes for men and women who decide to invest in tertiary education. They focus on the role of peers in college and estimate the effect of opposite sex classmates on graduation, labor market outcomes, and fertility. They find significant effects of peer quality, but only for same-sex classmates: higher-quality peers of the same sex have positive effects on graduation and earnings and negative effects on fertility, both for men and women. This result suggests that investments in female human capital may have a multiplier effect in advancing gender equality: supporting girls to become top students not only has a positive effect on them, but also on their future female peers. This study also sheds light on the role of mentoring by suggesting that social structures that promote interactions between women of high- and low-performance levels might increase gender equity.

The next chapters focus on factors other than human capital formation that may also contribute to gender inequalities in the labor market. **Chapter 6** studies mobility patterns and the extent to which they may restrict access to jobs for women. Florencia Caro Sachetti, Julian Echandi, and Gala Díaz Langou use high-quality data for the metropolitan area of Buenos Aires to document mobility patterns by gender, as well as potential disparities in terms of job accessibility. They find that women make more daily trips than men, travel more outside of rush hour, walk more, use more public transport, and have a significant share of trips devoted to care responsibilities. Moreover, gender gaps in mobility are greater among the poor.

The authors also estimate access to job opportunities by gender, finding that women have less access to jobs than men due to higher travel costs and longer distances. This pattern is particularly salient in the lowest income quintile. This study thus stresses the importance of gender-sensitive transport and urban policies to foster women's labor market participation and economic autonomy.

In **Chapter 7**, Austin Davis and Jennifer Poole focus on the role that globalization and foreign direct investment (FDI) may play in driving or mitigating gender disparities in the labor market. In a case study for Brazil, they evaluate whether the increased presence of multinationals may promote pro-women policies and practices in firms via cultural exchange. In particular, they investigate the extent to which worker mobility from

multinationals to local firms leads to spillovers in terms of female-friendly labor practices. The results show that local firms with more workers with multinational experience have smaller gender gaps in earnings, with stronger effects among workers in managerial positions. However, the effects are small in terms of their economic significance. This indicates that countries should not certainly rely on FDI as a significant source of improvement in gender equality.

The final chapter focuses on the role of policy and considers how gender-neutral interventions in the labor market may differentially affect male and female workers. In **Chapter 8**, researchers from the Brazilian Women in Economics research group[1] analyze the effects of a policy that fostered the formalization of micro-enterprises in Brazil. The program reduced the red tape costs of registering a business and thus facilitated access to retirement, disability, and maternity leave benefits. The authors find significant increases in formalization as a result of the program, especially among women. Moreover, they observe higher formalization rates for women with young children, presumably because they seek greater social security benefits. These findings are consistent with the literature that shows that women value benefits more than men and seek more social security for the family. This study suggests that similar policies in other countries of the region may contribute to reducing gender gaps in the labor market.

The studies collected in this volume document persisting gender inequalities in Southern Cone countries. The research also shows how reducing gender gaps in the labor market would significantly boost economic growth and development in the region. Finally, several chapters in this volume point to avenues for progress and change, which is particularly useful in these dire times characterized by slow growth and low productivity levels. Now more than ever, countries in the Southern Cone need to focus on sustained and inclusive growth. A good start to these efforts is enacting programs and policies that reduce gender inequality and give women an opportunity to reach their full potential in the labor market and beyond.

1 Paula Carvalho Pereda, Renata Narita, Fabiana Rocha, Maria Dolores Montoya Diaz, Bruna Borges, Eloiza Regina F. de Almeida and Liz Matsunaga.

Talent Misallocation and Aggregate Productivity in Southern Cone Countries

David Cuberes, Florencia Saravia, and Marc Teignier*

This chapter first documents differences in labor market outcomes between race and gender groups in Brazil, Chile, Paraguay, and Uruguay. It then quantifies the effects that these differences have on the country's aggregate output. We observe that women tend to be underrepresented in occupations like Construction, Management, or Engineering, while they tend to be overrepresented in Secretaries, Nursing, or Home-related occupations. At the same time, women tend to earn less than men in most occupations, especially in Agriculture, Construction, and Science. In the case of non-white men in Brazil, we observe that they tend to be underrepresented in high-skill occupations such as Doctors, Lawyers, and Architects. The chapter uses the occupational choice model of Hsieh et al. (2019) to estimate the occupational hurdles such as wage discrimination, barriers to human capital formation, and social norms that are faced by women and non-whites, and to quantify the output losses associated with these barriers. We find that the observed fall in occupational barriers and preferences during the last 30 years implied an output gain of around 10% in each country studied. Moreover, if all occupational barriers faced by women were completely eliminated, aggregate output in Chile would have been between 9% and 24% larger in the period 1992-2017, between 16% and 24% in Uruguay in the period 2000-2018, and between 4% and 7% larger in Paraguay in the period 2000-2017. Moreover, eliminating all the occupational barriers faced by women and non-whites in Brazil would give output gains of about 30% in the entire period 1990-2018. ¶

2.1 Introduction

As the IDB (Marchionni et al., 2019) documents, in the last fifty years the presence of women in the work force in Latin America has experienced a dramatic increase, rising from 20% to 65%. Although this represents substantial progress, women in this region still face significant barriers to enter the labor force and to work in high-skill occupations. It is also known that women's salaries in this region are still significantly lower than those of men. On the other hand, recent studies show that in the Latin American and the Caribbean (LAC) region, indigenous peoples and Afro-descendants too remain at a disadvantage, with both the latter (about 25% of the population) and the former (8% of the population) being far more likely to be poor than the rest of the society.

One would expect that, as countries develop, the disparities between men and women in the labor market would diminish (Cuberes and Teignier, 2014). However, as Goldin (1995) pointed out, the cross-country data reveal a U-shape relationship between economic development and female labor force participation. The left panel of Figure 2.1. confirms this: it plots the ratio of women's labor force participation (LFP) over that of men for 164 countries on the y-axis against the country's GDP per capita (in logs) on the x-axis. The relationship between the two variables is indeed well described by a U-shape pattern. One interpretation of this is that once countries become sufficiently rich, further increases in their income are associated with smaller gender gaps in labor market participation. We can also see in the figure that the ratio in labor force participation between women and men in the Southern Cone countries (solid blue circles) is similar to its average value in Latin American countries (solid red squares) and to the rest of the countries in our sample. It is also apparent from the figure

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that the ratio is slightly higher than the value expected given the income per capita of these countries.[1] Finally, the data show that within this group of countries, the richer ones have a ratio closer to one than the poorer ones, a fact that is consistent with our theoretical model.

One possible explanation for the fact that women and/or ethnic minorities are underrepresented in the labor market or receive lower wages is that society discriminates against these groups. To illustrate this possibility, the right panel of Figure 2.1 displays an indicator of a country's view on women's right to work (together with the country's GDP per capita, in logs). More specifically, it plots the response to the question *When jobs are scarce, men should have more right to a job than women*.[2] The answer to this question has a 3-point scale, with larger numbers meaning more disagreement with the statement. It is clear from the figure that in richer countries, there is more disagreement with this statement than in poorer ones. The figure also reveals that in both Latin American and Southern Cone countries the views on women's rights - as measured by this question - display larger values than in other countries with similar income levels. As we will argue below, one could also interpret the correlations in Figure 2.1 as going from less gender inequality towards higher levels of income, that is, in countries where women participate more actively in the labor market or in which women's rights are more protected, income per capita tends to be higher. One explanation for this may be that the innate talent of women is better used in countries where women have the same right to work as men, which translates to an aggregate increase in the country's productivity.

The main goal of this research project is to answer the following question: *What is the output gain of reducing talent misallocation in the Southern Cone countries in the period 1990-2020?* We focus on a subgroup of Southern Cone countries, namely Brazil, Chile, Paraguay, and Uruguay. We first measure differences in labor market outcomes by gender and race (the latter only in Brazil) at the occupational level. We then quantify the effects that these differences have on the country's aggregate output. Intuitively, if all groups of individuals have the same innate talent distribution and the same preferences, we should observe the same proportion of workers and the same average earnings in all occupations. Differences across gender/race groups can then be interpreted as the result of barriers and restrictions that prevent workers of some groups from choosing the occupation where they have a comparative advantage. These restrictions distort the efficient allocation of talent and reduce aggregate output because, *ceteris paribus*, when one individual is not working in his/her best occupation, another one with less talent will take the job. The model is flexible enough to account for three types of friction: barriers such as employer discrimination, barriers to the accumulation of human capital, and group preferences or social norms.

In many countries, socioeconomic inequality has become one of the most pressing issues, and Latin America in particular has been pointed out as one of the regions with the highest level of inequality (Stiglitz, 2013; Milanovic, 2016). In terms of gender gaps, although there has been substantial progress in most regions of the world (see Blau and Kahn, 2016), there still exist big differences in labor outcomes between men and women, not only in terms of presence in the labor market but also with respect to salaries and the presence of women in high skilled jobs. Olivetti and Petrongolo (2016) offer a review of gender gaps in the labor market. A recent summary of the literature focusing explicitly on gender wage gaps can be found in Barth et al. (2021).[3] On the other hand, in many countries an individual's race/ethnicity also has a significant role in her/his labor market opportunities, perhaps due to discrimination by employers or to gaps in the accumulation of human capital (see, for example, Gandelman et al., 2011).[4] Ñopo (2012) and Lustig et al. (2019) show that the

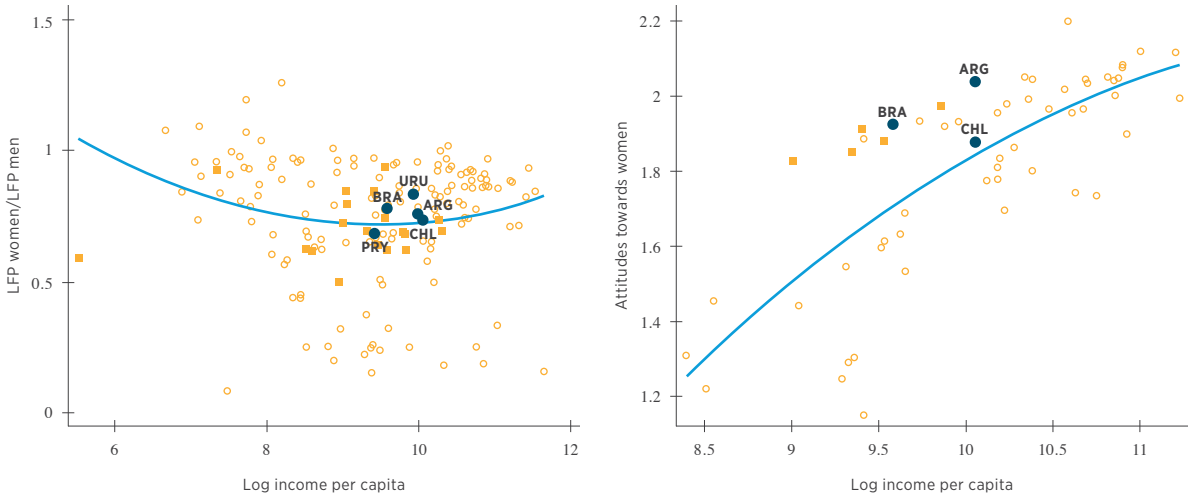
1 The countries used to construct this figure in Latin America and the Caribbean are Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Mexico, and Peru. For the Southern Cone group, we have data for Argentina, Brazil, and Chile. In all cases we use the latest available year.

2 The data are from the World Value Survey, Wave 7, 2017-2021.

3 See also Goldin (2014), and Bertrand et al. (2010).

4 Merriam-Webster (https://www.merriam-webster.com/words-at-play/difference-between-race-and-ethnicity) states "Today, race refers to a group sharing outward physical characteristics and some commonalities of culture and history. Ethnicity refers to markers acquired from the group with which one shares cultural, traditional, and familial bonds".

Figure 2.1 Labor Force Participation (LFP) Ratios Between Women and Men and Economic Development & Views on Women´s Values and Economic Development



Sources: *ILOSTAT, Penn Word Tables & World Value Surveys.*

indigenous population and African descendants are still over-represented in the poor spheres of society with less human capital and lower incomes.

In the labor economics literature, three channels have been identified as potential explanations for these gaps: discrimination, differences in observed productivity, and differences in unobserved factors like preferences (Azmat and Petrongolo, 2014). Regarding gender discrimination, studies show a significant discrimination against women in senior positions or jobs historically dominated by men, as well as discrimination against men in jobs historically dominated by women. Such discrimination can be understood as a dislike for interactions with minorities (Becker, 1971) or the so called "statistical discrimination" (Altonji and Blanck, 1999) which is based on imperfect information about the productivity of the members of the minority. With respect to the differences between the preferences of men and women, there is a large literature based on experiments (Croson and Gneezy, 2009 and Bertrand, 2011) that concludes that men are less risk averse, have better performance in competitive environments, and are better at negotiating than women. This line of literature argues that women segregate into certain occupations that give them more security or flexibility while men tend to choose those occupations where there is more risk and that are usually better paid. However, as Gneezy et al. (2008) point out, this could have a cultural explanation instead of a biological one. The Western-culture concept of the role of women has evolved over time with contributions of discoveries such as the birth control pill (Goldin and Katz, 2002), and with them the role of women in the labor market.

Our chapter contributes to the literature that sheds light on the very high degree of inequality in Latin America. Two recent studies that discuss inequality in the Latin America and the Caribbean region are Messina and Silva (2019) and Busso and Messina (2020). Messina and Silva (2019) document the existence of a marked Kuznets curve in terms of wage inequality in Latin America since 1995, with a sharp reduction in this type of inequality starting in 2002. Their study considers gender as a control group but does not focus on gender inequality per se. In their recent book, Busso and Messina (2020) extensively discuss different dimensions of inequality in Latin America and the Caribbean. One of the chapters in their book addresses gender, ethnic, and racial inequality. With respect to gender, the authors point out that although pay gaps between men and women in this region have narrowed in the past few decades, women still earn, on average, 13% less than men and are less likely to be found in higher-paying jobs and socially prestigious occupations. Regarding gaps in race and ethnicity, their research shows that on average across the countries of the region, 43% of the indigenous

population and 25% of Afro-descendants are poor. Moreover, wage gaps relative to the rest of the population remain quite high and, even after adjusting for education, wages for Afro-descendants are, on average, 17% lower than the rest of the population, while those of indigenous people are 27% lower.

Inequality between groups in a society may result in the talent of some individuals not being fully exploited in the labor market, which in turn may hinder economic growth (Cuberes and Teignier, 2016, and Alesina et al., 2016). Although the literature on inequality between groups is vast, there is still a lot to learn about how individuals anticipate these disparities and how it can affect their labor market decisions. In this chapter we closely follow the still very scarce literature that uses quantitative macroeconomic models to estimate the aggregate costs associated with the under-representation of women or ethnic minorities in high-skill occupations (Hsieh et al. 2019, Cuberes and Teignier, 2016). To the best of our knowledge, this approach is relatively new not just for the LAC region but for most countries, and only a few papers — see the literature review in Cuberes and Teignier (2014, 2016) — have followed this path. Most of the previous literature has been more micro-oriented and has focused on the effects of under-representation of women and/or minorities in the labor market on the individual rather than the aggregate implications of these gaps.

This chapter is organized as follows. In Section 2.2 we describe the methodology used, first in the empirical analysis and second in the numerical one. Section 2.3 presents the stylized facts and the quantitative results for Chile, Section 2.4 for Brazil, Section 2.5 for Uruguay, and Section 2.6 for Paraguay. We conclude the chapter in Section 2.7. Appendix A2 presents the tables with the occupational wage gaps and relative propensities for each country, Appendix B2 the model details, and Appendix C2 the model parameterization.

2.2 Methodology

Data and Measurement. We start our exercise analyzing the databases in the Household Survey for the LAC region, provided by the IDB's Center of Harmonized Microdata, for the period 1990-2018. To estimate the model, we need data every 9-10 years so that we have different cohorts. As stated above, we focus on four Southern Cone countries: Brazil, Chile, Paraguay, and Uruguay. Table 2.1 - Table 2.4 show the number of years used for each country along with the number of observations, occupations, and groups in which we batched these occupations.[5] In the cases of Uruguay and Paraguay, we use data starting in 2000 and create a smaller number of occupations due to the reduced number of observations. It is important to point out that due to these differences in the number of observations the results of our exercises are not directly comparable across countries.

To be able to work with these databases, we first had to harmonize them over time for each country, since countries often changed the method of classifying occupations. Next, in order to construct the occupation groups, we followed the classification systems used in each country, which are based on the International Standard Classification of Occupations by the International Labor Organization (ILO).[6] In particular, whenever possible, we used the 49 sub-headings (shown in the tables in Appendix A2) to form our occupational classification. For example, in Chile, occupations such as Physicist, Chemist, Geologist, Biologist, Pharmacologist, and related occupations were put together into the occupation group that we labeled Natural Sciences. In the case of Uruguay and Paraguay, we did not have enough observations to build the model with so many occupations,

5 To calculate the number of observations we take into account the weights associated with each observation. In the early 1990s data for Uruguay, this is not possible because this weight takes a unique value for all observations. We therefore did not include this year in the analysis.

6 We chose an individual's primary occupation, that is the one in which she/he spent the most time or earned most of her/his income.

so we had to put these 49 occupations into broader groups. We then added the home sector as an occupation for those not employed in the labor market.[7]

Table 2.1 Data for Brazil

Years	1990	2001	2009	2018
Weighted Observations	49,505,013	62,759,261	76,035,042	80,784,102
Raw Observations	106,410	138,416	157,676	173,499
Occupations	365	374	482	427
Occupation Groups	50	50	50	50

Table 2.2 Data for Chile

Years	1990	2001	2009	2018
Weighted Observations	4,787,854	5,265,236	5,224,507	5,885,391
Raw Observations	50,108	84,425	74,904	69,319
Occupations	126	427	487	387
Occupation Groups	50	50	50	50

Table 2.3 Data for Uruguay

Years	2001	2009	2018
Weighted Observations	503,483	963,113	1,061,602
Raw Observations	11,844	38,122	31,196
Occupations	87	122	125
Occupation Groups	18	18	18

Table 2.4 Data for Paraguay

Years	2001	2009	2018
Weighted Observations	2,053,282	1,745,937	1,389,372
Raw Observations	10,206	5,570	8,897
Occupations	100	99	97
Occupation Groups	15	15	15

We restrict the sample to include only individuals between the ages of 25 and 54 to focus the analysis on individuals that have finished schooling and that have not yet reached retirement age. We define three ages within a cohort's life-cycle: young (ages 25–34), middle (ages 35–44), and old (ages 45–54). We then split the data by gender and, in the case of Brazil, also by race/ethnicity.[8] It is important to point out that when analyzing gender gaps in occupations, we observe only the occupations for those working in that

7 Following Hsieh et al. (2019), an individual is classified as being in the home sector if she or he is not currently employed or works less than ten hours per week. Those working 10 – 30 hours per week are classified as part-time workers, and we weigh them equally between the home sector and the reported market occupation.
8 For Brazil we have four groups according to gender and race: white men, white women, non-white men and non-white women, where non-white refers to individuals classified as afro-descendants or indigenous.

occupation, not the percentage of men and women holding professional titles in that area.[9] A second thing to notice about our occupation data is that we include self-employed workers and workers without social security in our sample.[10]

Once we have a set of occupations for each country, we compute the fraction of people from each group working in each of the occupations, as well as the average earnings of each group by occupation. Table A2.1-Table A2.5 in Appendix A2 show the values for the initial and final years, while Figure 2.2a, Figure 2.4a, Figure 2.5, Figure 2.7a, and Figure 2.9a in the next section plot some of the values for the first year of study for each country.

Theoretical Framework and Numerical Simulations. We follow the framework by Hsieh et al. (2019) to study the aggregate effects of differences in labor market outcomes between groups. Their calculations are based on a version of the Roy (1951) model of occupational choice.[11] Within the model, an individual is born with a range of talents across all occupations, independent of their race or gender. As in McFadden (1974) and Eaton and Kortum (2002), the worker's idiosyncratic talent follows a multivariate Fréchet distribution.

Individuals choose their human capital investment and their occupation in an initial "pre-period" to maximize their intertemporal utility, given their talent and their group preferences, also referred to as social norms towards each occupation. They then work in their chosen market occupation or in the home sector for three working life-cycle periods (young, middle, and old). Their intertemporal utility depends positively on the consumption level at each period and negatively on their schooling time. Consumption in each period equals after-tax earnings net of expenditures on education, which in turn depend on the innate talent and the acquired human capital. The barriers faced by women and non-whites are modeled as taxes affecting all individuals in those groups: labor market discrimination represents a tax on earnings, while barriers to human capital attainment are modeled as an additional cost associated with human capital accumulation expenditures. Aggregate output in the economy is produced by a representative firm, which hires workers in each occupation to maximize profits net of the utility cost of discrimination.

This setup implies that if a given group faces higher barriers in a given occupation, only the most talented ones will enter that occupation. On the other hand, if the barriers faced are lower, this results in "lower-quality" workers entering these jobs and, hence, lower earnings. It turns out that with a Fréchet distribution of talent, this selection effect precisely offsets the direct tax effect on earnings, which implies that we should not observe any correlation between the two (consistent with the near-zero correlation observed in Figures 2.2a, 2.4a, 2.5, and 2.7a).

In equilibrium, the fraction of women working in a given occupation relative to men depends on their relative wage as well as the composite frictions faced by the group, τ. The relative share of women in the home sector, on the other hand, depends on their relative wage and their relative group preferences (social norms), $\tilde{z}$. This implies that data on wage gaps as well data on participation gaps between men and women at the occupational level allow us to recover both the composite frictions τ and the group preferences $\tilde{z}$.

The next step is to distinguish between barriers to human capital investment (τ^h), and labor market discrimination (τ^w).[12] We do this using the wage growth equation and taking the average across occupations and periods.[13] Recall that the model assumes that workers choose their human capital investments before they enter

9 It would be very interesting to have information on the numbers of men and women who work in fields different than those they studied. Unfortunately, with our data it is not possible to match an individual's field of study to their occupation.
10 Whether an individual is considered to be self-employed is based on her/his self-reported answer which may introduce some measurement error in our calculations.
11 See Appendix B2 for a more detailed description of the theoretical framework and the numerical simulation of Hsieh et al. (2019). We refer the reader to the original paper for more details.
12 In the model in Annex B2, barriers are modeled as taxes: labor market discrimination τ^w represents a tax on earnings and barriers to human capital attainment τ^h are modeled as an additional cost associated with human capital accumulation.
13 In order to minimize the impact of measurement error, in the results presented below we use the annual average across occupations to decompose τ^w from τ^h.

the labor market, and that this decision cannot then be reversed. Since we divide workers into young-, middle-, and old-age, any change in the wage gap over the life cycle is due to τ^w only and human capital discrimination is akin to a cohort effect while labor market discrimination should be interpreted as a time effect (since it is assumed that labor market discrimination affects all cohorts within a given time period).

To quantify the effects of decreasing the barriers faced by women or other groups, we first simulate the model with estimated values for τ^w and τ^h and then simulate the model when τ^w and τ^h are reduced or completely eliminated. We follow Hsieh et al. (2019) to choose the value of the model parameters and the exogenous variables, which are described in Tables A2.6 and A2.7 in Appendix C2.

2.3 The Case of Chile

Stylized Facts

Figure 2.2a shows the relationship between the occupational wage gap (defined as one minus the ratio of the women's average wage and the men's average wage) and the relative propensity to work in the occupation for the two groups (defined as the fraction of women working in a given occupation relative to the men's) for the initial year. Every blue dot represents one of the 50 occupation groups we clustered (49 market occupations plus the home sector for those not working). Focusing first on the horizontal axis, dots to the right of one represent occupations where the presence of women in that occupation is higher than that of men (i.e., women are overrepresented in those occupations), while the opposite occurs for dots to the left of one. Occupations such as Nursing, Secretaries, Social Scientists, and Personal Services are strongly female-dominated in Chile in 1992. For example, women are four times more likely to work in Personal Services such as babysitting, hairdresser, beauticians, etc. and 16 times less likely to work in Natural Sciences (Physicists, Chemists, Biologists, etc.). On the other hand, dots located above zero on the y-axis represent occupations where men have higher wages than women on average, while dots below zero represent occupations where women have higher wages than men. We can see that men have much higher salaries than women in most occupations, suggesting the presence of an important gender wage gap in the period of study.[14] Going back to our previous example, it is interesting to notice that although women in Personal Services and Natural Sciences appear far away on the horizontal axis, they are very close on the vertical axis, which means they have similar wage gaps.

We also observe that in Chile gender gaps are quite common in high-skill occupations, which we define as occupations that require a university degree. Out of the nine occupations that we considered high-skill[15], the relative propensity of women is above one in only one of them (Social Scientists). As we observe in Figure 2.2b, in Chile in 1992, 94% of Mathematicians and Computer Scientists, 84% of Architects and Engineers, and 79% of Natural Scientists were men. However, it is important for our analysis to note that these percentages have decreased significantly in recent years and in 2017 were 80%, 73%, and 57%, respectively.

14 Naturally, these are just raw data and one would need to control for many other wage determinants to prove this claim.
15 Managers, Management related, Architects and Engineers, Math and Computer Science, Natural Science, Doctors and Vets, Professors, Social Scientists, and Lawyers and Judges.

Figure 2.2 Gender Wage Gaps and Occupational Gaps in Chile

Figure 2.2a Wage Gaps Versus Propensities Across Occupations for Women in Chile in 1992

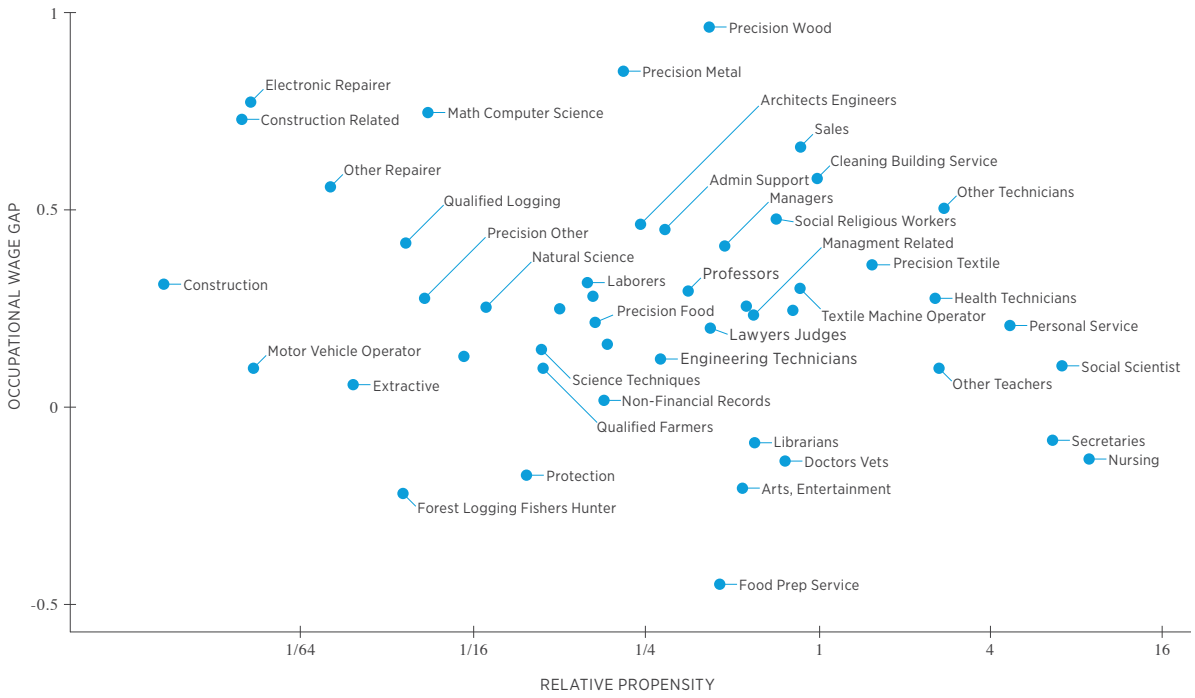
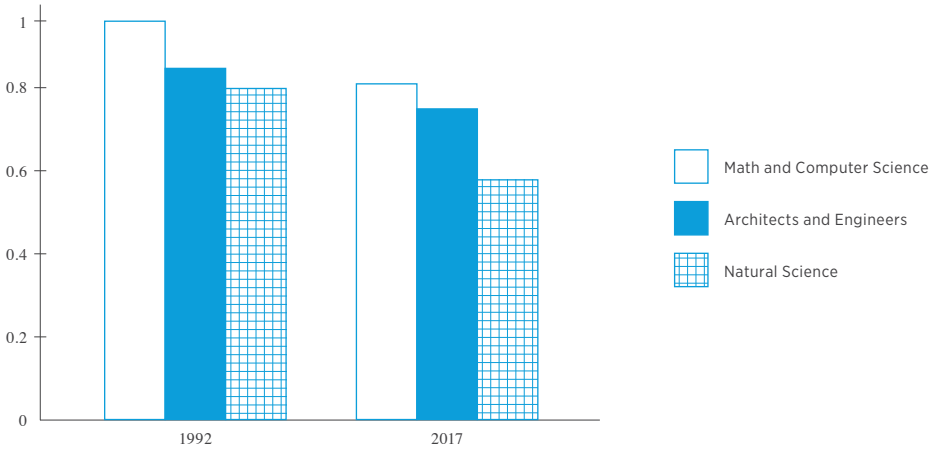


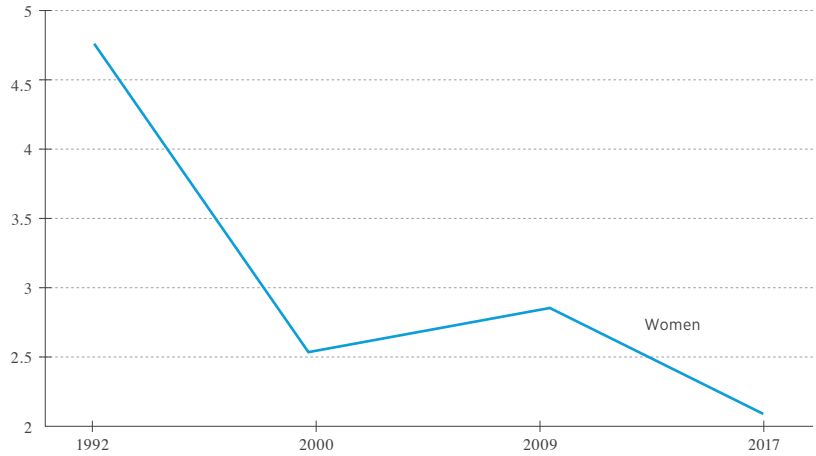
Figure 2.2b % Of Men in Selected High Skilled Occupations in Chile 1992-2017



Quantitative Results

As we can see in Figure 2.3, our theoretical framework finds that women in Chile faced important barriers in their labor market choices for the entire sample period, since the value of the composite occupational frictions τ is above one in all years. We can also see that in this country the value of τ is significantly lower than initially, and that most of the decline took place before the year 2000.

Figure 2.3 Chile – Earnings – Weighted Mean of Composite Frictions (τ) for Different Groups



Gains from the observed fall in τ. Our first numerical exercise consists of analyzing the aggregate gains in terms of total output associated with the actual decline in τ that took place during the sample period. The results of this exercise are shown in the in Table 2.5, where the output of the benchmark simulation is compared to a counterfactual one where the composite friction τ is held fixed at 1990s levels. Columns 1 and 2 show the output gain from the fall of τ^h and τ^w, while Column 3 shows their combined effect. Our calculations imply that the observed reduction in τ since 1992 resulted in an output gain of 8.6% in 2017. This is driven by the decline in labor market and human capital frictions, which allowed women to better exploit their comparative advantage and reduce misallocation in the economy. As we can see in the last column of Table 2.5, the change in the group preferences parameter $\tilde{z}$ also contributed positively to the output gains in 2009 and 2017.

Table 2.5 GDP Gains from Observed Fall in Gender Barriers – Chile (%)

	All Occupations			
Year	$\tau^h = \tau^h$ (1992) (1)	$\tau^w = \tau^h$ (1992) (2)	$\tau = \tau$ (1992) (3)	$\tau = \tau$ (1992) $\tilde{z} = \tilde{z}$ (1992) (4)
1992	0	0	0	0
2000	1.1	1.0	1.6	0.8
2009	2.8	2.3	4.3	4.7
2017	5.2	4.4	8.6	10.2

Gains from further decreasing τ. The rest of the numerical exercises examine the gains of further decreasing τ. For this exercise, we need to assume that, at least in some occupations, we can reduce the existing gaps beyond the values observed because they are not only due to differences in innate talent. We introduce three exercises that explore different alternatives on additional reductions to τ. The results of these exercises are shown in Table 2.6, where Columns 1 and 2 show the output gains of setting τ^h and τ^w to 0 individually, while column 3 shows the combined effect of setting them both to zero. In the case of Chile, we find that eliminating both τ variables results in an output gain of 24.3% in 1992 and 9.1% in 2017.

Our next numerical exercises, presented in Table 2.6, relax the assumption that all groups draw from the same distribution of talent in all occupations. In particular, in Columns 4-6, we consider the possibility that men have higher innate human capital in occupations that rely more on physical strength, the so-called brawny

occupations.[16] We go to the extreme case of assuming that the frictions faced by women in any of these occupations cannot decrease to levels below those observed in the last year. Columns 4 and 5 show the results of eliminating τ^h and τ^w individually in the 'non-brawny' occupations, while reducing them to their values at the end of the sample in brawny occupations. Column 6 shows their combined effect. As expected, we get lower but still sizable output gains: eliminating both τ variables results in an output gain of 10.3% in 1992 and 5.3% in 2017.[17]

Finally, in our last numerical exercise, we incorporate the idea that there may be innate gender differences in human capital in all low-skill occupations, not only in those that require physical strength. More specifically, we make the even more extreme assumption that frictions faced by women can only decrease further in high-skill occupations. As we can see in the last three columns of Table 2.6, the output gains of eliminating τ only in high-skill occupations, while decreasing them to their final value for the other occupations, results in an output gain of 9.4% in 1992 and 3.5% in 2017.

Table 2.6 GDP Gains of Decreasing Gender Barriers Further – Chile (%)

	All Occupations			"Non-brawny" occ.			"High-skilled" occ.		
Year	$\tau^h = 0$ (1)	$\tau^w = 0$ (2)	$\tau = 0$ (3)	$\tau^h = 0$ (4)	$\tau^w = 0$ (5)	$\tau = 0$ (6)	$\tau^h = 0$ (7)	$\tau^w = 0$ (8)	$\tau = 0$ (9)
1992	13.0	7.9	24.3	9.7	4.0	10.3	9.2	3.6	9.4
2000	9.5	5.5	15.7	8.2	4.3	11.2	7.5	3.7	9.5
2009	6.8	3.7	11.1	5.1	2.2	6.7	4.4	1.6	5.2
2017	4.8	3.3	9.1	3.2	1.5	5.3	2.4	0.8	3.5

2.4 The Case of Brazil

Stylized Facts

In the case of the Brazilian labor market in our first year of study (1990), we also find important differences across men and women in terms of occupations and wage gaps. In Figure 2.4a, every dot represents one of the 49 occupation groups in Brazil. We can see that occupations such as Nursing, Secretaries, and Teachers are strongly female-dominated since they are located furthest to the right of the Relative Propensity axis (the x-axis). For example, women in Brazil in 1990 are more than 16 times more likely to work as Secretaries than men. Although most high-skill occupations are located to the left of the one in the x-axis, indicating a more prominent presence of men than women in those occupations, they are not as male-dominated as some brawny occupations such as Construction and Extraction.

When analyzing gender gaps in high-skill occupations, we can see in Figure 2.4b that in Brazil in 1992 men accounted for 88% of Architects and Engineers, 78% of Mathematicians and Computer Scientists, and 68% of Managers. However, those percentages decreased significantly in the last 28 years to 73% and 58% in the case of Architects and Engineers and Managers respectively. In the case of Mathematicians and Computer Scientists there were no significant changes.

16 In footnote 35, Klenow et al. (2019) state *"Rendall (2017) classified occupations based on the importance of physical strength, and we define brawny occupations for our analysis as those occupations in the top half of her brawny distribution."* We follow this jargon here. A good example of a brawny occupation in our paper is Construction.
17 We keep the negatives values obtained for τ^h and τ^w in some occupations instead of setting them to zero, since they may be an indicator of higher human capital initial endowment.

Figure 2.4 Gender Wage Gaps and Occupational Gaps in Brazil

Figure 2.4a Wage Gaps Versus Propensities Across Occupations for Women in Brazil in 1990

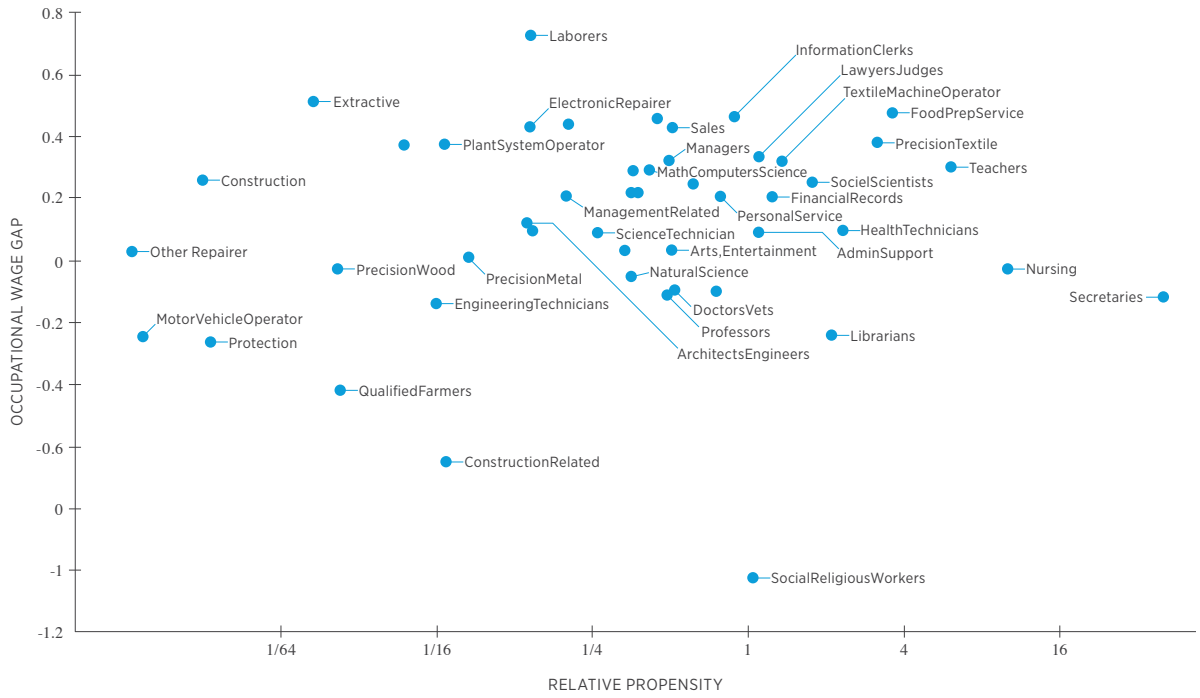
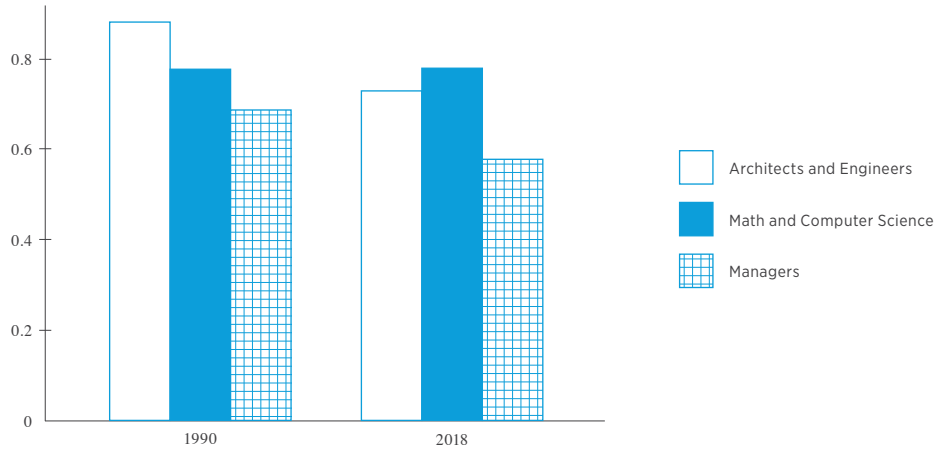


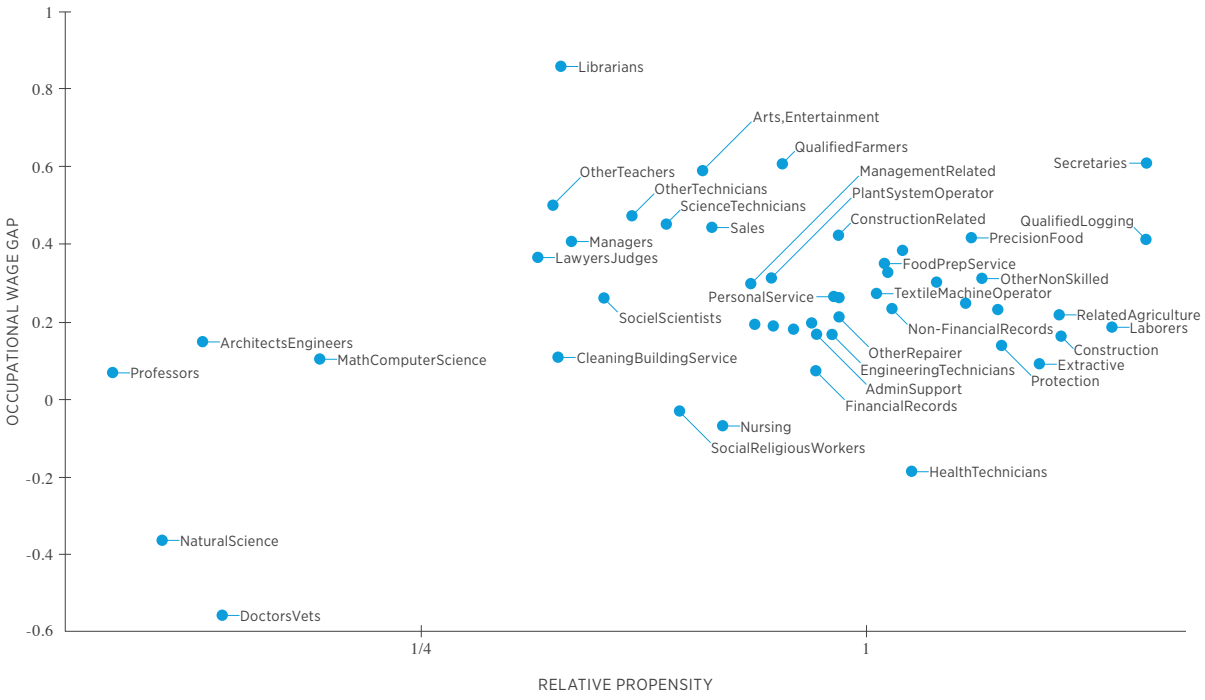
Figure 2.4b % Of Men in Selected High Skilled Occupations in Brazil 1990 – 2018



In terms of ethnic/racial gaps, we also find evidence that there are important differences in wages and relative propensities between non-white and white men in Brazil. Figure 2.5 displays the wage gaps between non-white men and white men (defined as one minus the ratio of average wages for non-white men over average wage for white men). These ratios suggest that in 1990 white men had higher salaries than non-white men for most occupations in Brazil. Figure 2.5 also shows the probability that a non-white man in Brazil works in a given sector relative to a white man's probability of working in that sector. In 1990, we can see that this ratio

was higher than that for low-skill occupations. We also observe that most of the high-skill occupations show the lowest values (occupations are furthest to the left on the x-axis of Figure 2.5), confirming that non-white men are underrepresented in these jobs relative to white men.

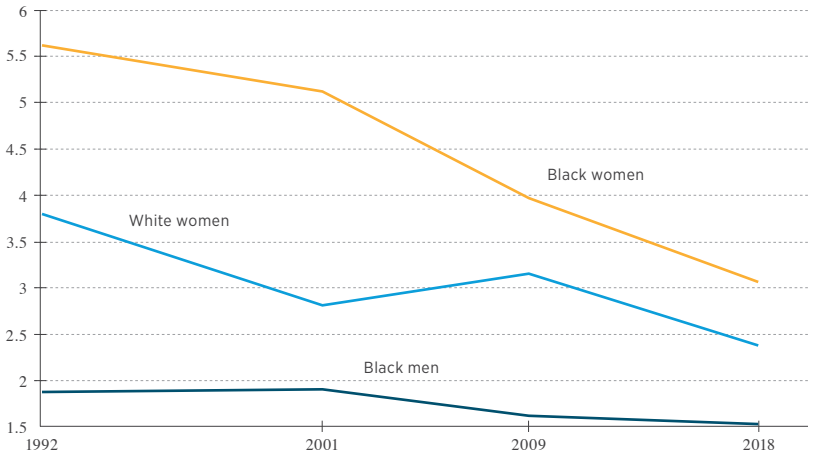
Figure 2.5 Wage Gaps Versus Propensities Across Occupations for Non-white Men in Brazil in 1990



Quantitative Results

In the case of Brazil, Figure 2.6 shows that barriers appear to be more significant for women (both white and non-white) than for non-white men. The decline of composite occupational frictions τ appears to be homogeneous across years.

Figure 2.6 Brazil - Earnings-Weighted Mean of Composite Frictions (τ) for Different Groups.



Gains from the observed fall in τ. Our first exercise consists of analyzing what are the aggregate gains of the decline of ethnic and gender barriers (τ) that already took place. We can see in Table 2.7 that having reduced labor market and human capital frictions since 1990 implies a 7.9% increase in output in 2018. In this case, human capital barriers are the most relevant ones. Again, the combined effect of τ and $\tilde{z}$ (occupational preferences/social norms) accounted for a larger output gain in 2009 and 2018 than the τ alone. Hence, these changes in norms and preferences have contributed positively to output gains.

Table 2.7 GDP Gains from Observed Fall in Gender & Ethnic Barriers - Brazil (%)

	All Occupations			
Year	$\tau^h = \tau^h$ (1992) (1)	$\tau^w = \tau^h$ (1992) (2)	$\tau = \tau$ (1992) (3)	$\tau = \tau$ (1992) $\tilde{z} = \tilde{z}$ (1992) (4)
1990	0	0	0	0
2001	1.0	0.1	0.9	0.9
2009	2.3	0.8	2.7	5.5
2018	7.0	1.7	7.9	11.0

Gains from further decreasing τ. The following numerical exercises study the gains of further reducing τ. In the case of Brazil, the third column of Table 2.8 shows that eliminating both τ variables results in an output gain of 29.9% in 1990 and 30.4% in 2018.[18]

In the next numerical exercise (columns 4 - 6) we find that eliminating τ only in non-brawny occupations gives lower output gains than those in the previous exercise. However, these gains are still very relevant: eliminating both τ variables results in an increase in output of 22.7% in 1990 and 24.4% in 2018.

The last three columns show the increases in output associated with eliminating τ only in high-skill occupations, while decreasing them to their final value for the other occupations. We can see that we still find substantial output gains when focusing on these few occupations. Eliminating both τ variables results in an output gain of 18.9% in 1992 and of 18.5% in 2017.

Table 2.8 GDP Gains of Decreasing Gender & Ethnic Barriers Further - Brazil (%)

	All Occupations			"Non-brawny" occ.			"High-skilled" occ.		
Year	$\tau^h = 0$ (1)	$\tau^w = 0$ (2)	$\tau = 0$ (3)	$\tau^h = 0$ (4)	$\tau^w = 0$ (5)	$\tau = 0$ (6)	$\tau^h = 0$ (7)	$\tau^w = 0$ (8)	$\tau = 0$ (9)
1990	25.9	1.2	29.9	20.1	1.3	22.7	16.5	1.2	18.9
2001	31.7	2.2	37.3	24.9	2.1	29.3	20.3	1.8	24.2
2009	26.7	1.1	31.0	22.1	1.2	25.6	17.6	0.7	18.5
2018	25.9	1.2	30.4	20.9	1.1	24.4	15.5	0.7	18.5

18 Since we do not have the previous year's data, the results for the first year (in this case 1990) are a lower bound for the potential gains.

2.5 The Case of Uruguay

Stylized Facts

As we can see in Figure 2.7a, in the year 2000, the Uruguayan labor market also shows interesting features to be analyzed. When focusing on the horizontal axis, we can see that most occupations are to the left of one, but some are to the right. The occupations where the presence of women is higher than that of men, the female-dominated occupations, in this case are Professors and Teachers, and Secretaries.

In terms of wage differences, we can also see in Figure 2.7a that most of the dots are located above zero on the vertical axis, representing those occupations where average wages for men are higher than average wages for women. This figure suggests that gender wage gaps were still significant in Uruguay in the year 2000.

Nevertheless, it is also the case that male-dominated high-skill occupations have shown a significant decline in the percentage of men. More specifically, as can be seen in Figure 2.7b, in Uruguay in 2000, 100% of Mathematicians and Computer Scientists, 73% of Natural Scientists, and 68% of Architects and Engineers were men. However, in 2018 those percentages were reduced to 82%, 61%, and 58% respectively.

Figure 2.7 Gender Wage Gaps and Occupational Gaps in Uruguay

Figure 2.7a Wage Gaps Versus Propensities Across Occupations for Women in Uruguay in 2000

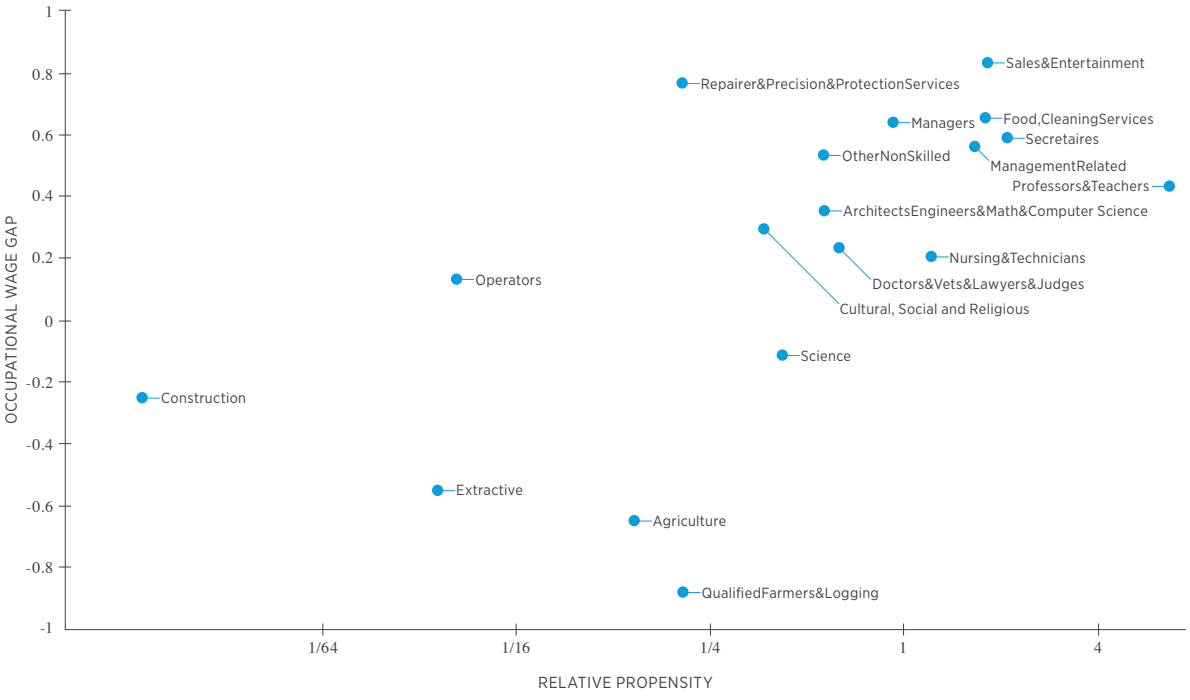
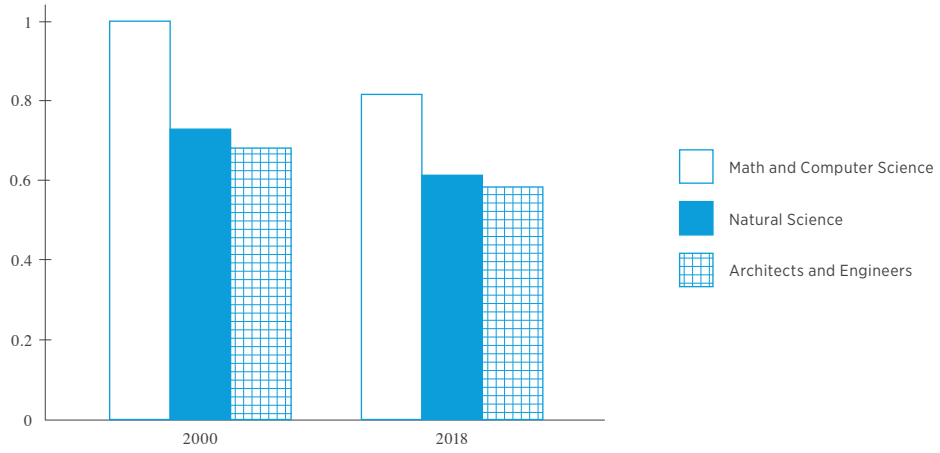


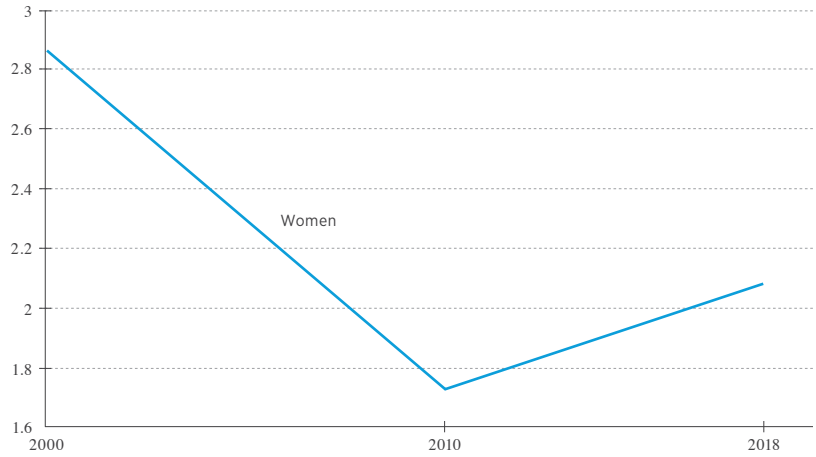
Figure 2.7b % Of Men in Selected High Skilled Occupations in Uruguay 2000 – 2018



Quantitative Results

For the case of Uruguay, composite frictions do not exhibit an important decline from 2000 to 2018. As can be seen in Figure 2.8, there is a significant decline in composite frictions between 2000 and 2010 but there is then a small rise between 2010 and 2018.

Figure 2.8 Uruguay - Earnings-Weighted Mean of Composite Frictions (τ) for Different Groups.



Gains from the observed fall in τ. In the case of Uruguay, we can see in Table 2.9 that the reduction in the labor market and human capital frictions (τ) since 2000 translated into an output gain of 4.1% in 2018.[19] Human capital barriers are the most relevant, together with $\tilde{z}$ (occupational preferences/social norms). Therefore, we conclude that changes in occupational preferences and norms have contributed positively to output gains.

19 Recall that for this country we are not able to include the 1990s.

Table 2.9 GDP Gains from Observed Fall in Gender Barriers - Uruguay (%)

	All Occupations			
Year	$\tau^h = \tau^h$ (2000) (1)	$\tau^w = \tau^h$ (2000) (2)	$\tau = \tau$ (2000) (3)	$\tau = \tau$ (2000) $\tilde{z} = \tilde{z}$ (2000) (4)
2000	0	0	0	0
2010	1.3	0.5	1.3	3.4
2018	4.2	0.7	4.1	10.3

Gains from further decreasing τ. The following numerical exercises examine the gains of further decreasing τ in Table 2.10. In the case of Uruguay, we find that τ^w and τ^h take negative values for some occupations in some years. When we perform this counterfactual, we set τ^w and τ^h to zero for occupations in which we find a positive value for all years, and we use the lowest one for occupations in which they are negative for some years. We find that eliminating both τ variables results in an output gain of 18.5% in 2000 and 16.5% in 2018.

Column 6 shows the effects of the second exercise. Again, we observe important increases in output and, as expected, these gains are lower than those in the first exercise. Eliminating both τ^w and τ^h results in an output gain of 15.5% in 2000 and 11.8% in 2018.

When focusing on the output gains of eliminating the τ variables in high-skill occupations, while decreasing them to their final value for the other occupations, we observe that eliminating both τ variables results in an output gain of 14.9% in 2000 and 10.8% in 2018.

Table 2.10 GDP Gains of Decreasing Gender Barriers Further - Uruguay (%)

	All Occupations			"Non-brawny" occ.			"High-skilled" occ.		
Year	$\tau^h = 0$ (1)	$\tau^w = 0$ (2)	$\tau = 0$ (3)	$\tau^h = 0$ (4)	$\tau^w = 0$ (5)	$\tau = 0$ (6)	$\tau^h = 0$ (7)	$\tau^w = 0$ (8)	$\tau = 0$ (9)
2000	17.3	1.3	18.5	15.9	0.7	15.5	15.7	0.1	14.9
2010	20.0	1.6	24.1	16.6	0.2	16.2	15.8	-0.3	14.8
2018	14.0	1.6	16.5	11.4	0.7	11.8	11.1	0.0	10.8

2.6 The Case of Paraguay

Stylized Facts

In Figure 2.9a we analyze the gender wage gaps and the relative propensity to work in each occupation in Paraguay in the year 2000. We can see that there are some occupations such as Teachers, Secretaries, and Natural and Social Scientists that are notoriously female-dominated since they are those located furthest to the right of the Relative Propensity axis (the x-axis). Remember that occupations are classified differently in Paraguay due to the number of observations. While the Natural Scientist group appeared very male-dominated in Chile and Brazil, it is more female-dominated here where it is combined with Social Scientists. On the other hand, some brawny occupations such as Operators and Agriculture, Construction and Extraction are located furthest to the left, indicating a more prominent presence of men than women in those occupations. Moreover, we can also observe that most of the occupations in Figure 2.9a are located above zero in the y-axis, suggesting an important gender wage gap in the year 2000.

In terms of gender gaps in high-skill occupations, we can see in Figure 2.9b that in Paraguay in 2000 men accounted for 87% of Mathematicians and Computer Scientists; 67% of Architects and Engineers; and 67% of Lawyers and Judges. However, in 2017 (the last year of our analysis), those percentages were reduced to 80%, 52%, and 54% respectively.

Figure 2.9 Gender Wage Gaps and Occupational Gaps in Paraguay

Figure 2.9a Wage Gaps Versus Propensities Across Occupations for Women in Paraguay in 2000

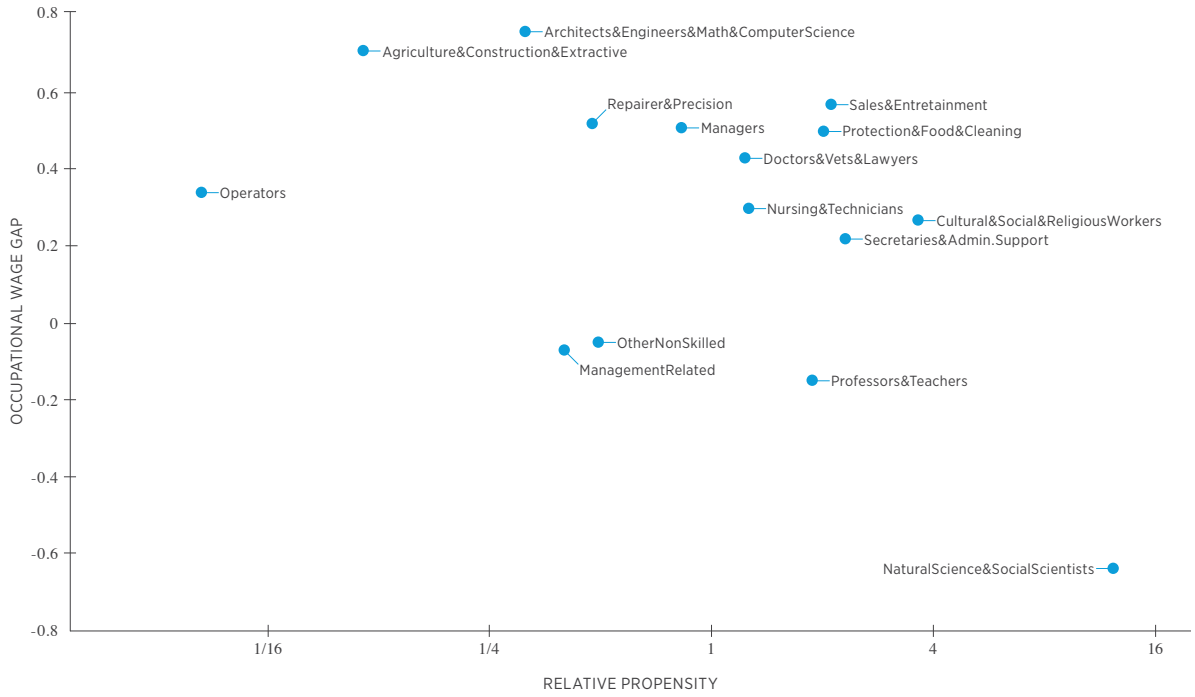
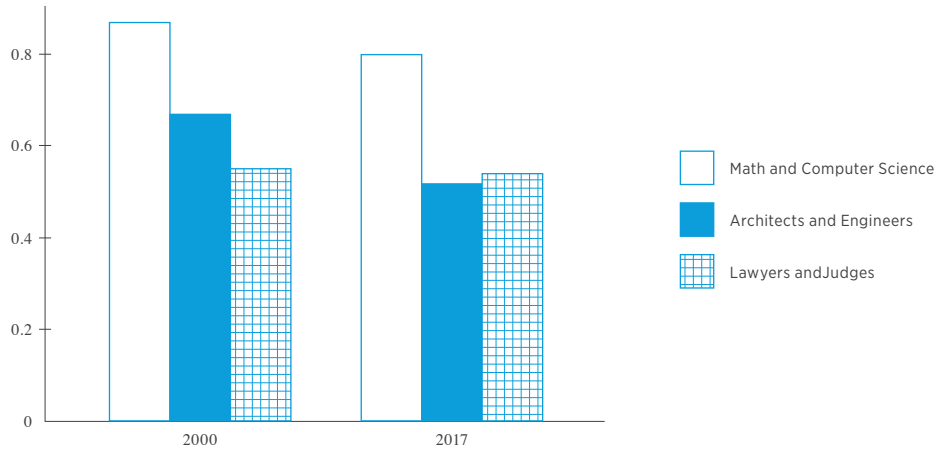


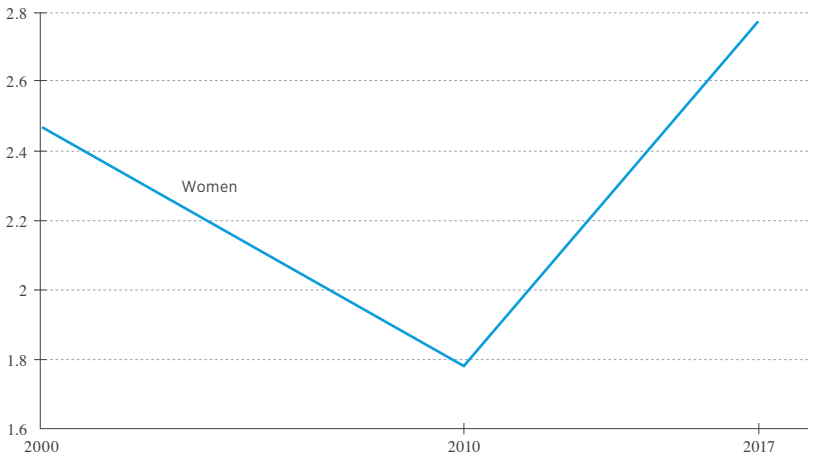
Figure 2.9b % Of Men in Selected High Skilled Occupations in Paraguay 2000 – 2018



Quantitative Results

In the case of Paraguay, the composite occupational frictions do not exhibit a decline in the period 2000-2018, as we see in Figure 2.10. We observe a fall in the first decade but, surprisingly, the frictions rise significantly in the second decade and surpass the initial level.

Figure 2.10 Uruguay - Earnings-Weighted Mean of Composite Frictions (τ) for Different Groups.



Gains from the observed fall in τ. Given the lower number of observations available for Paraguay, we focus on the first counterfactual exercise. The results are shown in Table 2.11, Columns 1 and 2, where the output of the benchmark simulation is compared to a counterfactual with τ held fixed at their 2000 levels. We find that the reduction in τ variables since 2000 implies an output gain of 1.7% in 2018, while the combined effect of τ and $\tilde{z}$ accounted for a larger output gain of 9.6% in 2018.

Table 2.11 GDP Gains from Fall in Gender Barriers - Paraguay (%)

	All Occupations		
Year	$\tau = \tau$ (2000) (1)	$\tau = \tau$ (2000) $\tilde{z} = \tilde{z}$ (2000) (2)	$\tau = 0$ (3)
2000	0	0	7.3
2010	0.5	2.0	5.2
2018	1.7	9.6	4.3

Gains from further decreasing τ. Column 3 of Table 2.11 shows the effect on output of further reducing τ in occupations where it is positive. We can see that this results in an output gain of 7.3% in 2000 and 4.3% in 2017 when taking into account all occupations.

2.7 Conclusion

In this project we present evidence that that there are significant gender and racial/ethnic gaps both in earnings and labor market participation at the occupational level in Southern Cone countries. We use the framework proposed by Hsieh et al. (2019) to infer the occupational barriers faced by each group, and to compute the gains in aggregate output associated with removing these barriers. The model is flexible enough to account for three types of friction: barriers such as employer discrimination, barriers to the accumulation of human capital, and group preferences or social norms.

Intuitively, when a group faces a large barrier to work in a given occupation, talent is not efficiently allocated because less talented workers from other groups end up working in that job. When barriers are eliminated for all groups and these groups have the same occupational preferences, aggregate efficiency and total output are maximized because each worker is allocated according to their comparative advantage.

We find that the observed changes in occupational barriers and preferences of women imply an output gain of around 10% in the cases of Chile, Paraguay, and Uruguay, while the observed changes in occupational barriers and preferences of women and non-whites imply and output gain of 11% in the case of Brazil. Moreover, if all the occupational barriers faced by women were eliminated, output would further rise between 9% and 24% in Chile, between 16.5% and 24% in Uruguay, and between 4% and 7% in Paraguay. In Brazil, if all the occupational barriers faced by women and non-whites were eliminated, output would further rise by around 30%. When taking into account that some occupational gaps may be due to innate differences in productivity and only eliminating the barriers in the other occupations, our predicted gains decrease but remain significant in all countries.

Our results suggest quite important aggregate effects of barriers to occupational choices on the economy as a whole. A natural policy implication of these results is therefore to implement policies that facilitate the incorporation of women in the labor market in general, and in high-skill occupations in particular. This could be done directly by imposing penalties to firms that discriminate against women or more indirectly by reducing gender gaps in education at early ages so that there are fewer differences between men and women when they enter the labor market. Finally, given the growing importance of high-skill occupations, it seems that an emphasis on education in STEM (Science, Technology, Engineering, and Math) may be particularly helpful.

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VIEW APPENDIX ONLINE

A Multi-Dimensional Approach to Gender Gaps in Financial Literacy in Argentina, Chile, and Paraguay

José Espinoza-Delgado* and Jacques Silber**

This chapter takes a multi-dimensional approach to the measurement of financial literacy. Rather than focusing only on financial knowledge, it also takes into account financial behavior and attitude. Data for Argentina, Chile, and Paraguay are analyzed using a survey that captures the three components of literacy to identify gender differences in financial literacy. We find small but significant gender differences in all three countries. The econometric analysis examines the impact of a variety of socio-economic indicators on financial literacy, finding that the gap persists even after controlling for demographic and economic characteristics. While factors such as income, income stability, and education seem to have the strongest effect on financial literacy, there are other influencing characteristics (e.g., age, marital status, employment status, stability of household income, who is making financial decisions in the household) that vary across genders and countries. A traditional Blinder-Oaxaca decomposition indicated, however, that the respective role played by the explained and unexplained effects varied by country. ¶

3.1 Introduction

Gender equality has been the subject of many public policy debates. It is at the center of the Sustainable Development Goals, with Goal 5 calling for "achieving gender equality as well as empowering all women and girls" (UN, 2015).

After decades of seemingly continuous advance in lessening gender inequality, "since about 2000, there has been an unexpected stagnation and regress in many dimensions of gender inequality" in developing as well as developed countries (Klasen 2020). As a result, gender differences continue to exist in many domains, including labor force participation rates and occupational distribution (Borrowman and Klasen, 2019; Klasen, 2019, 2020; Sparreboom, 2014); school enrollment rates and adult literacy rates (Goldin, 2006); mortality and life expectancy at birth (Klasen and Wink, 2002, 2003; Sen, 1998); care burdens, domestic responsibilities, and expenditures within the household (Anxo et al., 2011; Kabeer, 2004, 2005; Knudsen and Wærness, 2008; Thomas, 1993); access to assets and credit (Doss, 2013); the extent of food security (Johnston et al., 2015); and vulnerability to poverty (Klasen, Lechtenfeld, and Povel, 2015).

One aspect of gender inequality concerns the issue of financial literacy, a topic that has become more popular in recent years, particularly in the wake of the global financial crisis (Lusardi and Mitchell, 2014; Mitchell, 2017). Atkinson and Messy (2011) define financial literacy as "a combination of awareness, knowledge, skill, attitude, and behavior to make sound financial decisions and ultimately achieve individual financial well-being". Studies dealing with the determinants of financial literacy have shown that it is positively related to income (see, e.g., Klapper, Lusardi, and Panos, 2012), and education (see, e.g., Calvet, Campbell, and Sodini, 2009).

Moreover, the literature shows that there are negative impacts to having lower skills in financial literacy. It appears that financial literacy and financial management skills are correlated (Jappeli and Padula, 2013), and that people who are less financially literate use more costly forms of borrowing (Lusardi and Scheresberg,

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2013), have a smaller consumption growth (Jappelli and Padula, 2017), tend to use informal sources of borrowing (Klapper, Lusardi, and Panos, 2012), plan their retirement less well (Boisclair, Lusardi, and Michaud, 2017; Mitchell, 2017), are less likely to invest in stocks (Arrondel, Debbich, and Savignac, 2012), and get a lower return on their investments when they participate in financial markets (Chu, Wang, Xiao, and Zhang, 2017; Clark et al., 2017). This means there are significant economic gains to be realized by increasing financial literacy.

In this context, it is important to understand the causes of financial literacy differences. Fonseca et al. (2012) examine potential explanations for the gender gap in financial literacy, including the role of marriage and who within a couple makes the financial decisions. Implementing a Blinder–Oaxaca decomposition, they conclude that most of the gender gap in financial literacy is not due to differences in the characteristics of men and women but to differences in the regression coefficients. In other words, it is how literacy is produced which matters. The authors add that the financial decision-making of couples is not centralized in one spouse, but it is certainly related to the relative educational level of spouses. To further examine the underlying causes of the gender gap in financial literacy, Robson and Peetz (2020) explore the explanatory value of psychological characteristics, in addition to demographic variables and roles in household financial decision-making. They conclude that gender is not a significant predictor on three scales of financial capability. After a decomposition analysis, they also find that underlying differences in individual characteristics explain most of the observed gender gap in financial literacy when psychological traits are taken into account.

Furthermore, analyzing the results of a 2014 survey conducted in Bolivia, Colombia, Ecuador, and Peru, Mejía, Pallota, and Egúsquiza (2015) concluded that financial capacities were lower among people with limited levels of education, inactive or unemployed individuals, residents in rural areas, people belonging to the lowest socioeconomic sectors, women, and youth (see also, Mejía Anzola and Guzmán, 2016).

In recent decades there has been much emphasis on the importance of financial inclusion as a key factor in countries' development in Latin America and the Caribbean (Roa and Mejía, 2018). Moreover, given the increasing complexity of the financial products and services that are available, financial knowledge, attitudes, and behavior are likely to have a major impact on the wealth of households and their standards of living.

In 2013, CAF, the Development Bank of Latin America, conducted a survey to measure financial capabilities in Bolivia, Colombia, Ecuador, and Peru. An analysis of the results of these surveys led to the following conclusions. First, strategies should be adapted to the subpopulation concerned, and particular attention should be given to individuals with low levels of education, low or irregular income, young individuals, women, people living in rural areas, old people, and those who are not able to save. Second, the ability to save has an important impact on an individual's financial capabilities, so financial inclusion and education programs should not only focus on knowledge, but also on changing attitudes towards the importance of saving. Third, women who are heads of household have better financial attitudes and behaviors. Finally, beneficiaries of social programs should receive training on basic financial concepts and the importance of saving. These findings confirm the importance of helping to create better financial understanding and behavior.

Finally, Azar, Lara and Mejía (2018), in a study of the financial inclusion of women in Latin America, stress the fact that financial inclusion is an important factor for the economic empowerment and autonomy of women, insofar as it allows them to expand their productive capacities and their personal development, as well as that of their family. However, there is evidence of gender gaps in terms of access, knowledge, and use of the products and services offered by the financial sector. Hence the importance of financial education for decision-making as well as for gender differences in terms of knowledge, skills, attitudes, and financial behaviors. This indicates that addressing the gender gap in financial literacy has the potential to improve gender equality more broadly.

The literature reviewed here indicates that gender gaps in financial literacy exist, and that they have negative effects for both individuals and economies as a whole. This chapter moves beyond previous work on the topic by proposing a more comprehensive view of the issue. We adopt a multi-dimensional approach, defining variables that aggregate numerous aspects of financial literacy and inclusion. We first adopt the approach of Lusardi and Mitchell (2014) and focus only on financial knowledge, looking at the answers given to five survey questions on the topic. Then, we take a more general view that considers not only financial

knowledge but also financial behavior and attitude. More precisely, we take into account the answers given to 27 questions. We also take a separate look at the three domains of financial literacy, presenting results of an econometric analysis that allows a greater understanding of the causes of the gender gap, to provide insights that could inform future policy.

We concluded that of the three Southern Cone countries we examined, Chile has the highest, and Paraguay the lowest, level of financial literacy, Argentina being in the middle. There were statistically significant gender differences in all three countries, but they were small in relative terms (less than 10%). The econometric analysis confirmed that gender differences were significant, with women being less financially literate. A traditional Blinder-Oaxaca decomposition indicated that in Chile, almost two-thirds of the observed gender difference in financial literacy was due to differences in the observable characteristics taken into account. On the contrary, in Argentina, 85% of the gender gap in financial literacy was related to differences in the coefficients of the explanatory variables. In Paraguay, neither the explained nor the unexplained parts of the gender gap were statistically significant at 5%.

3.2 Methodology

Data Sources[1]

Our empirical analysis was based on financial literacy surveys conducted in three Southern Cone countries: Argentina (2017), Chile (2016), and Paraguay (2016).[2] The survey questionnaires included 27 questions: 8 on financial behavior, 10 on financial attitude, and 9 on financial knowledge. There were also questions on the socioeconomic characteristics of the respondents (e.g., age, gender, education, employment status, and income).[3]

The questions on financial behavior investigated whether individuals planned their expenses and were saving; what financial products they had; how financial products were selected; and what financial operations (e.g., credit/debit card use, internet payment, etc.) were undertaken during the last two years. The questions on financial attitude asked the individuals whether they were careful when buying, cared about the future, preferred spending to saving, were paying on time, took risks, and monitored their assets. Finally, the questions on financial knowledge asked the individuals whether they thought they had better financial knowledge than others, and if they understood the impact of interest on deposits; the relation between returns and risks; the meaning of inflation; and the notion of diversification (see Appendix A3 for more details).

The Approach

As mentioned above, we took a multi-dimensional approach to data analysis. Our study includes four components: a descriptive analysis of financial knowledge, an overall assessment of financial literacy, an econometric analysis to estimate the gender gap in financial literacy, and a decomposition to assess the causes of this gap.

For each question in the survey, the individual can give either a correct or a wrong answer. Let a_{hk} be a binary variable, equal to 1 if individual h gives a correct answer to question k, and to 0 otherwise.

In the empirical section of this chapter, we gave the same weight to all the questions. We first take a look at the whole set of questions and then we examine the three parts of the questionnaire separately. As a simple illustration, below is the formulation for the case in which we examine the whole questionnaire and give the same weight to each question.

1 The datasets used in our analyses are publicly available at https://scioteca.caf.com/handle/123456789/1086.
2 As an example, see Appendix A3 for the list of questions asked in the survey conducted in Argentina.
3 The surveys weights were included in the datasets and were computed by the company that was in charge of data collection (IPSOS). In each country, the survey weights were estimated considering "the actual distribution of region, sex and age".

If, as a whole, there are K questions, the proportion of questions to which the individual h gives a correct answer will be expressed as

(3.1) $$a_h = \left(\frac{1}{K}\right) \sum_{k=1}^{K} a_{hk}$$

If T refers to the total number of individuals participating in the survey, the proportion of individuals with a correct answer to question k will be

(3.2) $$\bar{a}_k = (1/T) \sum_{h=1}^{T} a_{hk}$$

If we now consider the whole questionnaire, the proportion $\bar{a}$ of correct answers will be

(3.3) $$\bar{a} = \left(\frac{1}{T}\right)\left(\frac{1}{K}\right) \sum_{h=1}^{T} \sum_{k=1}^{K} a_{hk} = \left(\frac{1}{K}\right) \sum_{k=1}^{K} \left[\left(\frac{1}{T}\right) \sum_{h=1}^{T} a_{hk}\right] = \left(\frac{1}{K}\right) \sum_{k=1}^{K} \bar{a}_k = \left(\frac{1}{T}\right) \sum_{h=1}^{T} \left[\left(\frac{1}{K}\right) \sum_{k=1}^{K} a_{hk}\right] = \left(\frac{1}{T}\right) \sum_{h=1}^{T} a_h$$

Given that we gave equal weight to each question and that there are 27 questions, each question has a weight of 1/27.

In our econometric analysis, we focus on trying to understand the gender gaps by exploring the determinants of financial literacy. For this analysis, the dependent variable is the number of questions to which an individual gave a correct answer while the explanatory variables are various socioeconomic characteristics. The choice of these variables was based on the literature on financial inclusion and human capital.

We used ordinary least squared (OLS) models, overall and separately for each gender, for the three countries as a whole (pooled regressions), and each of them individually. In the regressions which include men and women, we added a dummy variable equal to 1 for women. In all regressions, there is also a set of covariates that the literature on financial literacy has shown to be theoretically and empirically important and that could explain gender differences in this domain (Cupák et al., 2018; Bucher-Koenen et al., 2017; Fonseca et al., 2012; Karakurum-Ozdemir et al., 2019; Preston & Wright, 2019; Lusardi & Mitchell, 2011).

We included as covariates the following demographic characteristics: age and the square of age; area of residence (a dummy variable equal to 1 for rural areas); and information on the marital status and number of dependent children (three dummy variables corresponding respectively to those married with children, married without children, and divorced with children). We also included socioeconomic explanatory variables: the highest level of education achieved (primary, secondary, tertiary, and university levels of education), the current labor market status (employed full-time, employed part-time, and retired), variables related to the individual's income level (a dummy variable equal to 1 if the individual has a relatively lower income[4]), and the household's income stability.

We also included two additional covariates. The first one accounts for who is responsible for the day-to-day money management decisions (two dummy variables where the decision-maker is the individual's partner and when it is someone else). The second covariate was introduced in the pooled regressions and controls for the individual's country of residence, using Argentina as the base country. Note that our regressions consider variables such as gender, age, marital status, and education, which have been typically included in wage equations modeled within a human capital framework. In other words, we consider that

4 Individuals are considered to have a relatively lower income if their income is below the median of the income distribution; in our analysis, we have also included individuals who did not provide information on their income (those under the category "No response"), so here we are somewhat overestimating this variable.

"financial literacy is a form of human capital" (see, Preston & Write, 2019, p. 5). The list of explanatory variables we included also took into account the literature on the determinants of financial inclusion in developing countries (Zins & Weill, 2016).

Finally, for our decomposition analysis, we implemented the method developed by Blinder (1973) and Oaxaca (1973), and generalized by Neumark (1988) and Oaxaca and Ransom (1988, 1994), which allowed us to decompose the number of correct answers in each country into a part explained by differences in observed characteristics and a part attributable to differences in the estimated coefficients (Sinning, Hahn, and Bauer, 2008).

3.3 Results

The Descriptive Analysis

Implementing the Lusardi and Mitchell Approach

This was the first stage of our analysis, given that these two authors pioneered the study of financial knowledge and many studies have followed their approach. We used the following questions (see Tables B3.1 to B3.3 in Appendix B3 for the percentage of correct answers given to each question, for the sample as a whole, and separately for men and women):

- **Question 23 (Q23):** "Suppose you deposit $100,000 in a savings account with an interest rate of 2 percent per year. You make no other payments to this account and do not withdraw any money. How much would be in the account at the end of the first year, after interest payments are made?"

- **Question 24 (Q24):** "And at the same 2% interest rate, how much money would be in the account after five years? (Not including fees and taxes). It would be: More than $110,000 (1); Exactly $110,000 (2); Less than $110,000 (3); It is impossible to know from the information given (4)."

- **Question 25 (Q25):** "I would like to know if you think the following statement is true or false: An investment with a high return is likely to be high risk."

- **Question 26 (Q26):** "I would like to know if you think the following statement is true or false: High inflation means the cost of living is rising rapidly."

- **Question 27 (Q27):** "You are less likely to lose all your money if you invest it in more than one place."

Table 3.1 gives the percentage of individuals who gave a correct answer to each of these questions. We observe that the two questions on interest rate have the lowest percentage of correct answers, regardless of the country. In Argentina, the question with the highest percentage of correct answers is Question 26 (definition of inflation) with 91% correct answers. In Chile, it is Question 25 (correlation between return and risk) also with 91% correct answers, while in Paraguay it is question 26 with only 72% correct answers. In general, men obtain better results than women, but this gender difference is significant in only 7 out of the 15 results we have. It is interesting to note that in Chile women do significantly better on the question on diversification of risk (Q27) Apparently, they know better than men that you should not 'put all your eggs in one basket'.

Table 3.1 Financial Knowledge: Proportion (Mean) of Individuals Who Have Given a Correct Answer to Questions 23 to 27, and Gender Differences (female mean – male mean)

ARGENTINA								
Question	All Mean	SE	Men Mean	SE	Women Mean	SE	Gender Abs.	Difference Rel.
Q23 (interest after one year)	0.224	0.012	0.270	0.018	0.176	0.016	-0.094***	0.65
Q24 (interest after five years)	0.369	0.014	0.387	0.020	0.349	0.019	-0.037	0.90
Q25 (correlation risk-return)	0.677	0.013	0.714	0.018	0.640	0.020	-0.074**	0.90
Q26 (definition high inflation)	0.912	0.008	0.915	0.011	0.908	0.012	-0.007	0.99
Q27 (notion of diversification)	0.595	0.014	0.605	0.020	0.584	0.020	-0.021	0.96
CHILE								
Question	All Mean	SE	Men Mean	SE	Women Mean	SE	Gender Abs.	Difference Rel.
Q23 (interest after one year)	0.188	0.011	0.246	0.018	0.131	0.014	-0.115***	0.53
Q24 (interest after five years)	0.495	0.014	0.522	0.020	0.470	0.020	-0.052	0.90
Q25 (correlation risk-return)	0.911	0.008	0.917	0.011	0.905	0.012	-0.013	0.99
Q26 (definition high inflation)	0.895	0.009	0.899	0.012	0.892	0.012	-0.007	0.99
Q27 (notion of diversification)	0.661	0.014	0.628	0.020	0.692	0.018	0.064*	1.10
PARAGUAY								
Question	All Mean	SE	Men Mean	SE	Women Mean	SE	Gender Abs.	Difference Rel.
Q23 (interest after one year)	0.059	0.007	0.088	0.012	0.033	0.007	-0.055***	0.38
Q24 (interest after five years)	0.388	0.014	0.403	0.020	0.374	0.019	-0.029	0.93
Q25 (correlation risk-return)	0.574	0.014	0.601	0.020	0.550	0.020	-0.051	0.92
Q26 (definition high inflation)	0.723	0.013	0.769	0.018	0.681	0.019	-0.088***	0.89
Q27 (notion of diversification)	0.556	0.014	0.573	0.021	0.540	0.020	-0.033	0.94

Sources: *Authors' estimates based on financial capability surveys of Argentina (2017), Chile (2016), and Paraguay (2016).*
Notes: *survey weights used, which were estimated by the company that collected the data and considered, in each country, the actual distribution of region, sex, and age; SE: standard error at 95% confidence level; *, **, ***: the difference is statistically significant different from zero at 5%, 1%, and 0.1%, respectively.*

Overall Financial Literacy Measurement

Let us first ignore the distinction between financial behavior, attitude, and knowledge and look at results based on all 27 questions.

The results obtained are shown in Table 3.2. First, we observe that Chile is the country that has the best results, while Paraguay has the lowest level of financial literacy. Note that this ranking is also valid if we look at men and women separately.

We also note that in all countries men do better than women, and the resulting gender gap in financial literacy is always statistically significant, although at different degrees. It is worthy to note, however, that in all three countries, the gender difference is less than 10% in relative terms, which seems to be a feature of Latin American countries and developing countries more broadly. For example, Cupák et al. (2018), considering seven questions and an equal weighting scheme, found that in Brazil the size of the gender gap in financial literacy is 4% in relative terms; these authors also concluded that the gap is generally larger in more developed countries

than in relatively less developed countries.[5] Ooi (2020)[6] found that although there is no statistically significant gender gap in financial knowledge in Bolivia, Chile, Ecuador, and Mexico, there is in Argentina, Colombia, Peru, and Uruguay, but it is less than 8%, in relative terms. Karakurum-Ozdemir, Kokkizil, and Uysal (2019), who assessed financial literacy in five developing countries[7], found that there is no statistically significant gender difference in financial literacy in Mexico and that Uruguay and Colombia have a relatively small gender gap when compared to the other countries under analysis.

Table 3.2 Financial Literacy in Argentina, Chile, and Paraguay, and Gender Differences, assuming the same weight is given to each question.

Country	All Mean	SE	Men Mean	SE	Women Mean	SE	Gender Abs.	Difference Rel.
Argentina	0.473	0.004	0.484	0.006	0.463	0.006	-0.021*	0.96
Chile	0.601	0.004	0.616	0.006	0.586	0.006	-0.029***	0.95
Paraguay	0.422	0.004	0.432	0.006	0.413	0.006	-0.019*	0.96

Sources: *Authors' estimates based on financial capability surveys of Argentina (2017), Chile (2016), and Paraguay (2016).*
Notes: *survey weights used; SE: standard error at 95% confidence level; *, **, ***: the difference is statistically significant at 5%, 1%, and 0.1%, respectively.*

A Graphical Representation of Gender Differences in Financial Literacy

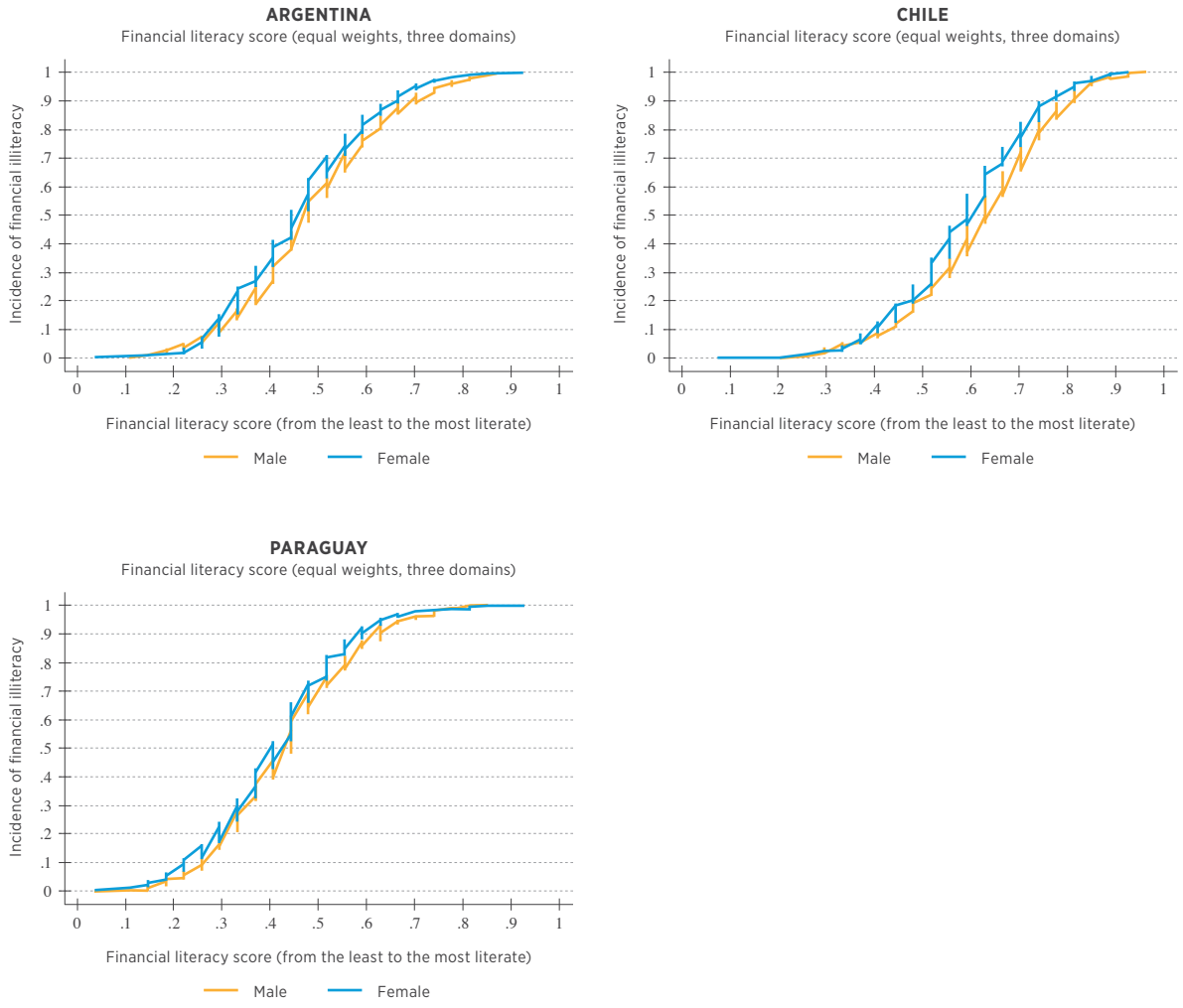
Here we adapt the notion of a poverty incidence curve (see, Atkinson, 1987; Foster and Shorrocks, 1988; Fields, 2001). This concept was extended by Duclos et al. (2008) to analyze multi-dimensional poverty but their approach is useful mainly in the case where only two domains of financial literacy are considered. If more than two domains are assumed, no graphical representation may be given. We will therefore apply the traditional tool and define a financial illiteracy incidence curve, but it should be remembered that the individual financial literacy score is derived from a multi-dimensional approach to measurement.

More precisely, using Equation 3.1 and adopting equal weights, we rank the individuals by increasing financial literacy score. On the horizontal axis, we plot individual financial literacy scores. On the vertical axis, for each score, we plot the proportion of individuals who have a financial literacy score smaller than or equal to a_h. This yields an increasing curve which could be called a *financial illiteracy incidence curve* that is drawn separately for men and women.

5 In addition to the case of Brazil, Cupák et al. (2018, p. 105) also estimated gender gap in financial literacy in Austria, Canada, Croatia, Finland, Germany, Hong Kong, Hungary, Jordan, the Netherlands, Russia, and the United Kingdom, and the resulting gap ranges from 3% in Croatia and Russia to more than 20% in the Netherlands.
6 See [*on line*] https://www.oecd.org/daf/fin/financial-education/Core-Competencies-Framework-Adults.pdf.
7 Karakurum-Ozdemir, Kokkizil, and Uysal (2019, p. 330) focused on five questions that measured "basic mathematical and financial concepts, such as division, time value of money, calculation of interest on a loan, calculation of interest and principal as well as the concept of compound interest".

Figure 3.1 shows the financial illiteracy incidence curve for each of the three countries. It appears that, as a whole, financial illiteracy is higher among women than among men.

Figure 3.1 Financial Illiteracy Incidence Curves



Looking Separately at Each of the Three Financial Literacy Domains Distinguished

Here we followed the approach of the OECD that suggested that financial literacy is a combination of awareness, knowledge[8], skill, attitude, and behavior necessary to make sound financial decisions and ultimately achieve individual financial well-being (Atkinson and Messy, 2011, 2012). We consequently made a distinction between questions related to financial behavior, knowledge, and attitude. If we use equal weights within a given domain, then the weight of each question will be $(1/K^d)$ where K^d refers to the number of questions in the financial literacy domain d.

8 Note that our definition of financial knowledge is not identical to that used by Lusardi in her various papers.

Table 3.3 presents the results. If we look at the whole population, we observe that Chile always has the best score, around 0.600, whatever the domain. Argentina does better than Paraguay for financial behavior and knowledge, but Paraguay does better than Argentina for financial attitude. Note, however, that the scores for financial behavior of Argentina (0.346) and Paraguay (0.244) are much lower than those of Chile. The previous observations are also true when we look separately at men and women. As far as gender differences are concerned, men do better than women for financial behavior and financial knowledge, whatever the country, but the gap is not significant for Argentina in the case of financial behavior. For financial attitude, men do better than women in Chile and the difference is significant. Women do better than men for financial attitude in Argentina and Paraguay, but the gap turns out not to be significant.

Table 3.3 Financial Literacy by Domain and Gender Differences

FINANCIAL BEHAVIOR								
Country	All Mean	SE	Men Mean	SE	Women Mean	SE	Gender Abs.	Difference Rel.
Argentina	0.346	0.007	0.352	0.010	0.340	0.010	-0.012	0.97
Chile	0.608	0.006	0.629	0.009	0.587	0.009	-0.042***	0.93
Paraguay	0.244	0.006	0.256	0.010	0.233	0.009	-0.023	0.91
FINANCIAL ATTITUDE								
Question	All Mean	SE	Men Mean	SE	Women Mean	SE	Gender Abs.	Difference Rel.
Argentina	0.501	0.006	0.500	0.008	0.502	0.008	0.002	1.00
Chile	0.600	0.006	0.609	0.008	0.590	0.008	-0.019	0.97
Paraguay	0.515	0.005	0.510	0.007	0.519	0.007	0.008	1.02
FINANCIAL KNOWLEDGE								
Question	All Mean	SE	Men Mean	SE	Women Mean	SE	Gender Abs.	Difference Rel.
Argentina	0.556	0.005	0.583	0.007	0.527	0.007	-0.056***	0.90
Chile	0.597	0.004	0.612	0.006	0.582	0.006	-0.030***	0.95
Paraguay	0.478	0.006	0.501	0.008	0.457	0.008	-0.044***	0.91

Sources: *Authors' estimates based on financial capability surveys of Argentina (2017), Chile (2016), and Paraguay (2016).*
Notes: *survey weights used; SE: standard error at 95% confidence level; *, **, ***: the difference is statistically significant at 5%, 1%, and 0.1%, respectively.*

In Figures 3.2 to 3.4, we present incidence curves separately for financial behavior, attitude, and knowledge for each of the three countries. Additional results for each question, gender, and country are presented in Appendix B3.

Figure 3.2 Incidence Curves for Financial Behavior

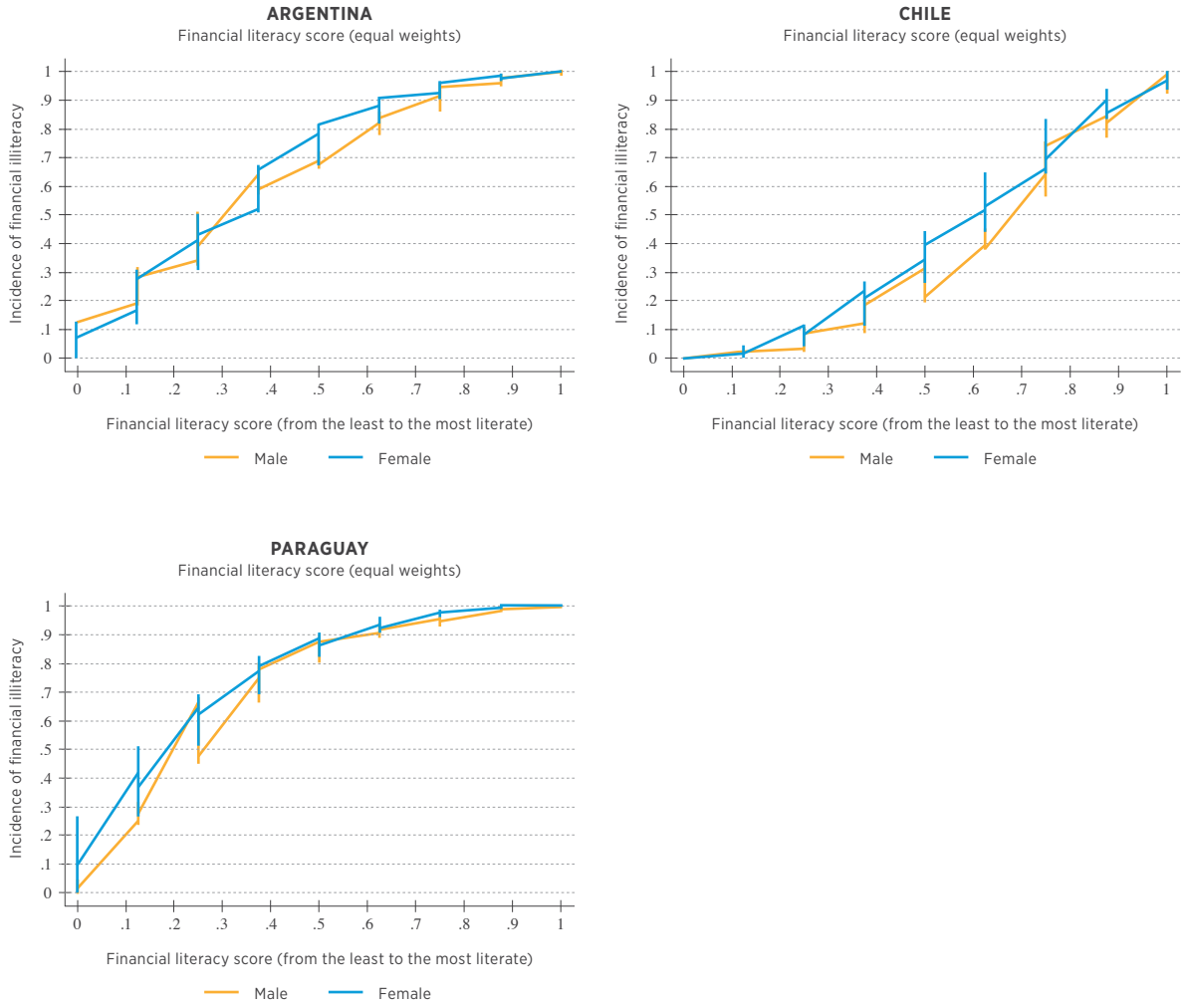
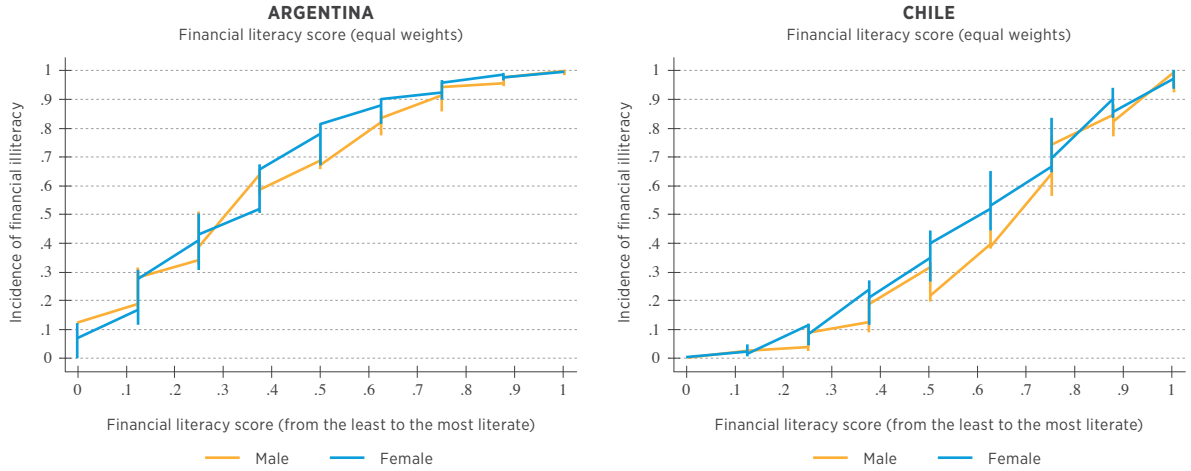


Figure 3.3 Incidence Curves for Financial Attitude



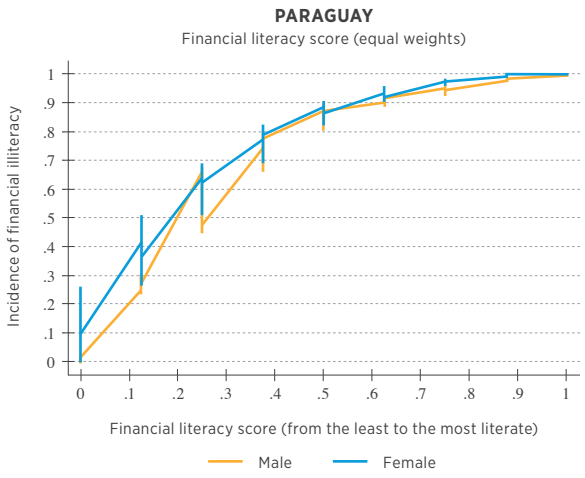
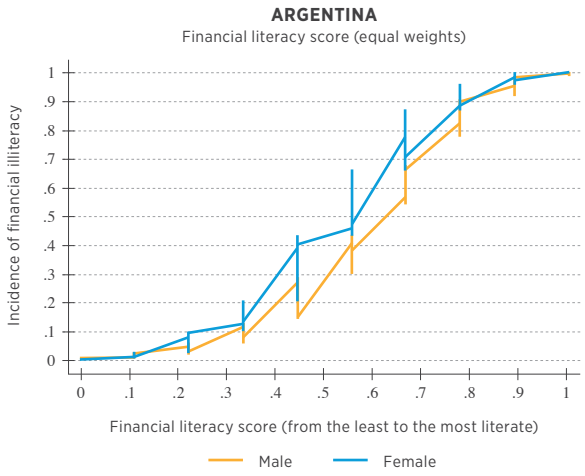
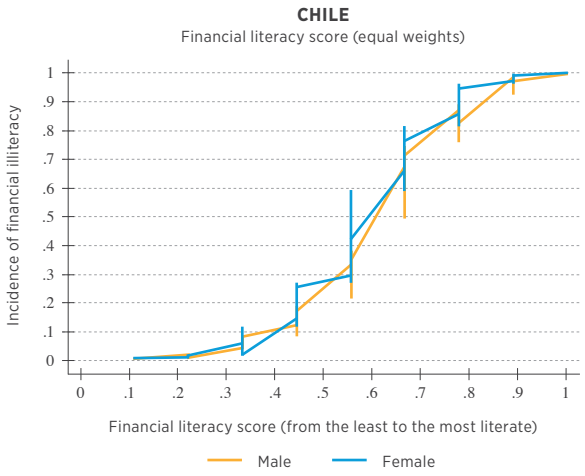
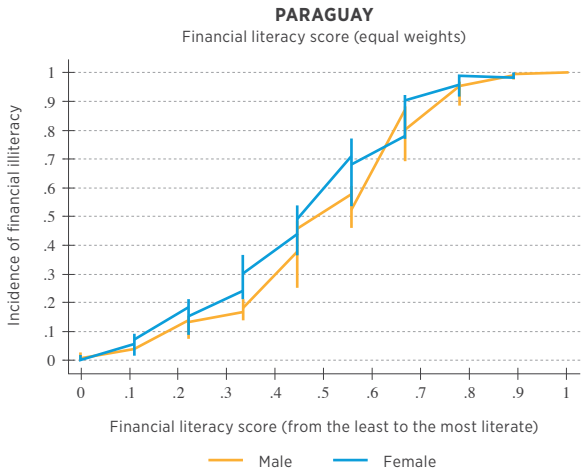


Figure 3.4 Incidence Curves for Financial Knowledge







Econometric Analysis: Understanding the Gender Gaps in Financial Literacy

Overall, the descriptive analysis presented above shows that Chile has the highest, and Paraguay the lowest, level of financial literacy, with Argentina in the middle. This analysis also suggests that there are statistically significant gender differences in financial literacy in the three countries analyzed, although the size of these gaps, in relative terms, is less than 10%.

However, until now, we have only taken into account the actual gaps in financial literacy between men and women. The question then becomes: are these gaps still observed when we take into account gender differences in demographic and economic characteristics? In other words, are the estimated gender differences in financial literacy driven by differences in characteristics such as education and income? In this section, we turn to an econometric analysis and explore the determinants of financial literacy to better understand the reasons for gender differences.

Table 3.4 presents the pooled regression results for the three countries as a whole. Separate results for each country are presented in Appendix C3. In each table, the *All* column reports the results of the regression which includes men and women and hence a dummy variable for the gender (equal to 1 for women), while the *Men* and *Women* columns show the results of separate regressions.

Let us focus first on the results of the pooled estimates. The *All* column in Table 3.4 shows that most of the covariates included are statistically significant at 5% or less when men and women in the three countries studied are pooled together, and the R-squared and adjusted-R-squared values indicate that 41% of the variance in the number of correct answers may be explained by these variables, with an F-statistic statistically significant at 0.1%. The coefficient of the gender variable is negative and relatively small in magnitude, but statistically significant. After holding constant a large number of covariates, financial literacy, as measured by the number of correct answers, is on average 4.21% (0.3818 points) lower for women than for men. This means that there is a gender gap in financial literacy even after controlling for demographic and economic characteristics.

Table 3.4 also indicates that the age of individuals is statistically significant at 5% and the sign of the coefficients of the variables age (+) and age-squared (-) suggest an inverted U-shape relationship between age and financial literacy, which is in line with the literature (see, e.g., Karakurum-Ozdemir et al., 2019; Klapper and Lusardi, 2019; Preston and Write, 2019; and Robson and Peetz, 2020). The area of residence of individuals (*Rural* variable) is not statistically significant at 5%, but the marital status variables are collectively statistically significant at 5%, and being married seems to have a positive, albeit small, impact on financial literacy. Finally, the results confirm our descriptive analysis showing that Chile is the country with the highest level of financial literacy[9], and Paraguay the lowest.

As expected, the level of education attained is highly statistically significant and has a clear positive effect on financial literacy, confirming previous findings in the literature (Karakurum-Ozdemir et al., 2019).[10] On average, individuals who have not completed any level of education have a lower level of financial literacy, and the financial literacy scores increase strongly (by more than one point) with the level of education. The coefficients of the income-related variables included in our analyses are also highly statistically significant. The results also suggest that a relatively lower income and an unstable income have a negative effect on financial literacy. Table 3.4 also indicates that financial literacy appears to be lower for individuals who are not responsible for

9 These results confirm those of Klapper et al. (2015). The survey they used did not include Paraguay but they found that among the South American countries Chile had the second highest score (41) of adult financial literacy, Uruguay having the highest (45). The scores of the other South American countries were as follows: Argentina: 28; Brazil: 35; Colombia: 32; Costa Rica and the Dominican Republic: 35; Ecuador: 30; Guatemala: 26; Honduras: 23; Nicaragua: 20; Peru: 28. The score of Chile is much smaller than that of countries in Western Europe but it is similar to that of Poland which had a score of 42.
10 According to the joint significance F-test [(4, 3630) = 85.35, with a p-value = 0.0000] performed, all education-related variables are collectively significant at 0.1%.

Table 3.4 Ordinary Least Squares (OLS) Pooled Regressions

Outcome: The number of correct answers out of 27 questions	All	Male	Female
Gender: 1 are women, and 0 are men	-0.3818** (0.1340)	--- ---	--- ---
Age	0.0786** (0.0257)	0.0668 (0.0356)	0.0928* (0.0369)
Age, squared	-0.0010*** (0.0003)	-0.0008 (0.0004)	-0.0014** (0.0004)
Rural	-0.0987 (0.1792)	-0.0680 (0.2601)	-0.1081 (0.2437)
Country: Chile	2.9650*** (0.1632)	2.6578*** (0.2366)	3.1884*** (0.2278)
Country: Paraguay	-1.4128*** (0.1725)	-1.4163*** (0.2558)	-1.3854*** (0.2328)
Marital status: Married with children	0.4838* (0.1957)	0.2615 (0.2710)	0.6799* (0.2876)
Marital status: Married without children	0.3899* (0.1746)	0.2658 (0.2468)	0.4813 (0.2497)
Marital status: Divorced with children	0.3883 (0.2252)	0.5046 (0.3781)	0.3024 (0.2893)
Education: Primary	1.3253*** (0.2396)	1.4220*** (0.3265)	1.2982*** (0.3424)
Education: Secondary	2.5123*** (0.2514)	2.9342*** (0.3479)	2.1264*** (0.3512)
Education: Tertiary	3.9996*** (0.2760)	4.6589*** (0.3920)	3.3290*** (0.3801)
Education: University	4.7989*** (0.3323)	5.3436*** (0.4649)	4.2114*** (0.4700)
Income: 1 relatively lower income	-1.2888*** (0.1375)	-1.5348*** (0.1945)	-1.0418*** (0.1930)
Income household stability: 1: Stable; 0: Non-stable	1.0008*** (0.1592)	0.8195*** (0.2342)	1.2476*** (0.2155)
Decision maker: Partner	-1.2306*** (0.2610)	-1.0796** (0.3917)	-1.3853*** (0.3516)
Decision maker: Other	-0.6263** (0.1955)	-0.8344** (0.2747)	-0.3121 (0.2832)
Status: Employed full-time	0.5110** (0.1576)	0.2410 (0.2316)	0.7154** (0.2277)
Status: Employed part-time	0.4086* (0.1957)	-0.1606 (0.2942)	0.9072*** (0.2697)
Status: Retired	0.3003 (0.3251)	-0.1712 (0.4833)	0.7350 (0.4499)
Constant	9.0760*** (0.6124)	9.3978*** (0.8532)	8.3634*** (0.8779)
Observations	3,651	1,821	1,830
R-squared	0.4167	0.4311	0.4081
Adjusted R-squared	0.4130	0.4250	0.4020
F	104.9	66.29	48.78
p-value	0.0000	0.0000	0.0000

Source: *Authors' estimates based on financial capability surveys of Argentina (2017), Chile (2016), and Paraguay (2016).*
Notes: *surveys weights used; robust standard errors in parentheses. Significance levels: ***, **, and * indicate significance at 0.1%, 1%, and 5% respectively.*

day-to-day money management decisions in their households than for those who are, while being employed has a relatively small positive effect on financial literacy.[11]

The regression estimates for men and women are shown separately in Table 3.4. They suggest that age and marital status do not affect men's financial literacy but they do slightly affect women's. Education is highly statistically significant and has a strong effect on financial literacy among men and women. Interestingly, in the Southern Cone, men seem to benefit more from education than women, a result similar to what the literature has found in other contexts (see, for instance, Fonseca et al., 2012). Having a relatively lower income affects men's financial literacy more negatively than women's, while a stable household income has a much more positive impact on women's financial literacy. If the individual's partner is responsible for day-to-day monetary decisions, this situation affects women's financial literacy more negatively than men's. Finally, being employed seems to have a positive impact only for women.[12]

Considering the results of the regression estimates separately for Argentina, Chile, and Paraguay (Appendix C3), after controlling for demographic and economic characteristics, the coefficient of the gender variable is statistically significant at 5% only in Argentina, where, on average, the financial literacy score is 0.4968 points (6.2%) lower for women than men. In other words, the size of the gender gap increases slightly (2.2 percentage points) when compared to the observed (raw) gap of 4%, while the gender gaps in Chile (5%) and Paraguay (4%) shown in Table 3.2 disappear after controlling for these covariates.

An inverted U-shaped relationship between age and the number of correct responses is only observed in Argentina and Chile when men and women are considered together, and only among Chilean women when men and women are analyzed separately. In Argentina and Chile, the marital status of individuals does not seem to contribute to explaining financial literacy, except in the case of those who are married with children among Argentines and Chilean women. In Paraguay, being married without children or divorced with children has a positive effect on an individual's financial literacy when men and women are considered together. When looking separately at men and women in Paraguay, the impact of being divorced with children is only statistically significant for women.

As far as education is concerned, looking again at Tables C3-1 to C3-3, we can draw conclusions similar to those we had reached previously: education has a strong effect on financial literacy; based on F-tests, our results show that education-related variables are highly statistically significant at 0.1%. However, it is worth noting that in Argentina and Chile (only for men and women separately), the coefficient of the dummy variable that accounts for completed primary education is not statistically significant at 5%, meaning that, on average, the financial literacy score is not higher for people who only completed primary education than for those who did not.

The income variable is also statistically significant at 1% and has a strong and negative effect on financial literacy, except for Argentine women. More precisely, the results show that in all three countries financial literacy is lower for individuals who have a relatively lower income. It also appears that financial literacy is higher for individuals with a stable household income, except in the case of Chilean men.

Regarding the variables that account for who is responsible for money management in the household, our results suggest that the two corresponding dummy variables are collectively statistically significant at 5%, except in Paraguay when men and women are analyzed separately.[13] It should be observed that when men

11 All the labor market status variables included in the model are collectively significant at 1% [F-test (3, 3630) = 3.81, p-value = 0.0096].

12 The labor market variables are not collectively statistically significant for men at 5% [F-test (3, 1801) = 0.95, p-value = 0.4160].

13 We obtained the following results for the F-tests performed: Argentina [pooled estimate: F (2, 1205) = 8.72, p-value = 0.0000; men: F (2, 605) = 3.45, p-value = 0.0322; women: F (2, 583) = 5.28, p-value = 0.0053]; Chile [pooled estimate: F (2, 1205) = 3.59, p-value = 0.0280; men: F (2, 608) = 3.18, p-value = 0.0422; women: F (2, 580) = 4.34, p-value = 0.0135]; and Paraguay [pooled estimate: F (4, 1184) = 3.61, p-value = 0.0272; men: F (2, 554) = 2.72, p-value = 0.0666; women: F (2, 613) = 1.21, p-value = 0.2981].

and women are grouped together in Chile, the coefficients of these two dummy variables are not statistically significant at 5%, which can suggest the presence of data-based multicollinearity. However, we computed the variance inflation factor (VIF) and did not detect multicollinearity based on it (we did not obtain any VIF value greater than 4, except in the case of age and age squared, which are, by definition, highly correlated).

In Argentina, the results show that if the individual's partner is the person responsible for money management, there is a strong and negative effect on the individual's financial literacy. This is only true for women in Chile, and in Paraguay when men and women are analyzed together. This negative effect on financial literacy is also observed when looking at the coefficient of the second variable related to this topic (Decision maker: Other), but only for Chilean men and in Argentina when men and women are grouped together; in the rest of the cases, this second variable is not statistically significant at 5%.

Tables C3-1 to C3-3 also indicate that having a full-time job has a relatively small positive effect on financial literacy, except in Chile and for men in Argentina and Paraguay. Having a part-time job also has a positive effect on an individual's financial literacy score in Argentina when a pooled regression is run, and for women in Argentina and Paraguay. Being retired does not seem to affect financial literacy. Assessing the joint statistical significance of the block of variables related to the labor market, our results suggest that in Argentina, when a pooled estimation is performed, these variables are collectively statistically significant at 5%, but they are not collectively significant in Chile and Paraguay; neither are they for men in the three countries or women in Chile.

Our decomposition allows us to separate the effects into explained (attributed to observed characteristics) and unexplained components. Considering the pooled results, we observe that both the explained and unexplained parts are statistically significant at 5% and that the unexplained part of the estimated gender difference (-0.6411) is larger than the part of the gap explained by differences in the characteristics of the individuals. 59.3% of the overall gender gap is due to these unexplained factors, while 40.7% of the gap is 'explained' by differences between men and women in the mean values of the independent variables included in our regressions. These results suggest that the average human capital of men is significantly different from that of women. Additionally, the statistically significant unexplained component implies that the rates of return on the components of men's human capital are significantly different from those experienced by women.

Table 3.5 summarizes the Blinder-Oaxaca (B-O) decomposition at the mean of the number of correct responses for men and women, both pooling the three countries and looking at them separately. Looking at the B-O decomposition by country, Table 3.5 indicates that in Argentina, only the unexplained part of the gender gap is statistically significant at 5%, and 85.1% of the gap is due to differences in the coefficients (unexplained factors). On the contrary, the table shows that in Chile only the explained part is statistically significant, and 62.9% of the observed gender differences in this country are due to differences in the observable characteristics of the Chilean people. In Paraguay, unlike the other two countries, neither the gender gap nor the explained and unexplained parts are statistically significant at 5%.

Overall, the unexplained part may be related to social norms, social and economic environments (Cupák et al., 2018), or many other factors including "very different production processes for financial literacy" (Fonseca et al., 2012, p. 100). There is clearly room here for additional and important research on how norms and cultural environments are contributing to the gender gap.

Table 3.5 Blinder-Oaxaca Decomposition of the Gender Difference in Financial Literacy in Argentina, Chile, and Paraguay, as Well as Considering these Countries Together (pooled estimates)

Panel I: Gender difference	Pooled		Argentina		Chile		Paraguay	
Mean (women)	13.1652*** (0.1153)		12.4889*** (0.1566)		15.8342*** (0.1763)		11.1575*** (0.1868)	
Mean (men)	13.8062*** (0.1209)		13.0683*** (0.1658)		16.6302*** (0.1803)		11.6574*** (0.2005)	
Difference (raw)	-0.6411*** (0.1671)		-0.5794* (0.2280)		-0.7960** (0.2522)		-0.4999 (0.2741)	
Difference (%)	-4.64%		-4.43%		-4.79%		-4.29%	
Panel II: OB Decomposition	**Pooled**	**% of the difference**	**Argentina**	**% of the difference**	**Chile**	**% of the difference**	**Paraguay**	**% of the difference**
Explained	-0.2607* (0.1208)	40.7	-0.0864 (0.1420)	14.9	-0.5003*** (0.1465)	62.9	-0.0582 (0.1943)	11.6
Unexplained	-0.3803** (0.1334)	59.3	-0.4929* (0.2183)	85.1	-0.2957 (0.2214)	37.1	-0.4418 (0.2626)	88.4
Difference	-0.6411*** (0.1670)	100.0	-0.5794* (0.2280)	100.0	-0.7960** (0.2522)	100.0	-0.5000 (0.2741)	100.0

Source: *Authors' estimates based on financial capability surveys of Argentina (2017), Chile (2016), and Paraguay (2016).*
Notes: *surveys weights used; robust standard errors in parentheses. Significance levels: ***, **, and * indicate significance at 0.1%, 1%, and 5% respectively.*

3.4 Concluding Remarks

In this chapter, we took a multi-dimensional approach to the study of financial literacy. The latter was assumed to have three components: financial attitude, financial behavior, and financial knowledge. We were particularly concerned about differences between men and women in financial literacy and its components.

Using data for Argentina, Chile, and Paraguay, we started with a descriptive analysis which showed that Chile has the highest, and Paraguay the lowest, level of financial literacy, while Argentina appears to be in the middle. This descriptive analysis also indicated that there are statistically significant gender differences in financial literacy in the three countries analyzed, although the size of these gaps, in relative terms, is small and less than 10%.

We complemented this descriptive approach with an econometric analysis, to understand the impact of various potential determinants on financial literacy, considering a variety of explanatory variables. When focusing on a pooled regression including both genders, we found that gender differences were significant only in Argentina with women being less financially literate. When pooling the three countries, we concluded that gender differences were significant, women again being less financially literate, *ceteris paribus*.

We also implemented a traditional Blinder-Oaxaca decomposition which showed that in Argentina 85% of the gender gap is due to differences in unexplained factors. On the contrary, in Chile, only the explained part is statistically significant, and 63% of the observed gender difference in this country is due to differences in observable characteristics. Finally, in Paraguay, neither the explained nor the unexplained parts of the gender gap were statistically significant at 5%.

As far as the different explanatory variables are concerned, it appears that education along with household income and its stability are the main determinants of financial literacy in all countries whether we look at the pooled regression or men and women separately. From a policy point of view, these results show that by improving the educational level of individuals and increasing their income and financial

stability, governments could improve the financial literacy of individuals and decrease the gender gap in this domain. These achievements would certainly have an impact on economic growth and inclusion, as well as on women's empowerment.

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VIEW APPENDIX ONLINE

4

Joining the Men's Club
The Returns to Pursuing High-earnings Male-dominated Fields for Women†

Josefa Aguirre*, Juan Matta, and Ana María Montoya*****

The low participation of women in high-earnings fields such as technology and engineering (TE) is believed to contribute to the gender wage gap. While this fact may lead policymakers to want to encourage women to enter these fields, there is evidence that women may struggle to find success in male-dominated fields such as TE. This chapter investigates the labor market returns to pursuing majors in TE for men and women using data from Chile. We link administrative records on postsecondary application and enrollment to labor earnings and fertility data and exploit discontinuities in admission generated by Chile's centralized system of admission to higher education. We find that enrollment in TE as opposed to humanities, arts or social science increases men's earnings and employment but does not increase earnings or employment for women. The absence of returns for women seems to be the consequence of them failing to fully integrate into *the men's club*: enrollment in TE increases the probability of employment at high-paying industries and male-dominated firms for men, but not for women. Survey evidence suggests that this is not a consequence of gender differences in preferences for job attributes, but that women in TE may be subject to more discrimination than women in other fields. Finally, we show that enrollment into TE does not affect women's fertility or their partners' test scores and earnings. ¶

4.1 Introduction

The low participation of women in STEM fields has long been a matter of concern for researchers and policymakers. In the United States, 19.2% of those with a B.A. in technology or engineering are women.[1] In Chile, the focus of our chapter, women represented 22% of first-year students in these fields in 2005. The underrepresentation of women in these fields is seen as problematic in part because it prevents women from contributing to science and innovation, but also because it is believed to contribute to the gender wage gap. Some STEM fields, including technology and engineering, tend to pay particularly high wages to both men and women. In fact, several papers have documented that differences in men's and women's choices of college major (Sloane et al., 2019), occupation, and industry (Blau and Kahn, 2017; Groshen, 1991; Macpherson and Hirsch, 1995; Altonji and Blank, 1999; Blau et al., 2009) explain a significant part of the gender wage gap in an accounting sense. As a result, policymakers are increasingly interested in promoting the participation of women in these high-earnings, male-dominated fields.[2] Whether accessing degrees in technology and engineering can increase earnings for women is, however, an empirical question.

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1 NCES, 2016. Digest of Education Statistics. The percentage corresponds to persons aged 25-34 holding a Bachelors degree in 2016.
2 The National Science (NSF) and the National Institutes of Health (NIH) have sponsored a number of initiatives aimed at increasing undergraduate students' interest in studying science, technology, engineering, and math (STEM), improving STEM bachelor's degree completion rates generally, and improving STEM completion rates among women.

In this chapter, we study the returns to pursuing college majors in technology and engineering (TE) for men and women.[3] We link individual data on applications to higher education institutions in Chile to administrative records on earnings and fertility and exploit the quasi-random assignment of applicants into specific major-college combinations. Our results reveal high returns for men to enrolling in a degree in TE as opposed to a degree in humanities, arts, or social science (HASS). Enrollment into a TE field increases annual earnings by 54% ($ 6,703[4]) for men who have been out of high school between 11 and 20 years. However, we find no evidence of positive returns for women. We report that positive returns to TE fields for men are primarily driven by effects at the top of the earnings distribution. Enrolling in TE has a large, positive effect 18.8 percentage points (p.p.)) on the probability of men earning above $30,000 a year, but no effect on the same probability for women, which is consistent with the hypothesis of a *glass ceiling* preventing women from reaching the top of the earnings distribution (Bertrand, 2018). Gender differences in returns to TE fields are partly a consequence of the fact that they lead to a 30% increase in men's employment and a (statistically insignificant) 5% reduction in women's employment.

Our estimates for the returns to TE fields stand in contrast to observational earnings comparisons between students enrolled in TE and HASS, even after conditioning on measures of ability. Figure 4.2 shows how, conditional on math test scores, average earnings of both men and women in 2018-2019 when they had been out of high school between 11 and 20 years, are almost twice as much for individuals who enrolled in TE as for those who enrolled in any HASS field. This contrast suggests that women enrolling in TE fields are a self-selected group which should not be directly compared to those enrolling in other fields.

We overcome this selection problem by exploiting discontinuities in college admission generated by Chile's centralized application system to higher education. Like in most other countries, but unlike in the U.S., prospective students in Chile apply to specific majors within college institutions (we refer to the combination of a major and a college as a *program*). Applicants are allowed to rank up to 10 programs in order of preference, and the assignment problem is solved by a deferred-acceptance algorithm (Gale and Shapley, 1962). Each applicant is offered admission to their highest-ranked program for which their composite test score is above a program-specific admission cutoff. Under the assumption that potential outcomes change smoothly across admission cutoffs, we can reasonably attribute discontinuities in observed outcomes to differences in admission.

Our chapter's main contribution is to be the first to investigate gender differences in the returns to choosing one field compared to another. Although other papers have shown that career dynamics may differ for men and women in specific fields (e.g., Bertrand et al., 2010), this does not necessarily imply that such fields are not profitable for women as similar dynamics may also exist in alternative fields. Using data from Chile, Hastings et al. (2013) find no gender differences in the returns to different fields. Our analysis differs from theirs in that we use information on fallback alternatives as in Kirkeboen et al. (2016). For each application made to a program in TE, we have information on the program into which the applicant would be assigned in case of failing to qualify for admission in the TE program. This allows us to focus on applicants on the edge of being admitted into specific pairs of fields. Specifically, we focus on prospective students applying to programs in both TE and HASS fields whose composite test scores leave them near the margin of being admitted to either one or the other.[5]

3 We prefer to focus on TE rather than on STEM fields, mainly because many majors in science (particularly life sciences) are fairly balanced in terms of gender, and many majors in math are not particularly high-earning majors.

4 All figures are in 2019 USD.

5 This includes both students who rank a TE degree program above a HASS degree program, and whose composite test score is near the admission cutoff for the TE degree program, and those who rank HASS above TE and are near the admission cutoff for the HASS alternative.

Our finding of significant gender differences in the returns to TE fields does not extend to other high-earnings fields where women have higher rates of enrollment. We report that the returns for women from pursuing programs in business, a typically gender-balanced field, are high and very similar to those for men. We also find similar returns for men and women from pursuing programs in the female-dominated health field. This suggests that gender gaps in returns are a unique feature of male-dominated fields such as TE, and provides a plausible rationale for the low participation of women in these fields.

We find several mechanisms that could be relevant in explaining gender differences in the returns to enrolling in TE. First, although not significant, we observe differences in graduation rates for men and women in TE. While 47% of men who enroll in TE end up graduating, just 35% of women do. This is consistent with previous studies that suggest that women may have a harder time graduating from TE than men. Second, we find that the career paths for men and women tend to diverge after college graduation. In particular, we find that enrolling in TE, as opposed to HASS, increases the probability of employment in high-paying industries such as construction and mining for men, but not for women. For men, enrolling in TE also increases the probability of working in male-dominated firms with a low percentage of female workers and a low percentage of women in senior positions, but the same is not true for women.

Gender differences in the returns to pursuing a program in TE are probably aggravated by childbearing. Following Kleven et al. (2019b), we provide descriptive evidence that shows that the impact of children on the labor market outcomes of women relative to men — child penalty — is larger for women in TE (close to 30% three years after the birth of the child) than for women in other disciplines like HASS, business or health (close to 20%). Moreover, we find that the returns to enrolling in TE are positive for women without children and negative for women with children. Although this last analysis cannot be strictly interpreted as causal, as enrolling in TE might have direct effects on fertility, we provide evidence that enrolling in TE does not affect the age of first birth or the total number of children for men or women. This last result is interesting in itself and suggests that the choices of postsecondary education are not empirically important in explaining fertility choices.

We finalize by studying the effects of pursuing TE fields on marriage market outcomes for men and women. Our information on marriage is not perfect, roughly 50% of individuals in our sample have a partner and we are only able to get information for 76% of those individuals. Still, we find no evidence of there being a positive return for either men or women in the marriage market (Goldin, 1992, 2006). If anything, we find that enrolling in TE decreases partners' ability and earnings for women. Even though we only have proxy data on marriage, this is the first study to look at the causal effect of accessing a given field of study on both partners' ability and partners' earnings.

We complement our empirical findings with data from a survey that we designed and administered. Consistent with previous results, we find that women in TE have lower academic performance than men upon graduation. Compared to men, women in TE are less excited about their career, and less likely to believe that they chose a profession according to their abilities and aptitudes or allowed them to develop professionally. Survey evidence is also consistent with women in TE having trouble reaching senior positions. While women, in general, are less likely to hold managerial positions than men, differences are much starker in TE than in other fields. Women's underrepresentation in senior positions, as well as in high-paying male-dominated industries could be the result of gender differences in preferences for job attributes. However, although we find differences in preferences for job attributes, data shows that women in TE are not more likely than men in TE to hold a job that offers schedule and location flexibility, better work-life balance, or a shorter commuting time. This is consistent with other studies that report that although women have a higher preference for attributes such as flexibility, they are less likely to have a more flexible schedule, work from home often, or have a non-regular employment relationship (Mas and Pallais, 2019). Instead, survey evidence is much more consistent with women facing greater discrimination in TE than in other disciplines. Almost 50% of women in TE agree that their gender has played against them in the job searching. In addition, many women have felt discriminated against in terms of promotion (65%), earnings (76%), and development opportunities (57%). These figures are significantly smaller for women in other disciplines and much smaller for men in TE.

4.2 Institutional Setting

Gender in Chile

Chile is a middle-income OECD member country, with a per capita GDP equal to about $25,000 after adjusting for purchasing power parity. This is among the highest in Latin America and close to Eastern European States (World Bank 2018). In terms of gender equality, considerable progress has been made in the last twenty years, but there is still a long way to go. Employment rates for women aged 25 to 54 rose from about 45% in 2000 to about 65% in 2018. Comparatively, employment rates for women are 73% in the United States, 65% in Colombia, 63% in Brazil, and 54% in Mexico. At the same time, the gender wage gap, defined as the difference between median earnings of men and women relative to median earnings of men, is 12.5%, compared to 18.2% in the United States, 5.8% in Colombia, and 14% in Mexico (OECD, 2018).

Chile has made considerable progress in recent years towards gender parity in educational attainment. Thirty-seven percent of women between 25 and 34 years old had obtained a tertiary degree in 2018, compared to 30% of men. This number is below that of the United States, where 54% of women had completed postsecondary education in 2018, but above that of other Latin-American countries such as Brazil (23%), Colombia (33%), and Mexico (24%) (OECD, 2018). However, as is true in most other countries, women are underrepresented in certain fields. In particular, women represent just 25% of first-year students in technology and engineering.

In terms of career advancements for women, the country lags behind more developed economies. Employed women in Chile are about 50% less likely than men to hold a managerial position, hold just 8% of seats on boards of the largest publicly listed companies, and just 16% of the seats in parliament. In contrast, employed women in the United States are about 25% less likely than men to hold a managerial position, hold 22% of seats on boards of the largest publicly listed companies, and 19% of the seats in Congress (OECD, 2018). Chilean numbers, however, are similar to what is typically seen in other Latin American countries such as Brazil, Colombia, and Mexico.

People in Chile hold traditional views of gender roles. According to the World Value Survey from 2012, 18% of Chileans agree that when jobs are scarce men should have more rights to a job than a woman, 34% agree that if a woman earns more money than her husband this can cause problems, 36% agree that children suffer when a mother works for pay, and 20% agree that a university education is more important for a boy than a girl. People in Chile are also reluctant to see women as leaders: 27% agree that men make better political leaders than women, and 18% agree that men make better business executives than women. As shown in Table 4.1, these numbers are similar to what is observed in other Latin American countries such as Argentina, Brazil, Colombia, Mexico, and Peru; but they reflect much more sexist views than those of people in the U.S.

Table 4.1 Sexism in Latin America and the U.S

	% Agree						
	United States (1)	Chile (2)	Argentina (3)	Brasil (4)	Colombia (5)	Mexico (6)	Peru (7)
When jobs are scarce, men should have more right to a job than women	5.7%	17.6%	14.0%	16.1%	22.4%	16.8%	17.4%
If a woman earns more money than her husband, it's almost certain to cause problems	11.0%	33.7%	19.7%	34.3%	43.8%	43.3%	25.0%
When a mother works for pay, the children suffer	24.1%	36.0%		61.2%	42.4%	43.6%	36.4%
On the whole, men make better political leaders than women do	18.5%	27.0%	26.1%	27.1%	27.4%	23.0%	18.7%
A university education is more important for a boy than for a girl	6.7%	20.1%	16.0%	9.3%	10.8%	20.7%	14.0%
On the whole, men make better business executives than women do	11.4%	18.3%	21.5%	27.1%	19.6%	20.4%	14.6%

Source: *World Data Survey, different years according to the country.*

In sum, the subjects of this study work in an economy that is similar to that of other Latin American countries such as Brazil, Colombia, and Mexico. Comparisons to larger, higher-income countries like the United States are less straightforward. However, the barriers that women face in Chile are not substantially different from those they face in the United States.

College Admission in Chile

The Chilean postsecondary education sector consists of 60 universities that offer college degrees and 122 institutions that offer technical degrees. College degrees typically take 5 years to complete. Of the total number of universities, 33 participate in a centralized admission system called SUA (for *Sistema Único de Admisión*, or Unified System of Admission).[6] Universities that do not participate in this admission system are predominantly private and typically serve lower-scoring students. The 33 universities that participate in SUA are all non-profit but can be public, private, or private-parochial. These universities span a wide range of selectivity levels.

Students applying to these 33 institutions must take an SAT-like standardized test called PSU (for *Prueba de Selección Universitaria* or University Selection Test.) Students sign up online to take the PSU during their senior year of high school, and everyone must take the test on the same day in November. There is only one chance to take the test each year. All students take exams in mathematics and language, and they can choose whether to take optional tests in science and history. Scores for these tests are scaled to a distribution with a range of 150 to 850 and a mean and median of 500. Entrance exam scores, along with high-school GPA and GPA ranking[7] are the primary components of the composite scores used for postsecondary admissions.

After taking the PSU and being informed of their test scores, students submit their applications to the system using an online platform. As in many other postsecondary education systems, students in Chile apply directly to specific majors within postsecondary institutions (we refer to the combination of a major and a college as a *program*). As a reference, students applying in 2017 could choose from a total number of 1,477 programs in institutions participating in the centralized admission system. Each year, institutions must define ex-ante the weights each program will give to the different sections of the PSU as well as to high school GPA and GPA ranking. For instance, the composite admission score to a medicine major at *Pontificia Universidad Católica de Chile* gives a high weight to the science section of the PSU and no weight to the history section. Let s_i^ι be the score obtained by student i in PSU section ι (e.g., math, language, science, history, or GPA). The program-specific weighted score of student i applying to program j is computed as:

$$s_{ij} = \sum_{\forall \iota} s_i^\iota \cdot \alpha_j^\iota,$$

where α_j^ι is the weight given to PSU section ι in program j, with $\sum_{\forall \iota} \alpha_j^\iota = 1$. Because α_j^ι can vary across programs, the same student may have different weighted scores for different programs. The weights are public information and thus applicants can know beforehand what their weighted scores would be for each available program.

In their applications, students submit a list with up to ten programs ranked from most to least preferred.[8] Students have an incentive to rank programs correctly, meaning that they should not list a less-preferred choice over a more-preferred choice. However, they may incorporate admission probabilities when deciding which options to list, as they are capped at ten options.

Once students submit their applications, the system takes their rankings of alternatives, their program-specific scores, and the number of available seats by program, and implements a *deferred acceptance* assignment algorithm (Gale and Shapley, 1962) to determine which students are offered admission to each

6 Before 2012, only 25 Universities participated in the centralized admission system.

7 The GPA ranking was introduced in 2012 as a variable for admission. It measures a student's GPA relative to previous cohorts' average GPA.

8 Up until 2011 students could submit only eight options, but as of 2012 they can submit up to ten choices.

program. The algorithm generates program-specific admission cutoffs such that (i) each student is offered admission to his highest-ranked program for which his program-specific weighted score is equal to or above the program-specific admission cutoff (if any), and (ii) the number of students assigned to each program is equal to or less than the number of available seats for that program. While students apply with some knowledge of where they might be admitted, cutoff scores vary unpredictably from year to year due primarily to shocks in demand. Students' inability to precisely predict cutoff scores is consistent with the imprecise control condition required for unbiased regression discontinuity estimation (Lee and Lemieux, 2010).

The admission process has two rounds. During the first round, students receive at most one admission offer and decide whether to enroll, remain on the waitlist for a more-preferred program from which they were rejected, or withdraw from the application process. The seats that remain empty after the first round are then allocated in the second round of offers. These offers are generated following the same mechanism as the first round. In March of the following year, enrolled students begin their studies in their program. If students want to change to a different program, they usually need to wait an entire year and participate in the next admission process on equal terms with other applicants.

4.3 Data and Sample Construction

Data

This study uses a unique dataset that brings together administrative records on education, earnings, and fertility. To do this, we digitized hard copies of published test score results stored in a local newspaper (*El Mercurio*) for all students taking the standardized admission test from 1999 to 2007 and merged this information with educational, earnings, and fertility data.[9] We chose to focus on students who graduated from high school between 1999 and 2007 because these were the oldest cohorts for whom we could gather complete higher education application records. These students were between 30 and 38 years old in 2019, which is the last time we observe them.

Educational records for these students include socioeconomic information that students provide when signing up for the standardized admission test, their performance on the standardized college admission test, high school GPA, the application they submitted to the centralized system of admission, and whether they enrolled in any university participating in the centralized system of admission in 2000 to 2017.

Because enrollment records for the 2000 to 2017 period are only available for institutions participating in the centralized system of admission, we complement this information with more recent administrative records that capture enrollment and graduation for all higher institutions in the country. This allows us to analyze, for example, the probability that a student enrolls or graduates from a program in a given field from any institution. These records, however, are only available for the 2007 to 2017 period, which is why when looking at these outcomes we focus on students graduating from high school between 2006 and 2011.

In our analysis, we group programs using their OECD category with a few adjustments. Table 4.2 describes the 9 categories that we analyze and examples of programs contained in each category. We chose to build a separate category for business, which is typically categorized under social sciences because we believe it differs considerably from other programs in this field. We also chose to build a separate

9 Data from *El Mercurio* allowed us to gather information on students' unique national identification numbers (NIDs) and test score results. With the support of the Ministry of Labor we were able to add data on earnings and fertility records using students' NIDs.

category for architecture, which is typically categorized under TE. Finally, we leave aside the services field as it contains very few and diverse programs, and add programs in journalism, which are under services, to the social science field.[10]

Table 4.2 Example programs in each field of study

Category	Field of study	Example programs
Technology & Engineering	Engineering & Industry & Technology	Engineering, Construction, Computing
Humanities & Arts & Social Science	Education	Pedagogy
	Humanities & Arts	History, Design, Art, Translation and Interpretation, Language, Philosophy, Cinematography, Acting, Music
	Social Science	Psychology, Journalism, Sociology, Geography Anthropology, Political Science, Social Work, Public Administration
	Architecture	Architecture
Others	Health	Medicine, Nursing, Nutrition, Chemistry and Pharmacy, Obstetrics, Kinesiology, Dentistry, Medical Technology, Phonoaudiology
	Business & Administration	Business & Administration
	Agronomy	Veterinary, Agronomy, Forest Engineering
	Science	Biology, Biochemistry, Physics, Astronomy, Geology, Math, Statistics, Chemistry

Notes: *This table shows example programs in each field of study. Our central results estimate the effects of enrollment in programs in the first category (TE) when the counterfactual is a program in the second category (HASS).*

Earnings records are obtained from the unemployment insurance records of Chile's Ministry of Labor for the period between 2002 and 2019, which keeps track of the monetary contributions to the individual unemployment insurance account of each worker. We complement this data with records from the public sector for 2018-2019. Our data covers almost the entire formal sector, but it excludes the self-employed which represent approximately 15% of individuals in our sample.[11] Because we only have data on the public sector for 2018-2019, our main specification focuses on average annual earnings in this period, when individuals in our sample are between 29 and 38 years old. Earnings records from unemployment insurance are capped at roughly $5,000 a month. In our sample, about 2% of monthly earnings for men and women in the control group are at this cap in 2018-2019. Accessing a program in TE increases the probability of having monthly earnings above $5,000 by 6 p.p. for men and has no effect on the probability of being at this cap for women. Therefore, we expect that having a cap on earnings could lead us to underestimate the returns to pursuing a program in TE for men but should not affect our estimates of the returns to pursuing a program in TE for women.

Fertility and marriage records were obtained from the civil registration system in 2018. For each individual in our dataset, we were able to obtain marriage records and birth records for each of their offspring. We list two individuals as partners if they are married or if they have a child together. We identified a partner for 54% of individuals in our sample. However, we were only able to get information on an individual's partner if

10 Other small adjustments include excluding programs in industrial design and food engineering from the TE category, as these are rather low-earnings female-dominated programs. We also exclude programs in Law from the HASS category, as these programs take too long to complete and data on earnings is misleading.

11 The data also excludes workers with training contracts, workers under the age of 18, those in domestic service, and pensioners. However, people in our sample should not be under these categories. Table A.1 in the Appendix uses data from the Chilean household survey for 2017 (Casen, 2017) to characterize the percentage of individuals aged 29 to 38 who graduated from each field and who are unemployed, working in the private sector, working in the public sector, or self-employed.

they happened to be in our records (i.e., if they signed up for the standardized admission test in or after 1999), which is the case for roughly 72% of individuals who have a partner.

We complement administrative data with a survey that we designed and administered. The survey collected information about the completed program; educational outcomes; preferences for different job characteristics; actual job characteristics; life and job satisfaction; and individuals' perception regarding the extent to which societal barriers and discrimination have hindered their career development. The survey was sent by email to all students who enrolled in 1 of 14 institutions participating in the centralized system of admission in the 2000 to 2008 period. We were able to collect information for 3400 individuals.

Sample Construction

Our sample is composed of all students with composite test scores that leave them on the margin of admission to either a TE field or a HASS field. The sample includes both students who have TE as a more preferred alternative and whose counterfactual is a program in HASS, and students who have HASS as a more preferred alternative and whose counterfactual is a program in TE. Table 4.3 shows the percentage of students who applied to a program in HASS, TE, business, health, or science whose next best alternative is a program in one of these fields. As the table shows, most (about 60%) individuals who apply to a given field have a program in that same field as the next best alternative. However, although having a program in a different field as the next best alternative is rare, listing both a program in HASS and TE is not particularly uncommon. Roughly 5% (4%) of those who list TE (HASS) as a more preferred alternative have HASS (TE) next on their priority list.

Table 4.3 Applications across fields

	% next best alternative				
given that applied to..	**HASS**	**TE**	**Business**	**Health**	**Science**
HASS	80.9%	4.4%	5.8%	0.9%	8.1%
TE	5.1%	63.5%	7.5%	1.4%	22.5%
Business	14.6%	11.9%	59.8%	0.3%	13.3%
Health	13.8%	63%	1.7%	59.7%	18.4%
Science	13.6%	20.0%	6.3%	5.4%	54.6%

Notes: *This table shows the percentage of students who applied to a program in HASS, TE, business, health, and science who have a program in each of these fields as a next-best alternative.*

The sample includes i) students ranking a program in a TE field above a program in a HASS field whose composite score is near the admission cutoff for the TE program, and ii) students ranking a program in a HASS field above a program in a TE field whose composite score is near the admission cutoff for the HASS program. We pool both samples together to improve statistical power. We define the admission cutoff for program j, denoted by c_j, as the minimum weighted score among students who were offered admission to that program j in the first round. That is:[12]

$$c_j = \min_i \{s_{ij}\} \quad s.t.\ i \text{ is offered admission to } j$$

We also define the running variable r_{ij} as follows:

$$r_{ij} = \begin{cases} s_{ij} - c_j & \text{if } j \in TE \\ c_j - s_{ij} & \text{if } j \in HASS \end{cases}$$

12 An alternative would be to define cutoffs as the weighted score of the last student to enroll in j.

Under this definition, a student will be offered admission to a program in TE if $r_{ij} \geq 0$, and to a program in HASS if $r_{ij} < 0$.

As several papers have pointed out, this admission cutoff may not be relevant for some of the alternatives included in a student's application (e.g., Abdulkadiroglu et al., 2014). Take for instance the case of a student i who ranks program k with very low selectivity first, followed by program j with very high selectivity. For this student, crossing j's admission cutoff would have no effect on assignment to j, because the less selective but preferred program k is within reach when $r_{ij} = 0$. In this case, including i's application to j in our dataset would reduce the strength of our first stage, thus lowering statistical power and increasing the risk of weak instruments bias.

We deal with this issue following in spirit Dustan (2018) and eliminating from our sample any application to a program k by student i if there exists a program j such that both:

- i ranks j above k, and
- j is relatively less selective than k from i's perspective,

were relative selectivity is defined as follows:

Definition 1 (Relative Selectivity) *Let* $\phi_{ij} = \frac{r_{ij}}{\sqrt{\sum_{\forall \iota}\left(\alpha_j^{\iota}\right)^2}}$ *be the euclidean distance between i's vector of scores,* $(s_j^{\iota})_{\forall \iota}$*, and the admission line for* j *is defined as* $C_j = \{(s^{\iota})_{\forall \iota} : \sum_{\forall \iota} s^{\iota} \alpha_j = c_j\}$*. Then program* j *is said to be relatively more selective from* i*'s perspective than program* $k \neq j$ *if and only if* $\phi_{ij} < \phi_{ik}$*.*

It is easy to check that for the special case where programs j and k assign the same weights to each section of the test, the relative selectivity of j and k depends exclusively on the comparison between c_j and c_k. Approximately 55% of the applications survive the elimination process described by i and ii.

Finally, we exclude from our sample applications to programs that are not oversubscribed. In practice, we consider a program j to be oversubscribed if at least one student among j's applicants ends up being assigned to an alternative that is less preferred.

Sample Description

Table 4.4 presents summary statistics for the individuals in our sample and shows how they compare to the general population of high school graduates who signed up for the standardized admission test in 1999-2007.

Of the students who sign up for the PSU, 53% are women, and 43% live in the capital. Their households are composed of 4.5 individuals, where approximately 1.3 people work. Sixty-seven percent of households are headed by the father. A little over 25% of these students have a mother with tertiary education, and one-third have fathers with tertiary education. Two-thirds of them have a father that works full time, but only a third has a mother that works full time. Students have an average GPA of 5.6 and score in the 47th percentile on the math and language PSU. In 2018-2019, students had annual earnings of $10,039 for almost 7 months of work. This figure includes zeros for individuals who are not working and implies an annual wage of $18,000 for those who work year-round. Fertility records indicate that 62% of them had a child by 2018.

The sample of students used in the analysis has a higher socioeconomic status and is more academically advantaged. This seems reasonable considering that they are close to the admission cutoff for at least one oversubscribed program in the centralized system of admission. These students have more educated parents, higher GPAs, and perform better in the language and math sections of the PSU. In terms of income, they report average annual earnings of $11,182. They are also less likely to have children; only 48% of them have children. Conditional on having children, they tend to have them at an older age.

Table 4.4 Descriptive Statistics

	All			Sample		
	All (1)	Male (2)	Female (3)	All (4)	Male (5)	Female (6)
Socioeconomic Characteristics						
Female	0.527 (0.499)	0.000 (0.000)	1.000 (0.000)	0.451 (0.498)	0.000 (0.000)	1.000 (0.000)
Lives in the capital	0.427 (0.495)	0.433 (0.495)	0.422 (0.494)	0.327 (0.469)	0.324 (0.468)	0.331 (0.471)
Total HH members	4.533 (1.793)	4.477 (1.801)	4.583 (1.784)	4.509 (1.598)	4.502 (1.581)	4.517 (1619)
Total HH members work	1.292 (0.772)	1.320 (0.792)	1.268 (0.752)	1.263 (0.697)	1.276 (0.702)	1.247 (0.690)
Head of HH father	0.673 (0.469)	0.691 (0.462)	0.656 (0.475)	0.716 (0.451)	0.732 (0.443)	0.697 (0.460)
Head of HH mother	0.234 (0.423)	0.224 (0.417)	0.243 (0.429)	0.223 (0.416)	0.211 (0.408)	0.237 (0.425)
Mother primary ed	0.232 (0.422)	0.213 (0.409)	0.249 (0.432)	0.132 (0.339)	0.145 (0.353)	0.116 (0.321)
Mother secondary ed	0.501 (0.500)	0.511 (0.500)	0.492 (0.500)	0.509 (0.500)	0.506 (0.500)	0.513 (0.500)
Mother tertiary ed	0.267 (0.442)	0.276 (0.447)	0.258 (0.438)	0.358 (0.480)	0.349 (0.477)	0.370 (0.483)
Father primary ed	0.219 (0.413)	0.200 (0.400)	0.236 (0.425)	0.127 (0.333)	0.128 (0.334)	0.125 (0.331)
Father secondary ed	0.457 (0.498)	0.461 (0.498)	0.453 (0.498)	0.434 (0.496)	0.438 (0.496)	0.429 (0.495)
Father tertiary ed	0.324 (0.468)	0.339 (0.473)	0.311 (0.463)	0.440 (0.496)	0.435 (0.496)	0.446 (0.497)
Father works full-time	0.681 (0.466)	0.704 (0.457)	0.661 (0.473)	0.696 (0.460)	0.704 (0.457)	0.686 (0.464)
Father works part-time	0.127 (0.333)	0.116 (0.320)	0.136 (0.343)	0.125 (0.330)	0.116 (0.321)	0.135 (0.342)
Mother works full-time	0.336 (0.472)	0.346 (0.476)	0.328 (0.469)	0.356 (0.479)	0.361 (0.480)	0.350 (0.477)
Mother works part-time	0.062 (0.241)	0.061 (0.239)	0.063 (0.242)	0.058 (0.234)	0.055 (0.228)	0.062 (0.242)
Academic Performance						
GPA	5.628 (0.501)	5.554 (0.500)	5.693 (0.492)	5.901 (0.404)	5.833 (0.410)	5.984 (0.380)
Language Score Percentile	46.689 (28.984)	47.972 (29.341)	45.549 (28.616)	68.045 (19.709)	69.209 (19.592)	66.631 (19762)
Math Score Percentile	46.629 (28.965)	51.088 (29.125)	42.668 (28.238)	73.284 (17.849)	76.365 (16.954)	69.544 (18193)

Table 4.4 Descriptive Statistics (continuation)

	All			Sample		
	All (1)	Male (2)	Female (3)	All (4)	Male (5)	Female (6)
Earnings & Employment						
Months Employed (2018-2019)	6.640 (5.449)	7.087 (5.339)	6.242 (5.514)	6.575 (5.469)	6.653 (5.424)	6.480 (5.524)
Earnings (2018-2019)	10,039 (12,732)	11,495 (13,445)	8,743 (11,913)	11,182 (13,614)	11,775 (13,941)	10,462 (13,173)
Fertility						
Has Children	0.615 (0.487)	0.563 (0.496)	0.662 (0.473)	0.479 (0.500)	0.447 (0.497)	0.518 (0.500)
N of Children	0.932 (1.005)	0.818 (0.983)	1.034 (1.013)	0.732 (0.914)	0.679 (0.901)	0.797 (0.927)
Age at First Birth	25.745 (4.921)	26.583 (4.843)	25.141 (4.888)	27.412 (5.010)	27.712 (4.941)	27.098 (5.065)
Obs	1,360,283	643,848	716,435	5,471	3,001	2,470

Notes: *This table shows descriptive statistics for applicants in our analysis sample (column 1) and for everyone who signed up for taking the admission test between 1999 and 2007 (column 2). Socioeconomic characteristics are obtained from a survey taken at test registration; academic performance data are obtained from official records from the Ministry of Education; and earnings and employment data are obtained from administrative sources (unemployment insurance for private-sector earnings, government payrolls for public sector earnings.)*

4.4 Empirical Strategy

The admission process generates unpredictable admission cutoffs for different programs which, for a subset of applicants, effectively randomizes admission offers to either a TE or a HASS field. Our empirical strategy rests on the idea that applicants whose test scores leave them sufficiently near a margin involving both TE and HASS should be comparable in terms of observable and unobservable characteristics regardless of their actual admission. This allows us to estimate causal effects of admission by comparing the outcomes of applicants who were marginally admitted to a program in TE and whose counterfactual admission would have been a program in HASS to the outcomes of applicants who were marginally admitted into HASS and whose counterfactual admission would have been a program in TE.

Our reduced-form results are based on the following standard regression discontinuity specification:

$$y_{igjt} = \pi_{1g} \cdot r_{igjt} + \pi_{2g} \cdot \left(Z_{igjt} \times r_{igjt}\right) + \tau_g \cdot Z_{igjt} + \mu_{gj} + \eta_{gt} + \varepsilon_{igjt} \quad (4.1)$$

where y_{isjt} is the outcome of interest for student i of gender g in margin j (i.e., a given pair of programs, one of them in TE and the other in HASS), applying for admission in year t. The running variable r_{igjt} determines whether i is assigned into TE (i.e., $r_{igjt} \geq 0$) or HASS (i.e., $r_{igjt} < 0$), and Z_{igjt} is a cutoff-crossing indicator (i.e., $Z_{igjt} = \iff r_{igjt} \geq$). We include fixed effects for the student's gender, preferred program, and counterfactual program (i.e., gender × program × counterfactual program), and fixed effects for the student's gender and application year (i.e., gender × year). The slope parameters π_{1g} and π_{2g} are allowed to vary by gender. Our parameter of interest is τ_g, which recovers the effect of a marginal admission offer into a TE field for men and women in 2018 and 2019, when individuals have been out of high school between 11 and 20 years.

The model is estimated by ordinary least squares, using a uniform kernel with bandwidth h=40 (optimal bandwidths suggested by Calonico et al. (2014) are 33 for men and 40 for women). We cluster standard errors at the individual level. Estimates remain the same when using alternative bandwidths (see Appendix B.4).

Our instrumental variable (IV) results, on the other hand, are based on the following structural equation:

$$y_{igjt} = \delta_{1g} \cdot r_{igjt} + \delta_{2g} \cdot \left(Z_{igjt} \times r_{igjt}\right) + \beta_g \cdot d_{igjt} + \xi_{gj} + \zeta_{gt} + \epsilon_{igjt} \tag{4.2}$$

where d_{igjt} is a binary indicator taking the value 1 if the individual ever enrolls in the TE program of margin j. This model is estimated by two stages least squares, using Z_{igjt} as the instrument for d_{igjt}, and a uniform kernel with bandwidth h=40. The effect of ever enrolling in a program in TE will be captured by our estimate of β_g. The exclusion restriction for this structural specification requires an admission offer made to a program in TE to affect outcomes only through affecting the probability of enrollment in that program.

In some cases, we estimate the impact on outcomes, such as earnings or fertility, at one particular age a. In such cases, to gain efficiency, we use a panel and estimate the following equation:

$$y_{igjta} = \delta_{1g} \cdot r_{igjt} + \delta_{2g} \cdot \left(Z_{igjt} \times r_{igjt}\right) + \beta_{ga} \cdot d_{igjt} + \xi_{gj} + \zeta_{gt} + \rho_{ga} + \epsilon_{igjt} \tag{4.3}$$

where we allow β to vary for each specific age but have the slope parameters and fixed effects remain constant across different ages.

4.5 Empirical results

Regression Discontinuity Validation

We begin by presenting standard tests of the validity of our RD strategy. First, we perform balancing checks to examine whether individuals just above and just below the cutoff are similar in terms of their baseline observable characteristics. We focus on a set of socioeconomic variables, including family size, parents' education, and parents' work status. Large and significant discontinuities in the conditional means of these variables at the cutoff could be taken as an indication that potential earnings of individuals may also be discontinuous at the cutoff, thus violating the exclusion restriction.

Figure 4.5 summarizes results for male and female students in our sample. The figure plots the estimated discontinuities at the cutoff and their 95% confidence intervals. These coefficients are separately estimated for men and women from a specification analogous to (1), where the baseline characteristic is used as the dependent variable. We do not find statistically significant jumps at the cutoff for the covariates, except for a difference in the probability of having a mother with primary education for men, and the number of individuals in the household who work, and the probability of having the father as the head of household for women. An F-test for each sample rejects that these estimates are jointly significant.

Manipulation of PSU scores is highly implausible, not only because of the institutional setting but also because students do not know ex-ante what the cutoff score will be for a given program. Still, to check for any signs of manipulation, we test for a discontinuity in the density of the standardized weighted score around the cutoff. We do this by implementing the test suggested by Cattaneo et al. (2018), the results of which are presented in Figure 4.5 for men and women in our sample. As expected, we do not detect discontinuities in the distribution of the running variable.

First Stage

We continue by showing evidence of the relevance of admission cutoffs for individuals' assignment and enrollment. We say that an individual *ever enrolled* in j if he enrolled in j sometime between his application year and 2017.

Figure 4.6 pools together all the applications that meet the restrictions outlined in section 3.2 and illustrates how crossing the cutoff affects men's and women's: (i) probability of ever enrolling in the TE cutoff program, (ii) probability of ever enrolling in any program in a TE field, and (iii) probability of ever enrolling in any program in a HASS field. When analyzing the probability of enrolling in a TE or HASS field, we look at individuals who graduated from high school in 2006-2011 (as opposed to 1999-2007) because we only have enrollment records for the whole system as of 2007.

The effects of assignment to the cutoff TE program on men's and women's enrollment are illustrated in Figure 4.6. It shows that the probability of ever enrolling in the cutoff TE program jumps to about 60% and 52% at the cutoff for men and women respectively. Note that this probability is slightly above zero to the left side of the cutoff. This is the consequence of applicants retaking the standardized test in subsequent years and reapplying to the cutoff program. Also, the probability falls monotonically for scores to the right of the cutoff as higher-scoring students are assigned to more-preferred programs. Figure 4.6 also shows the effect of crossing the cutoff on applicants' probability of ever enrolling in any program in TE or HASS fields. Crossing the admission cutoff increases the probability that the applicant will ever enroll in a program in a TE field by 39 p.p., and it decreases the probability that he or she will ever enroll in a program in a HASS field by 32 p.p.

Effects of accessing a TE field on earnings and employment

We now turn to our main results. We begin by studying the effect of accessing a program in a TE field as opposed to a program in a HASS field on individuals' earnings. Figure 4.7 offers a visual display of our results. To get more precise estimates, we plot the residuals from a regression of earnings on students' preferred program, counterfactual program, and application year fixed effects (i.e., program x counterfactual program and year). The figures show, separately for men and women, non-parametric representations of average annual residual earnings in 2018 and 2019, when individuals in our sample have been out of high school between 11 and 20 years. We find evidence of a large and positive discontinuity at the cutoff for males and no evidence of a discontinuity for females, meaning that an admission offer to a TE program increases annual earnings for men but not for women.

These results are confirmed by the estimates presented in Table 4.5. The table shows the effects for men and women of enrolling in a program in a TE field, as opposed to a HASS field on annual earnings in 2018-2019. The reported coefficients correspond to 2SLS estimates of in equation 4.2. Column 1 reports estimates of total earnings, column 2 reports estimates of the probability of working for at least one month in 2018-2019, and columns 3 through 6 report estimates of the earnings distribution. Data shows that roughly 75% of individuals in our sample worked in the formal sector for at least one month in 2018-2019.

Our estimates of the returns to enrollment in a TE field are positive and statistically significant at 1% for men, indicating a $6,703 increase in earnings. This effect corresponds to an increase of 54% in baseline earnings ($12,423). On the contrary, estimates are statistically insignificant for women. Women enrolling in HASS programs earn $13,951 a year on average, and with 95% confidence we can reject an effect of enrolling in TE on earnings above $4,600 for women. Annual returns of enrolling in TE are $6,742 higher for men, with the difference being significant at the 5% level. Interestingly, we find that most of the positive effects on men's earnings correspond to a large increase in the probability of earning above $30,000 a year. In contrast, women are not more likely to earn more than $30,000 a year if enrolling in a TE field. While the probability of earning more than $30,000 a year is about 11% for men in HASS fields it is 24% for men who end up enrolling in TE fields. These findings are consistent with the idea of there being a "glass ceiling" for women (see Bertrand, 2017 for a recent review on the phenomenon).

Table 4.5 Effect of Enrolling in a TE Program on Earnings

	HASS Earnings (1)	Employed (2)	$0 < I \leq 15k$ (3)	$15k < I \leq 30k$ (4)	$30k < I \leq 40k$ (5)	$I > 40k$ (6)
Enrolls - TE						
Men	6,703*** (2,378)	0.141** (0.059)	−0.068 (0.061)	0.072 (0.054)	0.031 (0.037)	0.107*** (0.034)
Women	−40 (2,382)	−0.017 (0.072)	−0.033 (0.075)	−0.063 (0.072)	0.060 (0.042)	0.019 (0.037)
Men-Women	6,742** (3,352)	0.158* (0.093)	−0.035 (0.097)	0.134 (0.090)	−0.029 (0.056)	0.088* (0.051)
Mean - HASS						
Men	12,423	0.678	0.338	0.233	0.069	0.037
Women	13,951	0.751	0.335	0.302	0.066	0.047
N Clusters	5,476	5,476	5,476	5,476	5,476	5,476

Notes: *This table shows 2SLS estimates of the effects of enrollment into a TE program on annual earnings in 2018-2019 (column 1) as well as on the probability of earnings falling in several ranges (columns 2-6). Earnings are unconditional on employment status and the effects, therefore, include both the extensive and intensive margin. Cutoff-crossing indicators interacted with gender are used as instruments. Baseline estimates correspond to mean outcomes for men and women who, induced by a marginal admission offer, enrolled in a HASS field. Standard errors clustered at the individual level. *** p<0.01, ** p<0.05, * p<0.1*

Figure 4.7 shows model estimates for the evolution of mean earnings over the life cycle for men and women who i) were marginally assigned to, and enrolled in, a HASS field (blue lines), or ii) were marginally assigned to, and enrolled in, a TE field (red lines.) The coefficients are estimated using a panel where we allow our estimate to vary for each specific age but have the slope parameters and fixed effects remain constant across different ages (see equation 4.3). We observe outcomes for our full sample (who completed high school between 1999 and 2007) up to 12 years after high school graduation, but only get to observe outcomes 20 years after high school graduation for individuals who completed high school in 1999. Because we lose observations with each additional year, our estimates become much noisier over time. To get estimates at specific ages, we need to use data on earnings from 2010 - 2017 for which we have incomplete records for public sector employees, which is why mean earnings might look slightly different from our previous results. Still, results from the figure are consistent with previous findings. The plots show that earnings for both men and women tend to grow steadily with age in both TE and HASS fields. They also show that the effects of enrollment in TE, corresponding to the difference between the red and the blue lines, are stable over time.

Enrolling in a TE field also appears to affect the extensive margin. Table 4.6 shows the effects on employment for men and women in 2018 and 2019. Column 1 shows that even though women who enrolled in HASS fields tend to be employed more months than men who enrolled in HASS fields, enrollment into a TE field appears to increase male employment by 1.9 months a year (30%) while reducing female employment by 0.34 months a year (-5%), although this last result is not significant. Consistent with this, we find positive (negative) effects for men (women) on the probability of men working at least one month in a year, as well as on the probability of them working every month of the year (columns 2 and 3). Columns 4 and 5 show that the positive effect on male employment is concentrated on jobs with permanent contracts. Even though men in HASS fields are less likely to have a permanent contract than women in HASS fields (43% versus 53%,) men in TE fields are considerably more likely to have a permanent contract (60% versus 48%). These effects accumulate over time resulting in 16.5 additional months of experience for men by 2019, and no change in experience for women, as seen in column 6.

Table 4.6 Effect of Enrolling in a TE Program on Employment

	N of months employed in a year (1)	Works at least one month (2)	Worked every month (3)	Permanent Contract (4)	Fixed-term Contract (5)	N of months of experience (6)	N of employers (7)
Enrolls - TE							
Men	1.85*** (0.67)	0.14** (0.06)	0.19*** (0.06)	0.17*** (0.06)	−0.04 (0.06)	16.52*** (6.01)	1.45* (0.89)
Women	−0.34 (0.85)	−0.03 (0.07)	−0.01 (0.07)	−0.05 (0.08)	0.00 (0.06)	3.35 (7.40)	0.44 (1.00)
Men-Women	2.19** (1.08)	0.17* (0.09)	0.20** (0.10)	0.22** (0.10)	−0.04 (0.08)	13.16 (9.54)	1.01 (1.34)
Mean - HASS							
Men	6.19	0.63	0.35	0.43	0.34	59.39	9.74
Women	7.48	0.71	0.49	0.53	0.30	62.62	9.42
N Clusters	5,476	5,476	5,476	5,476	5,476	5,476	5,476

Notes: *This table shows 2SLS estimates for men and women of the effects of enrollment into a TE program on several employment outcomes in 2018-2019. Cutoff-crossing indicators interacted with gender are used as instruments. Baseline estimates correspond to mean outcomes for men and women who, induced by a marginal admission offer, enrolled in a HASS field. Standard errors clustered at the individual level. *** p<0.01, ** p<0.05, * p<0.1*

Our results for the returns to enrolling in TE stand in contrast to observational earnings comparisons between students enrolled in TE and HASS, even after conditioning on measures of ability. Estimates indicate that, conditional on math and language test scores and GPA, earnings are roughly $3,900 and $3,500 higher for men and women in TE compared to men and women in HASS. As can be seen in Figure 4.2, observational earnings comparisons for men and women suggest a positive return to enrolling in TE for men that is constant along the ability distribution and a positive return of enrolling in TE for women that increases with ability. Our casual estimates, instead, show a higher return to enrolling in TE for men than what is implied by observational estimates and a null return for women. Causal estimates for women remain insignificant even if we allow for heterogeneous returns by math test scores (see Figure 4.9). This suggests that individuals enrolling in TE, and particularly women enrolling in TE, are a self-selected group that should not be directly compared to those enrolling in other fields; this should stand as no surprise considering how rare it is for women to apply to TE.

Estimates of the effect of enrolling in TE as opposed to HASS are a combination of estimates for individuals who list TE as a more or less preferred alternative. Table 4.7 shows that the effect of enrolling in TE on annual earnings and months worked a year in 2018-2019 are similar for individuals who list TE as a more or less preferred alternative (columns 7 through 10). Individuals who list TE as a more preferred alternative are enrolling in a TE program that is more selective than their HASS alternative, while individuals who list TE as a less preferred alternative are enrolling in a TE program that is less selective than their HASS alternative (otherwise the admission cutoff would not be relevant, see section 4.4). To see how returns to field of study interact with returns to selectivity, columns 1 through 6 show the effect of enrolling in TE when the counterfactual is a HASS program at a less selective institution (columns 1 and 2), a HASS program at the same institution (columns 3 and 4), or a HASS program at a more selective institution (columns 5 and 6). Results are noisily estimated but suggest that returns vary more by field of study than they do by institution selectivity.

Table 4.7 Effect of Enrolling in a TE Program for Individuals who list TE as a more or less Preferred Alternative

	TE at a:						TE at a:			
	More selective Univ.		Equaly selective Univ.		Less selective Univ.		More preferred alt		Lesss preferred alt	
	Earnings (1)	Months worked (2)	Earnings (3)	Months worked (4)	Earnings (5)	Months worked (6)	Earnings (7)	Months worked (8)	Earnings (9)	Months worked (10)
Enrolls - TE										
Men	7,174 (4A07)	1.783 (1.438)	8,996*** (2,402)	2.383*** (0.849)	5,287 (5,386)	2.201** (1.097)	6,047* (3,366)	2.498** (1.132)	6,597** (3,208)	1.364 (0.843)
Women	4,832 (3,277)	−0.367 (1.311)	−3,533 (3,749)	−0.113 (1.156)	2,663 (7,540)	−0.366 (2.162)	−437 (2,805)	−1255 (1.114)	1,376 (3,639)	0.793 (1.235)
Men-Women	2, 342 (5,577)	2.150 (1.964)	12,529*** (4,427)	2.496* (1.430)	2,623 (8,998)	2.568 (2.418)	6,484 (4,416)	3.752** (1.592)	5,221 (4,864)	0.571 (1.494)
Mean - HASS										
Men	10,432	5.902	9,834	5.837	16,142	6.265	11,185	5.595	12,919	6.441
Women	12,159	7.353	14,678	7.114	12,444	7.553	15,425	8.397	12,854	6.878
N Clusters	1,659	1,659	3,139	3,139	1,329	1,329	1,947	1,947	3,865	3,865

Notes: *This table shows 2SLS estimates for men and women of the effects of enrollment into a TE program on annual earnings in 2018-2019 (column 1) as well as on the probability of earnings falling in several ranges (columns 2-6). Earnings are unconditional on employment status and the effects, therefore, include both the extensive and intensive margin. Cutoff crossing indicators interacted with gender are used as instruments. Baseline estimates correspond to mean outcomes for men and women who, induced by a marginal admission offer, enrolled in a HASS field. Standard errors clustered at the individual level. *** p<0.01, ** p<0.05, * p<0.1*

Robustness Checks

Part of the gender differences in returns to TE fields may be because men and women apply to different programs in TE and HASS fields. For instance, among applicants who rank a program in TE as their first choice, women might be more likely to rank a program in sociology second, while men might be more likely to rank a program in acting second. If earnings in sociology are higher than in acting, we might expect to see lower average returns for women than for men. Although this would not affect the validity of our estimates, it might affect their interpretation.

To see if this is driving our results, we re-estimate the earnings model using the same 2SLS specification, but re-weighting the data in such a way that the distribution of women's applications looks the same as the distribution of men's applications and vice-versa. Specifically, when using men's distribution, we weight women's observations by ϕ_j^m / ϕ_j^f and when using women's distribution, we weight men's observations by ϕ_j^f / ϕ_j^m, where ϕ_j^g is the number of gender g applicants in margin j. We focus only on margins where there is common support for men and women, that is, $0 < 0\phi_j^m$ and $\phi_j^f < 1$. The results of this analysis, shown in Appendix Table A. 4.2, are very similar to the unweighted analysis, suggesting that our results are not driven by gender differences in application patterns.

Our results may also be due to differences in the ability of male and female applicants. Two applicants in the same margin of admission and with the same composite test score might still differ in terms of their test scores on individual sections of the test or their GPAs. For instance, women on the margin of admission to a TE program might have higher language test scores and lower math test scores than men on the same margin. In fact, female students in our sample have slightly higher GPAs, and slightly lower math and language test scores. To test for this possibility, we run a model allowing for heterogeneous effects on GPA, math test score, and language test score. The results are shown in Appendix Table A. 4.3. Although our estimates show some evidence of effect heterogeneity by academic performance, allowing for additional heterogeneity does not significantly affect our estimates of mean effects for men and women.

Contrast with other fields

In this section, we show that the gender differences observed in the returns to TE fields are not observed in the case of high-earnings fields that are more gender-balanced or female-dominated, such as business or health.[13]

Table 4.8 shows estimates of the effects of enrollment into programs in business (columns 1-3) and health (columns 4-6). We observe large positive effects of enrolling in business for both men and women which are significant at the 10% level ($5,838 for men and $4,441 for women). Although returns are slightly higher for men, the difference is not significant. We also observe positive effects of enrolling in health that are higher for women ($3,620) than for men ($2,129). These results suggest that there is something intrinsically different in TE that makes it unprofitable for women despite being profitable for men.

Table 4.8 Effects of Enrolling in Health or Business

	Business vs. HASS			Health vs. HASS		
	Earnings (1)	Employed (2)	Months worked (3)	Earnings (4)	Employed (5)	Months worked (6)
Enrolls - TE						
Men	5, 838* (3,475)	0.11 (0.08)	1.48 (0.92)	2,129 (4,528)	−0.01 (0.10)	−0.23 (1.19)
Women	4,441* (2,581)	−0.06 (0.06)	−0.55 (0.70)	3,620** (1,693)	0.05 (0.04)	0.56 (0.51)
Men-Women	1,397 (4,332)	0.17* (0.10)	2.02* (1.16)	−1,492 (4,836)	−0.06 (0.11)	−0.79 (1.30)
Mean - HASS						
Men	16,157	0.64	6.52	18,391	0.75	7.84
Women	17,795	0.77	8.15	15,519	0.72	7.68
N Clusters	4,040	4,040	4,040	6,098	6,098	6,098

Notes: *This table shows 2SLS estimates for men and women of the effects of enrollment into i) a program in a business field (columns 1-3) or ii) a program in a health field (columns 4-6), on earnings and employment in 2018-2019. Earnings are unconditional on employment status and the effects, therefore, include both the extensive and intensive margin. Cutoff-crossing indicators interacted with gender are used as instruments. Baseline estimates correspond to mean outcomes for men and women who, induced by a marginal admission offer, enrolled in a HASS field. Standard errors clustered at the individual level. *** p<0.01, ** p<0.05, * p<0.1*

Explaining gender differences in returns to TE

Differences in graduation patterns

Heterogeneous returns for men and women could be a result of differences in graduation outcomes. Both men and women have a hard time persisting in STEM fields. Only a fraction of students who enroll in college expecting to major in a TE field finish.[14] This is not only due to students dropping out, but also to students switching from STEM to non-STEM fields. While true for both genders, dropping out of STEM has been shown to be particularly common among women. Prior studies suggest that this is not due to differences in preparation (Arcidiacono et al., 2012; Astorne-Figari and Speer, 2018, 2019; Kugler et al., 2017; Ost, 2010; Price, 2010)[15],

13 In the analysis we leave aside programs in advertising and accounting that are typically classified as business, but that tend to have low earnings. We also exclude degrees in occupational therapy that are typically classified as health but tend to have low earnings.

14 See Arcidiacono et al. (2016); Astorne-Figari and Speer (2019, 2018); Fischer (2017); Griffith (2010); Kugler et al. (2017); Ost (2010); Price (2010); Rask (2010); Stinebrickner and Stinebrickner (2013)

15 An exception is Griffith (2010) who finds that differences in preparation can explain a large portion of the gender difference in STEM attrition.

but could be a consequence of differences in competitiveness (Astorne-Figari and Speer, 2019; Buser et al., 2014; Fischer, 2017); gender composition of faculty and students (Carrell et al., 2010; Griffith, 2010; Hoffmann and Oreopoulos, 2009; Kugler et al., 2017; Rask and Bailey, 2002); future labor market considerations (Bronson, 2014; Gemici and Wiswall, 2014; Zafar, 2013); or gender differences in preferences for grades (Kugler et al., 2017; Rask and Bailey, 2002; Rask and Tiefenthaler, 2008).

In this section, we analyze the extent to which our results could be driven by differences in graduation outcomes. We look at the effects of accessing a program in TE on (i) the probability of earning any university degree, (ii) the probability of graduating from any program in a TE field, (iii) the probability of graduating from the cutoff TE program, (iv) the probability of graduating from any university program on-time (defined as having graduated within 6 years of high school graduation), (v) number of years enrolled in a university program, and (vi) number of years enrolled in a TE program. Because graduation outcomes are only available as of 2007, our analysis considers cohorts who graduated from high school between 2003 and 2007, who should not have graduated from a university before 2007.

The results of this analysis are shown in Table 4.9. Although noisily estimated, results show no significant effect of enrolling in a program in TE on the probability of completing any college degree or the probability of graduating on time. We do observe a 2.5 decrease in the number of years that men spent enrolled in higher education. Enrolling in TE also has a strong effect on the probability of graduating from a TE program. While only 4% of men who initially enrolled in a HASS program end up graduating from a TE program, 47% of those who enroll in the cutoff TE program obtain a degree in TE. Estimates are smaller but still strong for women. While 6% of women initially enrolling in HASS end up graduating from a TE program, this fraction increases to 35% for those who enrolled in TE. Although gender differences in the probability of graduating from a TE program are not significant, results indicate that women may spend a lower number of years enrolled in TE and may have a harder time graduating from these programs than men, which is consistent with what has been reported by previous studies. Students have a higher probability of graduating from health and business, and there are no major gender differences in graduation outcomes. Roughly 65% of students who enroll in business end up graduating, and about 80% of those who enroll in health end up graduating (see Appendix Tables A. 4.4 and A. 4.5).

Table 4.9 Effect of Accessing a Degree in a TE Program on Graduation

	Graduates					
	College graduation (1)	On-time college graduation (2)	Years enrolled (3)	Graduation from TE (4)	Graduation from cutoff program (5)	Years enrolled in TE (6)
Enrolls - TE						
Men	−0.02 (0.10)	−0.06 (0.09)	−1.52*** (0.58)	0.43*** (0.07)	0.38*** (0.06)	3.15*** (0.50)
Women	0.08 (0.16)	−0.16 (0.15)	−0.10 (0.84)	0.29*** (0.10)	0.33*** (0.07)	2.74*** (0.70)
Men-Women	−0.10 (0.18)	0.10 (0.18)	−1.42 (1.02)	0.14 (0.12)	0.05 (0.09)	0.41 (0.86)
Mean - HASS						
Men	0.58	0.27	5.60	0.04	-0.01	0.87
Women	0.66	0.34	5.40	0.06	0.00	0.45
N Clusters	2,453	2,453	2,453	2,453	2,453	2,453

Notes: *This table shows 2SLS estimates for men and women of the effects of enrollment into a TE program on several graduation outcomes. Cutoff-crossing indicators interacted with gender are used as instruments. Baseline estimates correspond to mean outcomes for men and women who, induced by a marginal admission offer, enrolled in a HASS field. Standard errors clustered at the individual level. Because graduation outcomes are only available as of 2007, our analysis considers cohorts who graduated from high school between 2003 and 2007, and who should not have graduated from a university degree prior to 2007. *** p<0.01, ** p<0.05, * p<0.1*

Industry of employment

In this section, we investigate the role of differential effects on industry of employment by gender. Figure 4.9 estimates the probability of being employed in 2019 in each of the 17 sectors considered, for men and women who i) were marginally assigned to, and enrolled in, a HASS field (blue bars), or ii) were marginally assigned to, and enrolled in, a TE field (red dots).[16] Red lines show 95% confidence intervals. Estimates indicate that men who enroll in HASS are primarily employed in the public sector (14%); education (11%); construction (10%); professional activities and administrative services (8%); manufacturing (4%); and commerce (4%). Enrolling in TE increases the probability of men working in the construction sector (by 10 p.p.); professional activities and administrative services (by 7 p.p); commerce (by 5 p.p.); and mining (by 3 p.p.). Women who enroll in HASS are also heavily employed in the public sector (15%); education (17%); professional activities and administrative services (9%); manufacturing (5%); and commerce (7%), but are much less likely than men to be employed in the construction sector (5%). Enrolling in TE increases women's probability of working in professional activities and administrative services (6 p.p.), but it does not affect their probability of joining the construction, commerce, or mining sectors.

Figure 4.10 further looks at the characteristics of the firms where individuals are employed. Figure 4.10(a) shows the effect of enrolling in TE on the probability of working in firms of different sizes, (b) shows the effect on the probability of working in firms with a different percentage of female workers, and (c) shows the effect on the probability of working in firms with a different percentage of women in senior positions, where we take the percentage of women among the 5 highest earners in each firm as a proxy. Enrolling in TE increases men's probability of working in a male-dominated firm. Estimates show that men in our sample who enroll in HASS are more likely to work in a male-dominated environment than women who enroll in HASS, with 37% of men working in a firm where less than 33% of employees are women compared to 22% of women. Additionally, 36% work in firms where there are either one or no women among the highest earners, compared to 24% of women. Estimates show that enrolling in TE increases these gender differences, with 54% of men who enroll in TE working in a firm where less than 33% of employees are women, compared to 30% of women in TE working in such firms. Finally, while 50% of men in TE work in firms where fewer than 20% of the highest earners are women, 31% of women in TE do so. We do not observe major gender differences by firm size.

Fertility and child penalty

Differential returns for men and women could be related to childbearing. Children pose a significant cost on the careers of women, something that has been documented by numerous studies (Waldfogel, 1998; Lundberg and Rose, 2000; Sigle-Rushton and Waldfogel, 2007a,b; Correll et al., 2007; Paull, 2008; Bertrand et al., 2010; Wilde et al., 2010; Daniel et al., 2013; Fitzenberger et al., 2013; Goldin, 2014; Adda et al., 2017; Angelov et al., 2016; Goldin and Katz, 2016; Kleven et al., 2018, 2019a). More importantly, these costs can vary across different occupations. As first highlighted by Goldin (2014), women with children might find it particularly hard to advance their careers in fields that disproportionally reward individuals who work long hours or particular schedules.

In this section, we study the extent to which heterogeneous returns by gender could be explained by the difficulty that women may have making a career in TE compatible with childbearing. We begin by providing evidence on the child penalty for individuals who enrolled in either TE, HASS, business, or health. Following Kleven et al. (2019b), Figure 4.11 uses an event study around the birth of the first child to estimate the impact of children on the earnings of mothers and fathers who enrolled in TE, HASS, business, or health in 2000 - 2008. Estimates in Figure 4.11 come from the following event study specification, which is run separately for men and women who enrolled in each field of study (Kleven et al., 2018):

$$(4.4)\quad Y^g_{\{ist\}} = \sum_{\{j \neq -1\}} \alpha^g_j \cdot I[j = t] + \sum_k \beta^g_k \cdot I\left[k = age_{\{is\}}\right] + \sum_y \gamma^g_y \cdot [y = s] + \epsilon^g_{\{ist\}}$$

16 If an individual happens to be employed in more than one sector in 2019, we take the sector where they report the highest earnings.

where $Y_{ist}^{g}\, g$ is the outcome for individual i of gender g in year s and at event time t. For each parent in the data, event time t is indexed relative to the year of the first childbirth. The first term on the right-hand side includes event time dummies, the second term includes age dummies (to control for life-cycle trends), and the third term includes year dummies (to control for time trends). We omit the event time dummy at t=-1, implying that the event time coefficients measure the impact of children relative to the year just before the birth of the first child. We can identify the effects of all three sets of dummies because, conditional on age and year, there is variation in event time driven by variation in the age at which individuals have their first child.[17] We convert the estimated level effects into percentages by calculating $P_t^g = \hat{\alpha}_t^g / E\left(\tilde{Y}_{ist}^g \middle| t\right)$ where $\tilde{Y}_{ist}^g$ is the predicted outcome when omitting the contribution of the event dummies.

Consistent with results from Kleven et al. (2019b), Figure 4.11 confirms the existence of a child penalty for women. Across fields of study, the earnings of men and women evolve similarly before parenthood —after adjusting for lifecycle and time trends— but diverge sharply after parenthood. Women experience a large drop in earnings after the birth of the first child, while men are essentially unaffected. Despite these similarities, the graphs reveal differences across individuals who enroll in TE and other fields. Three years after the birth of the first child women in TE show penalties of 30% compared to penalties of 20% for women in HASS, business, or health. While these differences cannot be attributed directly to the field of study, as women who enroll in TE differ from those who enroll in other fields, they indicate that child penalties are stronger for women in TE.

We complement previous findings with estimates from our regression discontinuity specification of the differential returns to enrolling in a TE field for women with and without children. Because this analysis cannot be strictly interpreted as causal, as enrolling in TE might have direct effects on fertility, we begin by studying the effect of enrolling in a program in a TE field on (i) the probability of having children, and (ii) the total number of children.

Figure A.4.5 shows model estimates of (i) and (ii) for men (A. 4.5a) and women (A. 4.5b) who have been out of high school for 1 - 18 years who enroll in a HASS field (blue line) and a TE field (red line). From this plot, we conclude that fertility trends of men and women in TE fields are statistically indistinguishable from those in HASS fields. Regardless of gender and field of enrollment, the probability of having a child goes up from nearly zero when individuals have been out of high school for a year to 55-70% when they have been out for 19 years.

We next look at the returns of accessing a program in a TE field for individuals with and without children on earnings in 2018-2019. Although the decision to have children is endogenous, the fact that we do not observe major differences in the probability of having children for individuals enrolling in TE and HASS makes us more confident about our analysis. These results are shown in Table 4.10. Although our estimates are noisy, the point estimates are positive for women without children ($7,365), but negative for women with children (-$5,045), consistent with there being a larger child penalty for women in TE fields.

17 Kleven et al. (2018) lay out the identification assumptions underlying this approach, compare its results to alternative approaches in the literature, and provide evidence of its ability to identify the causal effect of parenthood.

Table 4.10 Effect of Enrolling in a TE Program for Women with and without Children

	Earnings (1)	Works (2)	Months worked (3)
Men			
Ever Enrolls			
No Children	4,837* (2,51)	0.11 (0.08)	1.51* (0.87)
Children	8,684** (3,520)	0.17** (0.07)	219** (0.88)
Difference	−3,847 (3,797)	−0.07 (0.10)	−0.68 (1.13)
Baseline Mean			
No Children	10,637	0.61	5.77
Children	11,527	0.60	5.79
Women			
Ever Enrolls			
No Children	7,365* (3,874)	0.11 (0.11)	1.71 (1.29)
Children	−5,045* (2,686)	−0.1 (0.08)	−1.68* (0.98)
Difference	12,410 (4,395)	0.22 (0.13)	3.39 (1.47)
Baseline Mean			
No Children	11,957	0.67	6.91
Children	12,418	0.68	7.01
N Clusters	5,476	5,476	5,476

Notes: *This table shows 2SLS estimates of the effects of enrollment into a TE program on earnings and employment in 2018-2019 for men and women with and without children. Earnings are unconditional on employment status and the effects, therefore, include both the extensive and intensive margin. We use as instruments cutoff-crossing indicators interacted with gender and dummy variables for having children. Baseline estimates correspond to mean outcomes for men and women who, induced by a marginal admission offer, enrolled in a HASS field. Standard errors clustered at the individual level. *** p<0.01, ** p<0.05, * p<0.1*

Returns on the marriage market

Pursuing a program in a TE field could have effects on marriage outcomes. On the one hand, it changes the characteristics of peers at an age where many partnerships are formed. On the other hand, it may make an individual more attractive as a partner, either because it is taken as a sign of quality or because of higher expected earnings. This could in turn have an effect on earnings, particularly for women, as their earnings are likely to be more affected by their spouse's wage.

Roughly 50% of individuals in our sample have a partner in 2018 (based on marriage and fertility records). Enrolling in TE does not affect the probability of having a partner (see Table 4.11). Unfortunately, we can only get information on an individual's partner if they happen to be in our records (i.e., if they signed up for the standardized admission test in or after 1999). Table 4.11 column 2 shows that we can gather information on partners for 36% of men and women who enroll in HASS. Enrolling in TE increases the probability that we get information on a partner by 9 p.p. for men, but decreases this probability by 8 p.p. for women (although estimates are not significant). This is likely a consequence of men in TE partnering with younger women than men in HASS and women in TE partnering with older men than women in HASS. Table 4.11 next looks at the characteristics of the partners we can identify. This analysis cannot be strictly interpreted as causal because enrolling in TE might have a direct effect on whether someone has a partner for whom we can collect information. Caveats aside, results show that students, and particularly women, who enroll in TE partner up with individuals

with lower math and language test score percentiles than students who enroll in HASS (although differences are not significant). Also, while there are no major differences in partners' earnings for men, women who enroll in TE have lower-earning partners than women who enroll in HASS.

Unfortunately, we only have enrollment and graduation records for the whole system as of 2007, which prevents us from seeing whether an individual's partner ever graduated or enrolled in TE. However, we have more complete records (as of 2000) for the centralized system of admission, which allows us to see whether an individual's partner ever enrolled in the cutoff program.[18] Column 6 in Table 4.11 shows that enrolling in the cutoff program increases the probability of having a partner who enrolled in the cutoff program by 2 p.p. for men and 5 p.p. for women. These results are consistent with Kirkebøen et al. (2021) who find that enrolling in a program makes it more likely to marry someone from that same program. However, as Kirkebøen et al. (2021) point out, enrolling in a field does not affect the probability of marrying someone from that same field at a different institution. Thus, we should not expect men or women in TE to be significantly more likely than men and women who enroll in HASS to partner with someone in TE.

Table 4.11 Effect of enrolling in a TE Program on Partner Characteristics

	Has a Partner (1)	Has a Partner in our Sample (2)	Partner Percentile Math Score (3)	Partner Percentile Lang. Score (4)	Partner Earnings (5)	Partner ever enrolls in cutoff program (6)
Ever Enrolls						
Men	0.03 (0.06)	0.09 (0.06)	−2.56 (7.10)	−7.59 (7.06)	−963.50 (2,746.82)	0.02* (0.01)
Women	−0.02 (0.07)	−0.08 (0.08)	−14.32 (9.66)	−10.13 (8.78)	−10,854.38** (4,310.93)	0.05** (0.02)
Men-Women	0.05 (0.10)	0.18* (0.10)	11.75 (11.94)	2.54 (11.24)	9,890.88* (5,094.79)	−0.03 (0.03)
Baseline Mean						
Men	0.48	0.36	44.63	47.04	9,951.18	0.00
Women	0.53	0.36	59.43	54.93	17,201.44	0.01
N Clusters	5,651	5,651	1,656	1,656	1,656	5,651

Notes: *This table shows 2SLS estimates for men and women of the effects of enrollment into a TE program on the probability of having a partner (column 1), having a partner for whom we can gather information (column 2), partner math and language test score percentile and partners annual earning's in 2018-2019. Cutoff-crossing indicators interacted with gender are used as instruments. Baseline estimates correspond to mean outcomes for men and women who, induced by a marginal admission offer, enrolled in a HASS field. Standard errors clustered at the individual level. *** p<0.01, ** p<0.05, * p<0.1*

Previous studies have found that attending a specific program has a causal effect on marriage market outcomes (Kirkebøen et al., 2021). However, effects are mostly driven by students increasing their probability of marrying someone from their same institution. Because individuals in our sample are on the margin of attending one field or another at relatively similar institutions, we should not expect any major effects on their partner's institution or field of study. Enrolling in TE could still have an effect on marriage if it makes men or women more (or less) attractive as a partner. However, our results suggest that enrolling in TE has no major effect on marriage outcomes for men and, if anything, decreases partners' earnings for women.

18 We might underestimate the probability that an individuals' partner ever enrolled in the cutoff program because we are unable to capture individuals who enrolled prior to 2000.

Survey evidence

In this section, we exploit our survey to provide suggestive evidence of potential mechanisms that could explain differences in returns to attending a TE program for men and women. Table 4.12 shows information on educational outcomes for men and women who pursued a career in HASS, TE, business, or health. In particular, we asked individuals whether their graduation ranking was above average, average, or below average. In addition, we asked whether they thought they had chosen a profession that motivated them; for which they had abilities and aptitudes; and whether their profession had allowed them to develop professionally. Administrative data indicate that women are less likely to graduate from a program in TE than men. Consistent with this finding, our survey data shows that women in TE are much less likely than men to state that they graduated with an above-average ranking (35% versus 49%). Instead, there are no major differences between men (43%) and women (38%) in the probability of graduating with an above-average ranking in other fields. Similarly, we find that while 45% of men in TE strongly agree that "their profession motivates and excites them", 54% strongly agree that "they chose a profession according to their abilities and aptitudes", and 52% strongly agree that "their profession has allowed them to develop professionally", just 29%, 46%, and 41% of women in TE strongly agree with these statements. Although women in TE are not particularly dissatisfied with their profession, the data indicate that while men in TE tend to be more satisfied than men in other fields the same is not true for women. Results from our survey suggest that women may not only have a harder time than men graduating from TE but, conditional on graduating, could have lower academic performance. We also asked individuals how satisfied they were with their job life on a scale from 1 to 10. Job satisfaction is close to 7 for individuals in our sample and slightly higher for men. Life satisfaction is closer to 8 and indistinguishable by gender. Job satisfaction is similar across fields for men and women. Life satisfaction, however, tends to be lower for men and women in HASS compared to TE, business, and health.

Table 4.12 Survey: Educational Outcomes

	Male					Female				
	ALL (1)	HASS (2)	TE (3)	Business (4)	Health (5)	ALL (6)	HASS (7)	TE (8)	Business (9)	Health (10)
Graduation ranking										
Above average	0.43	O.41	0.49	0.42	0.38	038	0.39	0.35	0.40	0.39
Average	0.50	0.53	0.46	0.43	0.54	0.57	0.57	0.61	0.52	0.58
Below Average	0.07	0.06	0.05	0.15	0.08	0.05	0.05	0.04	0.07	0.03
I chose a profession that motivates and excites me % Strongly Agree	0.42	048	0.45	0.24	0.45	045	050	0.29	0.32	0.51
I chose a profession according to my abilities and aptitudes % Strongly Agree	0.47	0.46	0.54	0.42	0.48	0.46	0.48	0.46	0.43	0.47
My profession has allowed me to develop professionally % Strongly Agree	0.49	0.43	0.52	0.48	0.52	0.44	0.42	0.41	0.47	O.51
Job satisfaction										
Mean (1 to 10)	7.38	7.18	7.34	7.59	7.36	7.22	7.15	7.38	7.34	7.35
Life Satisfaction										
Mean (1 to 10)	7.77	7.53	7.89	7.93	7.77	7.76	7.62	8.11	7.96	7.90
Observations	1,387	334	332	217	145	2,049	913	172	240	342

Table 4.13 looks at employment status, employment characteristics, preferences for different job attributes, and actual job attributes for individuals in the survey sample. Roughly 78% of individuals in the survey sample work for a company, 13% are self-employed, and 9% are unemployed. Our administrative data does not capture the self-employed which according to the survey should be close to 13% (this number is in line with what is observed in the Chilean Household Survey Casen, 2017). Among those employed in TE and health, men are more likely than women to hold a management position (43 versus 32% and 20 versus 11%). We do not observe major gender differences in the type of position held by HASS or Business graduates.

Table 4.13 Survey: Preferences and job characteristics

	Male					Female				
	ALL (1)	HASS (2)	TE (3)	Business (4)	Health (5)	ALL (6)	HASS (7)	TE (8)	Business (9)	Health (10)
Employment status										
Dependent	0.79	0.76	0.83	0.77	0.83	0.78	0.77	0.83	0.80	0.85
Self-employed	0.13	0.16	0.09	0.07	0.14	0.13	0.15	0.07	0.09	0.10
Does not work	0.08	0.08	0.08	0.16	0.03	0.09	0.07	0.10	0.12	0.06
Observations	1,387	334	332	217	145	2,049	913	172	240	342
Main work										
Self-employed	0.11	0.17	0.08	0.07	0.08	0.11	0.13	0.05	0.09	0.08
Management position	0.27	0.20	0.43	0.26	0.20	0.20	0.19	0.32	0.29	0.11
Profesional without people in charge	0.47	0.50	0.36	0.55	0.45	0.52	0.55	0.42	0.52	0.44
Profesional with people in charge	0.15	0.13	0.12	0.13	0.27	0.18	0.14	0.21	0.10	0.37
Observations	1,274	308	306	183	141	1,864	845	154	212	323
Employment characteristics										
Hours per work day	8.87	874	9.11	8.77	9.27	8.56	842	8.82	8.59	8.88
Earnings	2,671	1,926	3,300	2,690	2,883	2,051	1,673	2,968	2,602	2,215
Observations	1,274	308	306	183	141	1,864	845	154	212	323
Preferences when looking for a job (% Strongly Agree)										
Being able to work where and when I want while	0.49	0.48	0.47	0.47	0.54	0.51	0.51	0.56	0.53	0.50
Have a fixed salary	0.42	0.51	0.33	0.32	0.52	0.56	0.59	0.47	0.44	0.61
Balance between work and other areas of my life	0.77	0.75	0.75	0.77	0.84	0.85	0.86	0.81	0.81	0.90
The opportunity to be a help to others or be useful to society	0.57	0.70	0.51	0.54	0.61	0.73	0.78	0.64	0.63	0.77
Make a lot of money	0.19	0.17	0.20	0.15	0.19	0.16	0.16	0.15	0.15	0.18
Have a job that involves contact with other people	0.30	0.35	0.24	0.31	0.30	0.44	0.49	0.36	0.35	0.48
Have a job close to my home	0.34	0.37	0.31	0.26	0.43	0.41	0.40	0.42	0.38	0.45
Have opportunities to advance to positions of greater responsibility	0.45	0.38	0.52	0.47	0.43	0.39	0.35	0.51	0.43	0.31
Having same sex coworkers (% Agree or Strongly Agree)	0.04	0.04	0.04	0.04	0.03	0.20	0.21	0.20	0.25	0.13
Observations	1,387	334	332	217	145	2,049	913	172	240	342

Table 4.13 Survey: Preferences and job characteristics (continuation)

	Male					Female				
	ALL (1)	HASS (2)	TE (3)	Business (4)	Health (5)	ALL (6)	HASS (7)	TE (8)	Business (9)	Health (10)
Job characteristics (% Strongly Agree)										
My job allows me to work where and when I want	0.34	0.30	0.39	0.36	0.21	0.27	0.27	0.32	0.33	0.19
Thave a fixed salary	0.52	0.53	0.54	0.55	0.55	0.57	0.57	0.68	0.60	0.52
I can balance between work and other areas of my life	0.32	0.26	0.31	0.42	0.32	0.28	0.27	0.31	0.32	0.27
Ican help others or be useful to society	0.44	0.50	0.36	0.42	0.64	0.56	0.61	0.40	0.40	0.71
My job allows me to make a lot of money	0.11	0.04	0.13	0.12	0.19	0.07	0.04	0.09	0.09	0.11
My job involves a lot of contact with other people	0.40	0.51	0.34	0.30	0.55	0.52	0.59	0.37	0.33	0.68
Thave a job close to my home	0.35	0.34	0.35	0.33	0.40	0.38	0.38	0.34	0.34	0.41
Thave opportunities to advance to positions of greater responsibility	0.17	0.14	0.21	0.14	0.18	0.13	0.12	0.16	0.19	0.13
Observations	1,274	308	306	183	141	1,864	845	154	212	323
Female coworkers										
More than 40% women coworkers	0.65	0.81	0.46	0.71	0.82	0.72	0.76	0.47	0.71	0.77
More than 40% women in senior positions	0.46	0.56	0.29	0.46	0.72	0.46	0.52	0.25	0.41	0.57
Observations	1,274	308	306	183	141	1,864	845	154	212	323

Consistent with administrative records, we observe that earnings are higher for individuals in TE, business, and health than in HASS. However, while individuals do not work longer hours in Business than in HASS, we observe that hours worked are much longer for men and women in TE and Health. Within TE, men tend to work longer hours than women in our sample (0.3 more hours per day). Our administrative data allows us to see earnings for workers, but not employment positions or hours worked. However, results from the survey are consistent with the idea that women in TE may have a particularly hard time accessing management positions. They also suggest that, conditional on working, women in TE may work fewer hours than men in that field.

Table 4.13 also shows individuals' preferences for different job characteristics as well as their actual job characteristics. For each statement, the Table documents the percentage of men and women who say they strongly agree with each of the statements. We see that women in our survey have a stronger preference than men for being able to work where and when they want; having a fixed salary; having a balance between work and other areas of life; being a help to others or useful to society; having a job that involves contact with other people; having a job close to home; and having same-sex co-workers. Instead, men have a stronger preference than women for making a lot of money and having the opportunity to advance to positions of greater responsibility. Gender differences in job attribute preferences have been documented by several papers. Results from this survey are novel in that they show the importance to women of having same-sex co-workers (20% agree this is important compared to 4% of men), and they show how preferences vary across fields of study.

Comparing women in TE and HASS, we observe that women in both areas assign a high value to having schedule and location flexibility; work-life balance; shorter commuting time; and same-sex co-workers. Differences in preferences between men and women could explain differences in returns to pursuing a program in TE if women were to sort into jobs with these kinds of attributes (and the cost of providing these features was particularly high in TE). Nonetheless, our data show that women in TE are not more likely than men in TE to hold a job that offers schedule and location flexibility, better work-life balance, a shorter commuting time, or more female co-workers. This is consistent with other studies that report that although women have a higher preference for flexibility, they are less likely to have a more flexible schedule, work from home often, or have a non-traditional employment relationship (Mas and Pallais, 2019). While women may demand more flexibility, in the market schedule and location flexibility are often accompanied by a less desirable attribute such as long work hours.

Women's preference for working with others and being helpful to society is another potential venue for explaining gender differences in the return to pursuing a program in TE. However, women in TE are not more likely than men in TE to hold a job where they can help others or be useful to society (40% versus 36%), or where they have a lot of contact with other people (37% versus 34%). Instead, differences between men and women in HASS are significant and much more pronounced than in TE. This is consistent with women in TE having a much weaker preference for these attributes than women in HASS. Overall, we do not observe major differences in the amenities of the jobs held by men and women in TE. Nonetheless, we observe that women in TE are more likely than men in TE to have a fixed salary (68% versus 54%) which is consistent with them being less likely to hold a managerial position.

Finally, Table 4.14 shows men's and women's perceptions regarding the barriers that they have faced during their careers and whether they have ever felt discriminated against. Data suggests that discrimination against women is more of a problem in TE than in other disciplines. Among women in TE, 49% agree or strongly agree that "their gender has played against them in the job searching", compared to 29% of women in HASS and 8% of men in TE. When asked whether they have ever felt discriminated against in promotion, opportunities to influence decision making, earnings, job evaluation, development opportunities, or task assignment, women are consistently more likely to report having felt discriminated against than men. However, measures of discrimination are particularly high among women in TE, especially with respect to promotion, earnings, and development opportunities. Sixty-five percent of women in TE have felt discriminated against for promotion, compared to 53% of women in HASS and 35% of men in TE; 76% of women in TE have felt discriminated against in earnings, compared to 65% of women in HASS and 48% of men in TE; and 57% of women in TE have felt discriminated against in development opportunities, compared to 48% of women in HASS and 40% of men in TE. Women in business and health are no more likely to report having felt discriminated against than women in HASS. This is consistent with the finding that women in TE are less likely to hold managerial positions and is more likely related to lack of opportunities than preferences. Fifty-two percent of women in TE agree that they are "willing to make sacrifices in order to reach high-level positions", which is close to the 54% of men in TE and compares favorably with the 37% of women in HASS who agree with this statement. Family barriers, however, are present across occupations, with 42% of women agreeing that "taking care of my family has hindered my professional development", compared to 18% of men; and 55% agreeing that "having more responsibilities at work has had a negative effect on my family life", compared to 43% of men. While family barriers are an issue, we do not find much evidence that this is more of a problem in TE than it is in other disciplines.

Table 4.14 Survey: Societal barriers and discrimination

	Male					Female				
	ALL (1)	HASS (2)	TE (3)	Business (4)	Health (5)	ALL (6)	HASS (7)	TE (8)	Business (9)	Health (10)
Gender, family and work (% Agree or Strongly Agree)										
I believe that in general, my gender has played against me in the job searching	0.07	0.09	0.08	0.06	0.11	0.35	0.29	0.49	0.45	0.18
Taking care of my family has hindered my professional development	0.18	0.20	0.16	0.17	0.27	0.42	0.43	0.45	0.33	0.41
Having more responsibilities at work has had a negative effect on my family life	0.43	0.47	0.44	0.37	0.50	0.55	0.57	0.53	0.50	0.57
I am willing to make sacrifices in order to reach high-level positions	0.49	0.44	0.54	0.57	0.41	0.40	0.37	0.52	0.53	0.30
Observations	1,387	334	332	217	145	2,049	913	172	240	342
Felt discrimination sometimes, frequently or always in:										
Promotion at work	0.38	0.42	0.35	0.31	0.39	0.55	0.53	0.65	0.54	0.49
Opportunities to influence decision making	0.49	0.58	0.40	0.45	0.54	0.67	0.69	0.70	0.60	0.61
Earnings	0.45	0.48	0.48	0.41	0.45	0.62	0.65	0.76	0.65	0.43
Job evaluations	0.33	0.40	0.30	0.24	0.37	0.42	0.42	0.40	0.39	0.37
Development opportunities	0.39	0.40	0.40	0.36	0.41	0.50	0.48	0.57	0.50	0.49
Task assignment	0.42	0.44	0.38	0.35	0.50	0.59	0.60	0.58	0.57	0.50
Observations	1,387	334	332	217	145	2,049	913	172	240	342

In sum, survey results suggest that gender differences in the returns to pursuing a program in TE are not a consequence of women having more schedule or location flexibility, better work-life balance, shorter commuting time, or having jobs with more same-sex co-workers that are more meaningful, or where they have greater contact with other people. Instead, survey evidence is consistent with women in TE facing greater discrimination than women in other disciplines, particularly in reference to promotion and development opportunities.

4.6 Conclusion

Exploiting an institutional setting that generates quasi-random assignment of applicants into different college programs, we have shown that enrollment in high-earnings, male-dominated fields such as TE increases employment and earnings for men but not for women. The absence of returns to TE for women appears to be the result of women having a harder time graduating from TE as well as following different career paths than men. In particular, women enrolling in TE are less likely than men to end up working in high-paying industries and male-dominated firms. While women have different preferences regarding a variety of job attributes including flexibility, survey evidence suggests that these are not the cause of the differences in returns. Women in TE report much higher perceived levels of discrimination than women in other fields. This discrimination may be the result of a de facto *men's club* in TE firms, meaning fewer women are hired, they are less likely to have managerial positions, and are unable to reach the same levels of success.

Our findings offer a plausible rationale for the low participation of women in TE and caution against policies that incentivize women's participation in TE while disregarding their subsequent academic and labor market trajectories. At the same time, our results raise questions about how to best counteract the difficulties encountered by women trying to advance their careers in male-dominated environments.

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VIEW APPENDIX ONLINE

The Long-term Effects of College Peers[†]

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We study long-term peer effects in higher education and their interaction with gender. Specifically, we are interested in whether or not college peers' ability has an impact on graduation, labor market outcomes, and fertility. To do this, we look at the effects of quasi-random variation in the average quality (as measured by math college admission test scores) of male and female college peers. We find that increases in the quality of same-sex peers lead to higher graduation rates, earlier graduation, higher earnings, and delayed fertility for both men and women. In contrast, we do not find effects coming from peers of the opposite sex. ¶

5.1 Introduction

Two decades have elapsed since the works of Sacerdote (2001) and Zimmerman (2003) initiated a productive line of literature that has carefully investigated peer effects in higher education. While the specific findings in this literature differ, there is a clear indication that at least some peers are relevant for academic performance. However, whether college peers are relevant for longer-term outcomes remains an open question.

In this chapter, we investigate the long-term effects of college peers in the context of higher education in Chile. Specifically, we study the effects of quasi-random variation in the quality of male and female college peers (as measured by their math college admission test scores) on long-term outcomes of men and women. Our findings reveal that having better same-sex peers increases college graduation and earnings, and decreases fertility up to age 28 for both men and women. These effects are statistically significant (although less so for men) and economically meaningful. For instance, a 10 percentage point increase in the average percentile (of the national distribution of math test scores) of same-sex peers increases yearly earnings by 4% for women and by 2.6% for men. In contrast, we do not find statistically significant peer effects across genders for any long-term outcome.

The setting we study offers two unique advantages for investigating peer effects in higher education. First, as in many other countries, but unlike the U.S., postsecondary students in Chile enroll directly into a specific major in a particular college institution. Students entering the same college-major combination (or *program* for short) in the same year constitute a well-defined group of peers (a *class*) that is likely to be relevant from academic and professional perspectives. This stands in contrast to many studies of college peer effects that rely on random assignment of roommates.[1] Although roommates spend significant time together and often become friends, the fact that many of these studies have failed to identify robust peer effects on academic achievement has called into question whether roommates constitute peers of "potential influence" (Stinebrickner and Stinebrickner, 2006).[2] Peer interaction in our context goes well beyond friendship. Students in the same cohort and

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1 This strategy was inaugurated by Sacerdote (2001) and Zimmerman (2003), but many others have followed them, e.g., Stinebrickner and Stinebrickner (2006); Foster (2006); Lyle (2007); Kremer and Levy (2008); Han and Li (2009); Hayashi (2016); and Zhang and Pu (2017).

2 A few studies have examined peer effects in military academies using random assignment of students to companies or squadrons, where peers interact in class as well as in residences (Lyle, 2007; Carrell, 2009.) Although this increases the potential for academic interaction with peers, it does so in a very specific context which may or may not generalize to other higher education settings.

program typically attend several classes together and may even eventually become work colleagues. Furthermore, college institutions in Chile do not offer campus housing, and students typically live with their families or on their own. This allows us to isolate peer effects originating in class interactions and distinguish them from those resulting from residential interactions. Finally, our focus on classmates allows us to study peer effects across genders, something that is generally not feasible in roommate studies.

A second advantage of the setting is that it allows us to study peer effects in higher education using a nationwide database covering 25 college institutions and over 100 majors in every area of study. To the best of our knowledge, this is the first study to analyze peer effects across several higher education institutions. Importantly, these institutions serve students from different socioeconomic backgrounds and different levels of academic ability, reducing concerns with external validity raised in the case of studies that focus on highly selective colleges or military academies.

One of the major challenges in the identification of peer effects is the fact that individuals are rarely assigned to peer groups at random (hence the popularity of the strategy that exploits random assignment of roommates). To the extent that similar students are likely to enroll in the same program, we might mistakenly attribute to peer influence what is really the result of peers being similar, or "correlated effects" to use Manski's (1993) terms. In the setting we study, student selection has two parts: students choose which programs they apply to and programs can select their students from the pool of applicants. We deal with students' self-selection into programs by exploiting variation in peer characteristics across cohorts and within programs. This strategy is very common in the literature studying peer effects in primary and secondary education.[3] The underlying assumption is that although prospective students may choose a program based on its characteristics (including the characteristics of their students), it is not possible for them to choose a program based on the characteristics of their specific cohort within that program, because those characteristics are not observable at the moment of making the choice. To deal with the programs' selection of students, on the other hand, we take advantage of Chile's unique system of admission to higher education. The system is such that whenever a program is oversubscribed, seats are assigned exclusively based on applicants' scores on an SAT-like standardized admission test. Since this is a case of selection on observables, we deal with it by controlling for students' test scores.

Our finding of positive peer effects within same-sex students is aligned with other studies within economics. Stinebrickner and Stinebrickner (2006) study peer effects among randomly assigned roommates at Berea College and report positive effects on first-year academic performance among female students who have female roommates with a high GPA in high school. In contrast, they find no peer effects among males and attribute this difference to the fact that women in their sample spend more time together and are more likely to become friends with their roommates. Similarly, Han and Li (2009) find positive peer effects among female roommates in a Chinese college where roommates have strong interactions. Exploiting variation in peers across cohorts and within STEM courses, Ost (2010) estimates positive endogenous peer effects in course persistence in sciences. Although these effects are positive for both genders, the effects for women are more than twice as large as those for men.[4] Our results are not just in line with these findings but also show that the consequences of having better same-sex peers are still present 10 years after college enrollment and include positive effects on graduation and earnings and negative effects on the timing of fertility. Our study is, to the best of our knowledge, the first to look at the long-term effects of college peers.

3 See for instance Hoxby (2000), Angrist and Lang (2004), Gould et al. (2009), Lavy and Schlosser (2011), Lavy et al. (2012), Black et al. (2013), Bifulco et al. (2014), Merlino et al. (2019), Cools et al. (2019) and Olivetti et al. (2020).
4 We are aware of two papers which, focusing on STEM fields, report results in the opposite direction. Fischer (2017) exploits random assignment of students into introductory STEM classes at University of California Santa Barbara and finds that women's persistence in STEM is negatively affected by the proportion of high-ability peers in their class (alas, the paper does not separately report effects coming from male and female peers). Feld and Zölitz (2021), on the other hand, exploit random assignment of students to sections and show that women with high-achieving male peers choose fewer math-intensive courses and majors and have lower earnings in the long run. These last results are in line with findings for secondary education, e.g., Cools et al. (2019) and Mouganie and Wang (2019).

The results of this study may have important policy implications. In particular, the existence of within-gender human capital externalities implies that underinvestment in women's human capital relative to men might be more harmful to gender equity than is typically assumed because of multiplier effects: investing in the human capital of one girl not only has a positive effect on her, but also her future female peers.

5.2 Data and Sample Description

Data Sources

Individual-level data on higher education in Chile is obtained from administrative records provided by the Ministry of Education. For each student enrolling in college in 2000 or later we can identify the program into which they enroll, their admission test scores, and basic demographic information from a survey students take when they register for the test.

Earnings data are obtained from unemployment insurance records of Chile's Ministry of Labor, which keeps track of monetary contributions to the individual unemployment insurance account of each worker. Unemployment insurance covers almost the entire formal sector. The groups excluded from insurance are workers with training contracts, workers under the age of 18, those in domestic service, pensioners, self-employed or own-account workers, and public sector employees. Lastly, fertility records were obtained from the civil registration system. For everyone in our dataset, we can obtain birth records for each of their children. Both earnings and fertility data cover the 2004 - 2017 period.

Table 5.1 displays the years in which graduation, earnings, and fertility can be observed for each cohort. For students who entered college in early 2000, we can first observe earnings, employment, and fertility in 2004, five years after enrollment. Earnings for students in this cohort can be observed every year up to 2017, eighteen years after college enrollment. For more recent cohorts, however, we observe earnings for fewer years. Individual graduation records are available for every student who graduated from college between 2008 and 2018. Since postsecondary programs in Chile are typically designed to last five years or more, students very rarely graduate from college in four years or less. For this reason, a student who enrolled in 2004 and did not graduate between 2008 and 2018 (i.e., after the fifth year of enrollment) can safely be assumed not to have graduated in 2018. In contrast, if a student who enrolled in 2003 did not graduate between 2008 and 2018, it may be either because he graduated in 2007 (i.e., by the end of the fifth year) or because he has not yet graduated in 2018. For this reason, when we study peer effects on graduation, we will focus on cohorts enrolling in 2004 or later.

The availability of data described in Table 5.1 presents us with a trade-off between adding extra cohorts to the analysis and studying longer-term outcomes. On the one hand, since our strategy relies on variation in peer quality across cohorts within programs, it will be important to have enough cohorts. On the other hand, since we're interested in labor market outcomes and fertility, we would like to observe these variables at older ages.

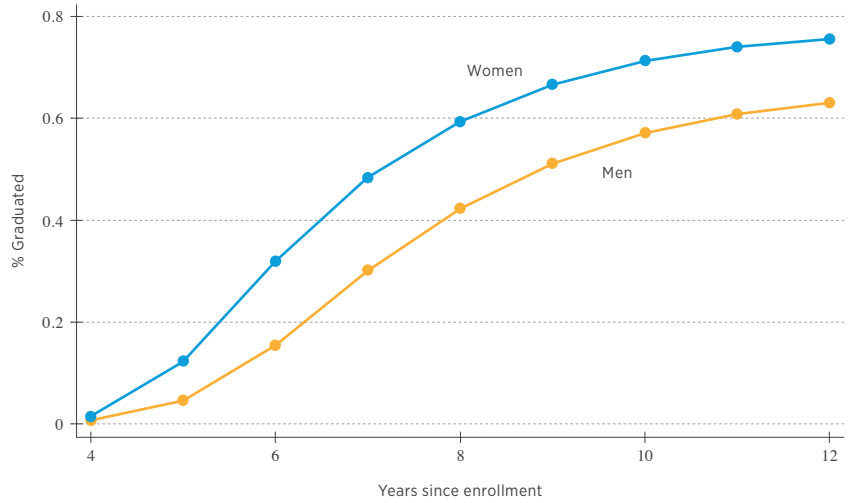
Figure 5.1 shows men's and women's probability of graduation as a function of the number of years since enrollment. A few issues are worth highlighting. First, although college programs in Chile are typically designed to last five or six years, in practice many students take considerably more time. Second, graduation rates are considerably higher for women. Third, graduation rates begin to stabilize starting on the 10th year. Since the probability of graduating after the 10th year is very small, it is reasonable to assume that by then most students will either have graduated or dropped out. Consistent with this, we also observe that employment rates begin to stabilize in year 10, as seen in Figure 5.2. Based on these observations, we will focus most of our analyses on outcomes observed 10 years after college enrollment, when individuals are approximately 28 years old. This means that our estimates of peer effects will be based on 9 cohorts (2000-2008) in the case of earnings and fertility outcomes, and 6 cohorts (2004-2009) in the case of graduation outcomes.

Table 5.1 Observation Years by Cohort

	Number of years since college enrollment														
Year of enrollment	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
Employement / Earnings / Fertility															
2000	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	
2001	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017		
2002	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017			
2003	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017				
2004	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017					
2005	2009	2010	2011	2012	2013	2014	2015	2016	2017						
2006	2010	2011	2012	2013	2014	2015	2016	2017							
2007	2011	2012	2013	2014	2015	2016	2017								
2008	2012	2013	2014	2015	2016	2017									
2009	2013	2014	2015	2016	2017										
2010	2014	2015	2016	2017											
2011	2015	2016	2017												
2012	2016	2017													
2013	2017														
Graduation															
2004	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018				
2005	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018					
2006	2010	2011	2012	2013	2014	2015	2016	2017	2018						
2007	2011	2012	2013	2014	2015	2016	2017	2018							
2008	2012	2013	2014	2015	2016	2017	2018								
2009	2013	2014	2015	2016	2017	2018									
2010	2014	2015	2016	2017	2018										
2011	2015	2016	2017	2018											
2012	2016	2017	2018												
2013	2017	2018													
2014	2018														

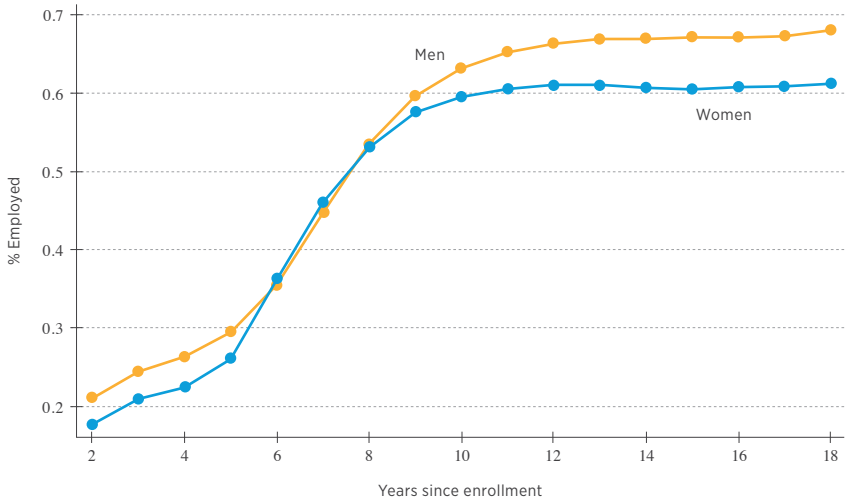
Notes: *For each cohort, the table shows the years for which graduation information is available. For instance, for the cohort enrolling in 2007, graduation data is available from 2011 (i.e., 5 years since enrollment) to 2018 (i.e., 12 years since enrollment).*

Figure 5.1 Graduation Timing



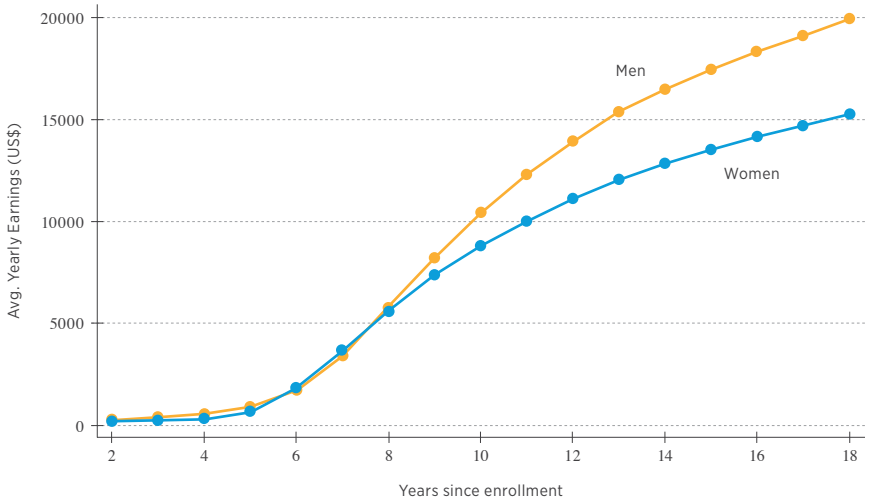
Notes: *The plot shows the probability of having graduated as a function of the number of years since college enrollment.*

Figure 5.2 Employment Timing



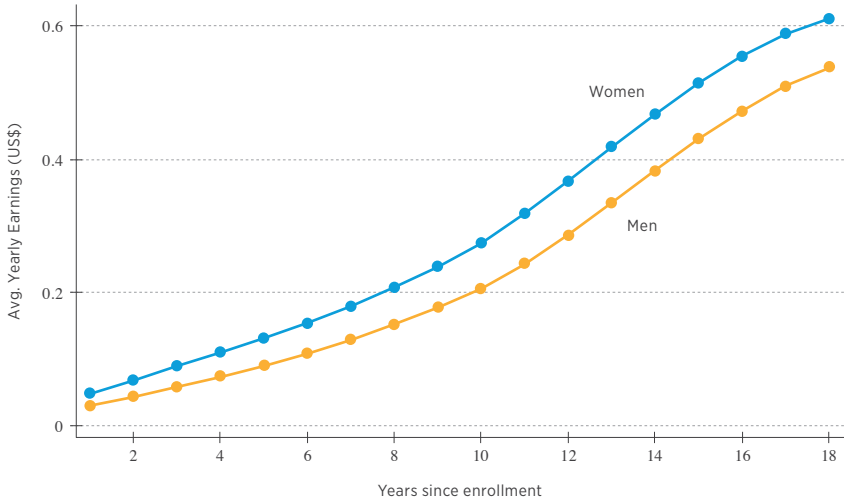
Notes: *The plot shows the probability of being employed as a function of the number of years since college enrollment.*

Figure 5.3 Earnings Timing



Notes: *The plot shows average earnings as a function of the number of years since college enrollment.*

Figure 5.4 Fertility Timing



Notes: *The plot shows the probability of having at least one child as a function of the number of years since college enrollment.*

Sample Description

Our sample consists of 366,359 students distributed across 936 programs and nine admission years. Column 1 of Table 5.2 shows descriptive statistics for this sample. A little less than half of the students in our sample are women. Average math and language test scores are slightly less than one standard deviation above the national average of 500 points. This is to be expected considering that i) not all students taking the test end up enrolling in college, and ii) institutions participating in the centralized admission process typically attract higher-scoring candidates. Twenty-one percent of mothers and 27% of fathers completed a university degree. Average labor force participation is 46% for mothers and 86.1% for fathers. The fraction of students coming from public, subsidized, and private high schools (typically serving low-income families, the middle class, and the elite, respectively) are 36%, 40.5%, and 20.6%.

Columns (2) and (3) divide the sample by gender. Men tend to outperform women in math, while women have a small advantage over men in language and a larger advantage in high school GPA. Men and women in our sample have similar backgrounds in terms of parental education and types of high schools attended.

Table 5.2 Descriptive Statistics

	(1) 2000-2008 Cohorts			(2) Women			(3) Men		
	mean	s.d.	obs.	mean	s.d.	obs.	mean	s.d.	obs.
female	0.475	0.499	366,359						
math score	621.7	90.2	366,359	604.9	86.5	173,903	637.0	90.8	192,456
lang score	606.7	85.2	366,359	607.5	83.0	173,903	606.0	87.1	192,456
gpa score	625.5	90.8	366,026	645.3	83.3	173,758	607.6	93.5	192,268
mother college	0.214	0.410	352,226	0.210	0.408	167,664	0.217	0.412	184,562
father college	0.270	0.444	334,634	0.262	0.440	158,484	0.277	0.447	176,150
mother lfp	0.460	0.498	350,902	0.459	0.498	167,015	0.460	0.498	183,887
father lfp	0.861	0.346	327,875	0.856	0.351	155,019	0.866	0.341	172,856
public high school	0.360	0.480	357,019	0.361	0.480	169,597	0.360	0.480	187,422
subsidized high school	0.405	0.491	357,019	0.423	0.494	169,597	0.388	0.487	187,422
private high school	0.206	0.405	357,019	0.194	0.395	169,597	0.218	0.413	187,422
catholic high school	0.385	0.487	348,762	0.397	0.489	166,143	0.375	0.484	182,619
rural high school	0.011	0.103	357,019	0.010	0.101	169,597	0.011	0.104	187,422

Notes: *The table displays means, standard deviations, and number of observations for different variables. Column (1) includes all students enrolled between 2004 and 2008. Columns (2) and (3) restrict the sample to women and men, respectively.*

5.3 Empirical Strategy

We identify peer effects by exploiting variation across years and within the program in male and female peers' test scores. Let y_{ijt} be the outcome of interest for student i in program j and cohort t observed ten years after college enrollment. Our base econometric specification is:

$$y_{ijt} = \alpha + \beta_f \cdot \bar{s}^f_{ijt} + \beta_m \cdot \bar{s}^m_{ijt} + \gamma \cdot s_{ijt} + \delta_j \cdot t + \lambda_j \cdot t^2 + \mu_j + \eta_t + \varepsilon_{ijt}, \quad (5.1)$$

where s_ijt is our measure of individual ability for student i. Specifically, we measure ability by the student's rank in the distribution of math test scores of year t.[5] The quality of female (male) peers is represented by $\bar{s}^f_{ijt}$ ($\bar{s}^m_{ijt}$) which correspond to the average of s_{kjt} for every female (male) student k in program-cohort jt, excluding i. The model includes fixed effects at the program (μ_j) and cohort (η_t) levels, as well as program-specific linear and quadratic time trends (δ_j, λ_j). Controlling for students' math rank not only helps improve efficiency but also eliminates the exclusion bias arising from the mechanical negative correlation between

5 We use ranks instead of test scores or other types of transformation to avoid problems originated in changes in test score scaling over time.

own test scores and the leave-out means (Caeyers and Fafchamps, 2020). Following standard practice in the literature, we cluster standard errors at the program level. The parameters of interest, β_f and β_m, capture the effects of variation in female and male peers' quality on the outcome of interest. To study gender asymmetries in peer effects, we will estimate the model separately for men and women.

The identification strategy relies on the assumption that, after conditioning on program and cohort fixed effects, program-specific time trends, and individual test scores, peer assignment is as good as random. Formally, we assume:

$$\varepsilon_{ijt} \perp \overline{s}^{f}_{ijt}, \overline{s}^{m}_{ijt} \tag{5.2}$$

Students, of course, are not randomly assigned to programs. Not only do they choose which programs to apply to, but colleges also choose among applicants whenever the number of applicants exceeds the number of available seats. Selection into programs means that students in the same program are likely to be similar in terms of both observable and unobservable characteristics, which may introduce bias in our estimations. To deal with student self-selection into programs, we follow a common approach in the peer effect literature and include both program and cohort fixed effects.[6] Program fixed effects control for common characteristics of all students who enroll in the same program across time. Cohort fixed effects, on the other hand, control for common characteristics of all students who start college in the same year. The underlying assumption is that, although prospective students may choose a program based on its characteristics (including the characteristics of their students), they cannot consider the characteristics of their specific cohort within that program, because those characteristics cannot be observed beforehand. The source of identification will then be provided by the unanticipated variation in peer-group composition. Finally, we include program-specific linear and quadratic trends to account for the possibility that program characteristics predictably change over time.

While variations of this strategy have been widely used in the education literature, most applications involve settings such as school choice in the United States in which supply-side selection typically plays a minor role. Although this is not true in our case, we have the advantage of knowing how college admission works in Chile. In particular, we know that admission is centralized and entirely determined by students' admission test scores, making this a case of selection on observables. Hence, we account for selection coming from the supply-side by including admission test scores in our regressions.

To further validate the empirical strategy, we estimate equation 5.1 using pre-determined individual characteristics instead of graduation as the dependent variable. Specifically, we use information on parental education, parents' labor force participation, and high school type. Since these characteristics cannot be affected by variation in peers' test scores, systematically significant estimates for β_f and β_m might be an indication that peer assignment is not as good as random. The results, shown in Table 5.3, are consistent with the quasi-random assignment of peers. All coefficients are small and statistically insignificant, meaning that peers' test scores do not predict pre-determined covariates. To improve the efficiency of our estimates, our full econometric specification will control for these covariates both at the individual and peer levels. Furthermore, as discussed in the next section, the inclusion of these covariates does not significantly affect our estimates, providing further support to the empirical strategy.

6 See for instance Hoxby (2000), Angrist and Lang (2004), Gould et al. (2009), Lavy and Schlosser (2011), Lavy et al. (2012), Black et al. (2013), Bifulco et al. (2014), Merlino et al. (2019), Cools et al (2019) and Olivetti et al (2020).

5.4 Results

Labor Market Outcomes

Table 5.4 summarizes the most important findings of our chapter. All specifications use as the dependent variable total yearly earnings in US dollars ten years after college enrollment and include at least cohort and program fixed effects. The specifications progress from left to right adding one layer of complexity at a time. We begin with a model without covariates (other than own test scores) or program-specific trends, then add linear and quadratic trends, and finally, add individual and peer-level covariates. Results remain qualitatively the same across specifications. Although the inclusion of program-specific linear and quadratic trends appears to affect the magnitude of the estimates, adding covariates at the individual and peer-level leaves estimates nearly unchanged. In terms of equation 5.1, the table shows estimates of β_f, β_m, and γ. Our preferred specification (columns 5 and 10) shows that a 10 percentage point increase in the average rank of same-sex peers increases yearly earnings by $351 for men and $286 for women. Relative to mean earnings, these effects represent 4% and 2.7% increases respectively. In contrast, peer effects across genders are not statistically significant for either men or women.

In Table 5.5 we use our preferred specification to show how peer effects evolve over time. These results indicate that same-sex peer effects are indistinguishable from zero five years after college enrollment and increase over time in proportion to mean yearly earnings.

Table 5.6 shows estimates of heterogeneous effects by math test scores. We classify students as having high or low math ability depending on whether their math test score is above or below the 80th percentile of the national distribution. The same-sex peer effects we estimate for women are similar in magnitude for women of high and low ability. However, since low-ability women have lower mean earnings, peer effects for them are larger in percentage terms. In the case of men, the loss in estimation efficiency from splitting up the sample means that we no longer see statistically significant effects. However, if we focus on the point estimates, male peer quality appears to have a stronger effect on earnings of high-ability men, both in absolute and percentage terms.

The effects we observe on earnings combine effects at the extensive and intensive margins. To understand how much of the effects on earnings are a result of effects on the extensive margin, we also study the effects of peer quality on employment. The results of Table 5.7 show that these effects are small and statistically insignificant, suggesting that most of the effects we observe on total earnings are a consequence of a positive effect on the intensive margin.

College Graduation

Table 5.8 shows estimates of the effect of peer quality on graduation within 10 years of college enrollment. These results are analogous to our results for earnings, with positive peer effects within-gender and no peer effects across-gender. The magnitude of the estimates implies that a 10 percentage point increase in the average rank of same-sex peers increases graduation within 10 years of enrollment by 1.9 percentage points for women and by 1.4 percentage points for men, representing respective increases of 2.7% and 2.5% relative to the mean.

The most salient result is the existence of a positive effect of having female peers with high math test scores on women's graduation rates. The estimate from the full specification (column 5) shows that a 10% increase in math scores of female peers translates into a 4.3 percentage point increase in the probability of graduation, or 6.2% relative to the mean. Interestingly, this effect is almost as large as the association between the probability of graduation and a 10% increase in women's own math test scores. Importantly, an increase in math ability of female peers appears to only affect women; its effect on men's graduation is estimated to be negative and statistically insignificant. Furthermore, the math ability of male peers, as well as the language ability of male and female peers, do not have any discernible effects on graduation for men or women.

From an economic perspective, it is important to look beyond the probability of ever graduating from college and focus as well on graduation timing. Table 5.9 shows the effects of peer ability on the probability of

graduating in 5 to 10 years, using the full econometric specification. These results show that the positive effects of having good female peers in math on women's graduation are already observed six years after college enrollment. In other words, the ability of female peers not only makes women more likely to graduate but also makes them graduate earlier. The case of men appears to be slightly different, with effects beginning to be observed later, which is consistent with them graduating later than women on average.

Fertility

Finally, we study peer effects on fertility. Figure 5.4 shows how the probability of having at least one child evolves over time. Ten years after college enrollment (i.e., when they are around 28 years old), most men and women have not had children yet. For this reason, our estimates of the effects of peer quality on fertility should be interpreted as effects on the timing of fertility rather than on total fertility. These results are shown in Table 5.10. Our estimates reveal that an increase in same-sex peer quality has a negative effect on the probability of having a child by age 28 for both men and women. Specifically, a 10 percentage point increase in the average ranking of same-sex peers results in a 1.2 percentage point (4.4%) drop in the probability of having a child for women and a 0.9 percentage point (4.5%) drop in this probability for men.

Table 5.3 Balance in Covariates

	Women		Men		All	
Variable	Mean rank of emale peers (1)	Mean rank of male peers (2)	Mean rank of emale peers (3)	Mean rank of male peers (4)	Mean rank of emale peers (5)	Mean rank of male peers (6)
parent with college degree	0.05 (0.05)	0.03 (0.04)	−0.04 (0.04)	0.05 (0.04)	0.00 (0.03)	0.03 (0.03)
mother LFP	−0.03 (0.05)	0.03 (0.05)	−0.07 (0.04)	0.07 (0.06)	−0.05 (0.03)	0.05 (0.04)
father LFP	0.05 (0.04)	−0.04 (0.03)	−0.01 (0.04)	0.02 (0.04)	0.02 (0.03)	−0.01 (0.03)
private high school	0.02 (0.03)	−0.00 (0.02)	−0.02 (0.03)	0.05 (0.03)	−0.00 (0.02)	0.02 (0.02)

Notes: *The table shows estimates of our base specification (see equation 5.1) using pre-determined covariates as the dependent variables. Non-significant coefficients indicate that peer quality does not predict pre-determined covariates, which is consistent with quasi-random assignment. Results are shown separately for women and men, as well as for the whole sample. Significance levels: * p < 0.1, ** p < 0.05, *** p < 0.01.*

Table 5.4 Effects of Peer Ability on Earnings

	Women					Men				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Mean rank of female peers	1,013 (1,213)	2,206* (1,137)	3,447*** (1,273)	3,468*** (1,273)	3,514*** (1,258)	76.95 (1,222)	223.0 (1,279)	994.3 (1,407)	968.3 (1,403)	909.2 (1,397)
Mean rank of male peers	−2,094*** (787.5)	−1,219 (839.5)	−211.2 (934.1)	−2010 (934.8)	−283.8 (950.5)	419.7 (1,362)	784.2 (1,326)	2,925** (1,486)	2,960** (1,481)	2, 860* (1,486)
Own rank	4,430*** (296.7)	4,478*** (295.8)	4,540*** (300.5)	4,403*** (290.2)	4,405*** (290.0)	4,523*** (366.5)	4,540*** (364.8)	4,643*** (369.2)	4,707*** (351.7)	4,705*** (351.2)
Linear trends		✓	✓	✓	✓		✓	✓	✓	✓
Quadratic trends			✓	✓	✓			✓	✓	✓
Individual covariates				✓	✓				✓	✓
Average peer covariates					✓					✓
N. Clus.	936	936	936	936	936	936	936	936	936	936
N. Obs.	167,357	167,357	167,357	167,357	167,357	184,911	184,911	184,911	184,911	184,911
R^2	0.151	0.159	0.165	0.165	0.165	0.163	0.171	0.176	0.177	0.177
Mean dependent variable	8,826	8,826	8,826	8,826	8,826	10,423	10,423	10,423	10,423	10,423

Notes: *The Table shows, separately for women (Columns 1 to 5) and men (Columns 6 to 10), estimates of the effect of peer ability on average earnings 10 years after enrollment. All the specifications include fixed effects by program and year as well as controls for own test scores. Specifications for women (2-5) and men (7-10) add one layer of complexity at a time: first linear trends by program, then quadratic trends, then individual-level covariates, and finally peers' average covariates. Standard errors are clustered at the program level. Significance levels: * p < 0.1, ** p < 0.05, *** p < 0.01.*

Table 5.5 Effects of Peer Ability on Earnings

	Women						Men					
	(1) 5 years	(2) 6 years	(3) 7 years	(4) 8 years	(5) 9 years	(5) 10 years	(6) 5 years	(7) 6 years	(8) 7 years	(9) 8 years	(9) 9 years	(10) 10 years
Mean rank of female peers	−340.6 (260.7)	65.06 (430.0)	1,236** (600.2)	3,167*** (795.1)	4,109*** (985.9)	3,514*** (1,258)	135.0 (304.1)	−35.91 (448.3)	137.9 (638.5)	930.9 (853.5)	1,163 (1,065)	909.2 (1,397)
Mean rank of male peers	341.6 (226.1)	43.86 (411.4)	−196.1 (547.6)	380.8 (693.2)	−311.7 (774.1)	−283.8 (950.5)	124.9 (301.0)	−342.0 (477.1)	275.9 (667.6)	1,619* (926.1)	2,802** (1,162)	2,860* (1,486)
Own rank	−232.4*** (63.15)	962.0*** (116.8)	2,275*** (175.7)	3,353*** (210.5)	4,233*** (249.6)	4,405*** (290.0)	−930.8*** (135.3)	−191.9 (191.3)	1,080*** (269.2)	2,404*** (281.1)	3,664*** (298.2)	4,705*** (351.2)
N. Clus.	936	936	936	936	936	936	936	936	936	936	936	936
N. Obs.	188,533	188,533	188,533	188,533	188,533	188,533	167,357	207,461	207,463	207,463	207,463	184,911
R^2	0.141	0.183	0.202	0.189	0.177	0.165	0.115	0.140	0.153	0.160	0.171	0.177
Mean dependent variable	627	1,786	3,577	5,537	7,357	8,826	893	1,717	3,412	5,797	8,224	10, 423

Notes: *The Table shows, separately for women (Columns 1 to 6) and men (Columns 7 to 12,) estimates of the effect of female and male peer ability on yearly earnings 5 to 10 years after college enrollment. All columns show results from the full specification, with fixed effects by program and year, controls for own test scores, linear and quadratic trends by program, individual-level covariates, and peers' average covariates. Standard errors are clustered at the program level. Significance levels: *p<0.1, **p<0.05, ***p<0.01.*

Table 5.6 Effects of Peer Ability on Earnings by Math Ability

	Women		Men	
	(1) low ability	(2) high ability	(3) low ability	(4) high ability
Mean rank of female peers	3,125** (1,300)	3,079 (2,931)	141.3 (1,748)	1,864 (1,971)
Mean rank of male peers	−1,151 (896.0)	2,321 (2,819)	1,142 (1,477)	3,676 (3,082)
Own rank	3,895*** (323.0)	5,165*** (1,558)	2,960*** (372.5)	10,970*** (1,349)
N. Clus.	871	873	858	885
N. Obs.	87,114	80,204	71,129	113,737
R^2	0.141	0.183	0.143	0.183
Mean dependent variable	7,646	10,109	8,398	11,689

Notes: *The Table shows heterogeneous peer effects by math ability. Students with math test scores below (above) the median for the complete sample are classified as having a low (high) math score. All columns show results from the full specification, with fixed effects by program and year, controls for own test scores, linear and quadratic trends by program, individual-level covariates, and peers' average covariates. Standard errors are clustered at the program level. Significance levels: *p<0.1, **p<0.05, ***p<0.01.*

Table 5.7 Effects of Peer Ability on Employment

	Women					Men				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Mean rank of female peers	−0.02 (0.05)	0.04 (0.05)	0.07 (0.06)	0.07 (0.06)	0.08 (0.06)	−0.04 (0.04)	−0.01 (0.04)	0.05 (0.05)	0.05 (0.05)	0.04 (0.05)
Mean rank of male peers	0.08** (0.04)	0.05 (0.04)	0.03 (0.05)	0.03 (0.05)	0.03 (0.05)	0.06 (0.05)	0.04 (0.05)	0.02 (0.06)	0.01 (0.06)	0.02 (0.06)
Own rank	0.05*** (0.01)	0.05*** (0.01)	0.05*** (0.01)	0.07*** (0.01)	0.07*** (0.01)	−0.02 (0.01)	−0.02 (0.01)	−0.02 (0.01)	0.01 (0.01)	0.01 (0.01)
Linear trends		✓	✓	✓	✓		✓	✓	✓	✓
Quadratic trends			✓	✓	✓			✓	✓	✓
Individual covariates				✓	✓				✓	✓
Average peer covariates					✓					✓
N. Clus.	936	936	936	936	936	936	936	936	936	936
N. Obs.	167,357	167,357	167,357	167,357	167,357	184,911	184,911	184,911	184,911	184,911
R^2	0.094	0.103	0.109	0.110	0.110	0.095	0.103	0.109	0.112	0.112
Mean dependent variable	0.59	0.59	0.59	0.59	0.59	0.63	0.63	0.63	0.63	0.63

Notes: *The Table shows, separately for women (Columns 1 to 5) and men (Columns 6 to 10), estimates of the effect of peer ability on the probability of being employed 10 years after enrollment. All the specifications include fixed effects by program and year as well as controls for own test scores. Specifications for women (2-5) and men (7-10) add one layer of complexity at a time: first linear trends by program, then quadratic trends, then individual-level covariates, and finally peers' average covariates. Standard errors are clustered at the program level. Significance levels: *p<0.1, **p<0.05, ***p<0.01.*

Table 5.8 Effects of Peer Ability on Graduation

	Women					Men				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Mean rank of female peers	0.26*** (0.05)	0.19*** (0.06)	0.20*** (0.07)	0.19*** (0.07)	0.19*** (0.07)	0.05 (0.05)	0.02 (0.06)	0.03 (0.07)	0.02 (0.07)	0.01 (0.07)
Mean rank of male peers	0.13*** (0.05)	0.09* (0.05)	0.03 (0.06)	0.03 (0.06)	0.04 (0.06)	0.29*** (0.06)	0.18*** (0.07)	0.16* (0.08)	0.15* (0.08)	0.14* (0.08)
Own rank	0.39***	0.39***	0.39***	0.37***	0.36***	0.46***	045***	0.45***	0.43***	0.43***
Linear trends		✓	✓	✓	✓		✓	✓	✓	✓
Quadratic trends			✓	✓	✓			✓	✓	✓
Individual covariates				✓	✓				✓	✓
Average peer covariates					✓					✓
N. Clus.	907	907	907	907	907	909	909	909	909	909
N. Obs.	126,560	126,560	126,560	126,560	126,560	134,998	134,998	134,998	134,998	134,998
R^2	0.148	0.159	0.166	0.168	0.168	0.132	0.141	0.147	0.149	0.149
Mean dependent variable	0.71	0.71	0.71	0.71	0.71	0.57	0.57	0.57	0.57	0.57

Notes: *The Table shows, separately for women (Columns 1 to 5) and men (Columns 6 to 10), estimates of the effect of peer ability on college graduation 10 years after enrollment. All the specifications include fixed effects by program and year as well as controls for own test scores. Specifications for women (2-5) and men (7-10) add one layer of complexity at a time: first linear trends by program, then quadratic trends, then individual-level covariates, and finally peers' average covariates. Standard errors are clustered at the program level. Significance levels: *p<0.1, **p<0.05, ***p<0.01.*

Table 5.9 Effects of Peer Ability on Graduation Timing

	Women						Men					
	(1) 5 years	(2) 6 years	(3) 7 years	(4) 8 years	(5) 9 years	(5) 10 years	(6) 5 years	(7) 6 years	(8) 7 years	(9) 8 years	(9) 9 years	(10) 10 years
Mean rank of female peers	0.03 (0.06)	0.20** (0.08)	0.20** (0.08)	0.20*** (0.08)	0.24*** (0.08)	0.19*** (0.07)	0.05 (0.03)	−0.01 (0.05)	0.03 (0.06)	0.02 (0.07)	−0.01 (0.07)	0.01 (0.07)
Mean rank of male peers	0.17** (0.08)	0.03 (0.07)	0.04 (0.07)	0.06 (0.07)	0.03 (0.06)	0.04 (0.06)	−0.02 (0.05)	0.05 (0.07)	0.10 (0.08)	0.10 (0.08)	0.15* (0.08)	0.14* (0.08)
Own rank	0.14*** (0.01)	0.32*** (0.01)	0.38*** (0.01)	0.39*** (0.01)	0.38*** (0.01)	0.36*** (0.01)	0.08*** (0.01)	0.22*** (0.01)	0.32*** (0.02)	0.39*** (0.02)	0.41*** (0.02)	0.43*** (0.02)
N. Clus.	907	907	907	907	907	907	909	909	909	909	909	909
N. Obs.	126,560	126,560	126,560	126,560	126,560	126,560	134,998	134,998	134,998	134,998	134,998	134,998
R^2	0.366	0.335	0.270	0.223	0.188	0.168	0.300	0.260	0.219	0.186	0.161	0.149
Mean dependent variable	0.11	0.31	0.47	0.59	0.66	0.71	0.05	0.15	0.30	0.42	0.51	0.57

Notes: *The Table shows, separately for women (Columns 1 to 6) and men (Columns 7 to 12), estimates of the effect of female and male peer ability on the probability of graduation 5 to 10 years after college enrollment. All columns show results from the full specification, with fixed effects by program and year; controls for own test scores; linear and quadratic trends by program; individual-level covariates; and peers' average covariates. Standard errors are clustered at the program level. Significance levels: *p<0.1, **p<0.05, ***p<0.01.*

Table 5.10 Effects of Peer Ability on Fertility

	Women					Men				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Mean rank of female peers	−0.22*** (0.04)	−0.17*** (0.04)	−0.13*** (0.05)	−0.13*** (0.05)	−0.12** (0.05)	−0.05 (0.03)	−0.05 (0.04)	−0.04 (0.04)	−0.05 (0.04)	−0.04 (0.04)
Mean rank of male peers	−0.02 (0.04)	−0.02 (0.04)	−0.01 (0.04)	−0.01 (0.04)	−0.00 (0.04)	−0.14*** (0.04)	−0.10** (0.04)	−0.10** (0.05)	−0.10** (0.05)	−0.09* (0.05)
Own rank	−0.13*** (0.01)	−0.13*** (0.01)	−0.13*** (0.01)	−0.10*** (0.01)	−0.10*** (0.01)	−0.05*** (0.01)	−0.05*** (0.01)	−0.05*** (0.01)	−0.02 (0.01)	−0.02 (0.01)
Linear trends		✓	✓	✓	✓		✓	✓	✓	✓
Quadratic trends			✓	✓	✓			✓	✓	✓
Individual covariates				✓	✓				✓	✓
Average peer covariates					✓					✓
N. Clus.	936	936	936	936	936	936	936	936	936	936
N. Obs.	194,368	194,368	194,368	194,368	194,368	214,207	214,207	214,207	214,207	214,207
R^2	0.074	0.079	0.084	0.086	0.086	0.052	0.057	0.062	0.065	0.065
Mean dependent variable	0.27	0.27	0.27	0.27	0.27	0.20	0.20	0.20	0.20	0.20

Notes: *The Table shows, separately for women (Columns 1 to 5) and men (Columns 6 to 10), estimates of the effect of peer ability on the probability of having a child 10 years after enrollment. All the specifications include fixed effects by program and year as well as controls for own test scores. Specifications for women (2-5) and men (7-10) add one layer of complexity at a time: first linear trends by program, then quadratic trends, then individual-level covariates, and finally peers' average covariates. Standard errors are clustered at the program level. Significance levels: *p<0.1, **p<0.05, ***p<0.01.*

5.5 Conclusion

In this chapter, we investigate the long-term effects of college peers. Using nationwide data from higher education in Chile, and exploiting variation across cohorts and within programs, we show that ability of same-sex peers can significantly affect outcomes by age 28. For both men and women, exposure to better same-sex peers increases college graduation, improves labor market outcomes, and delays fertility.

We measure peer quality as the average rank (valued 0 to 1) of peers' scores in a standardized college admission test. Our results show that a 10 percentage point increase in same-sex peers' quality increases graduation rates by 2.7% for women and 2.5% for men. In addition, having peers with higher test scores can help students graduate earlier. Interestingly, our analysis shows that higher math scores of female peers are almost as important as higher women's own math scores, with a 10 percentage point increase leading to a 6.2% increase in graduation relative to the mean. This same increase in test scores leads to earnings that are $351 higher for men, and $286 higher for women. As for the impact on fertility, a 10 percentage point increase in same-sex peer quality leads to an approximately 4.5% drop in the likelihood that men and women will have a child by age 28.

From a policy perspective, this chapter suggests that investments in female human capital may be more effective for advancing gender equality than it is usually assumed thanks to multiplier effects that propagate through women's networks of female peers. Furthermore, our results suggest that social structures that promote interactions between women of high and low ability might simultaneously increase efficiency and gender equity.

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Gender Differences in Daily Mobility and Job Accessibility

A Challenge to Women's Economic Autonomy in the Metropolitan Area of Buenos Aires, Argentina

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People experience differences in mobility patterns due to individual characteristics, which can enable or hamper access to opportunities. One crucial determinant of these disparities is gender. This chapter provides evidence on the differential mobility and job accessibility patterns of men and women in the Metropolitan Area of Buenos Aires, Argentina. To this end, the chapter develops an intersectional diagnosis of gender gaps in daily mobility and builds a potential job accessibility model. The findings suggest that the relative cost of public transport and the distance to job opportunities are associated with gender gaps in labor access. The chapter also outlines the implications of these results for urban and transport policies. ¶

6.1 Introduction

Mobility has a vital role in people's lives: by moving around, individuals can conduct activities related to work, education, health, and leisure. As a mean to achieve opportunities, mobility then becomes crucial to guaranteeing rights, promoting wellbeing, and fostering social interaction.

People experience differences in their mobility patterns due to their socioeconomic, demographic, and physical characteristics (Hernández & Hansz, 2021; Jirón Martínez, 2015; Mattson, 2012; Yañez-Pagans et al., 2019). These features can enable or hamper people's access to opportunities in their surroundings. One crucial determinant of these differences is gender: worldwide, women and men experience contrasts when moving through a given territory and when using the space as a consequence of gender norms (Ericksen, 1977; Law, 1999; Root et al., 2000). This shapes their access to opportunities, potentially affecting women's physical, economic, and decisional autonomies, defined as the ability to make free and informed decisions about their lives (Observatorio de igualdad de género de América Latina y el Caribe, 2011).

Studies from diverse disciplines have examined differences in how men and women live in cities and how this influences their travel patterns. Worldwide, mobility tends to reflect the traditional division of labor, with men as breadwinners and women as caregivers (Fontenelle Siqueira et al., 2020; Sanchez de Madariaga, 2013; Uteng, 2011). During the last century, a paradigm shift occurred as women's labor market participation surged (Goldin, 2006). Increasingly, families have become female-headed and/or have two providers (Buvinic, 1998; Folbre, 1990; Leonce, 2020). However, this process was not accompanied by a redistribution of care work, which still falls primarily on women, leading to their double burden of paid and unpaid work (England, 2010).

Evidence suggests that mobility policies are both fed by and reinforce these gender norms. Transport systems began to develop a century ago when mostly men participated in the public sphere (Pérez, 2019). Thus, their design aimed to respond to labor demand (Levy, 2013), with a tendency to concentrate in central urban areas with higher frequency during rush hours that coincide with working hours. In contrast, care-related mobility and women's needs were mostly ignored (Law, 1999; Sánchez de Madariaga & Zucchini, 2019). The gender blindness in the design of cities and their transport infrastructure increases costs and travel times, thus, limiting

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women's access to economic opportunities (Buenos Aires Ciudad, 2019; UNECE Inland Transport Committee, 2008). This lack of gender responsiveness can turn urban mobility into an obstacle for women's participation in diverse male-dominated spheres.

Latin America is no exception to this trend. The rapid population increase during recent decades has led to complex mobility patterns for people and goods, together with an uneven distribution of public services and job opportunities (CAF, 2011). As no space is gender-neutral, women experience fewer degrees of freedom, which affects their mobility, access to the public realm, and full autonomy (Casas et al., 2019; Pérez, 2019; Rozas Balbontín & Salazar Arredondo, 2015).

Given this context, it is relevant to examine the mobility patterns of people in Latin America and their access to economic opportunities through a gender lens. This analysis is crucial to help design appropriate policies; build inclusive infrastructure; and provide efficient and equitable transport services that are gender-responsive. To this end, this chapter provides evidence from the Metropolitan Area of Buenos Aires (MABA) in Argentina on the differential mobility patterns of men and women, and how these relate to women's labor inclusion.

To analyze the gendered links between urban traveling and labor participation, this chapter develops an intersectional diagnosis of gender gaps in mobility and builds a potential job accessibility index. This index will measure the ease of reaching a specific destination given a set of obstacles and opportunities related to the transport supply. Potential accessibility models are crucial analytical tools to study the interaction between urban structure, transport systems, and individual characteristics (Hernández & Hansz, 2021). They can measure access to key activities and inform policies that contribute to social inclusion (Social Exclusion Unit, 2003). In this chapter, the main hypothesis to test is whether women's limited access to job opportunities can be associated with constraints on their daily mobility, i.e., higher transport costs or longer commuting/traveling distance.

Buenos Aires is a good representative of a Latin American city, making it a relevant place to study these issues. In these urban areas, access to job opportunities is unequal; transport supply is uneven and unplanned; and sprawling urban growth expands faster than public services and transport networks. This situation increases social and geographic segregation (IDB, 2013; Yañez-Pagans et al., 2019) while allowing gender gaps in economic autonomy to persist. Although governments have enacted policies to address urban, socioeconomic, and gender gaps, nodes of intersecting and compounding inequalities remain. Therefore, there is a need to evaluate the interaction between these indicators with an intersectional approach. The overall goal of this chapter is to inform transport and urban policies to promote women's economic autonomy, which is a prerequisite to achieving inclusive and sustainable development in the region.

Key terms

Before we begin our analysis, it is necessary to clarify some definitions that are widely used throughout the chapter.

First, we refer to *mobility* as the daily movements of people from one place to another to conduct quotidian activities such as work, care, shopping, leisure, or socializing (Hanson, 2010). In this context, a *trip* is the basic unit of measurement of mobility. It is a movement in one direction between an origin and a destination, for a given reason, and following a particular route (A. I. Gutiérrez & Pereyra, 2019). Trips can be *chained*, which refers to a sequence of trips one after the other for diverse purposes. This chaining, in turn, leads to *polygonal* itineraries, which imply the combination of different, subsequent trips across a given territory. In contrast, *pendular* journeys are movements between the household and a given destination, such as the workplace or educational facilities.

Secondly, we interpret *gender* as the characteristics, roles, behaviors, expectations, and duties attributed to men and women. It is a social and cultural construction that transcends the binary categorization of biological sex, as it reflects the manifested gender identity of individuals. While we use this term to address the inequalities described in this document, the databases employed only include sex as a variable. This indicator allows the distinction between men and women but ignores other gender identities. Therefore, given the absence of gender-disaggregated data that would allow an exhaustive analysis, this research considers sex

disaggregation as a proxy to study gender gaps in daily mobility. Nonetheless, we recognize the limitations of this approach and the need for national statistics to include a gender variable to allow for a more in-depth analysis that considers the full spectrum of diversity.

Finally, this study calls for an *intersectional* approach to mobility patterns from a gender perspective. Intersectionality implies analyzing individual features that overlap and interact with gender, creating compounding inequalities (Crenshaw, 1989). While the data available does not allow a fully intersectional study, we dig into the interaction of gender and characteristics such as income level, household role, disability, and care responsibilities to better diagnose the daily experience of diverse groups of women. This, we believe, is crucial to making a substantial and transformative impact on gender equality.

6.2 Literature review

Mobility and gender

Mobility is enabled by, and also affects, the possibilities presented in the public space. A lattice of social dynamics and power relations shapes these opportunities and is reflected in the design of cities, transport systems, and public services. As a result, some populations face constraints in their traveling patterns. Women appear to be one of these, as a myriad of factors condition their movements and, consequently, affect their activities, autonomies, and wellbeing.

Around the 1970s, transport planners started to recognize the existence of some disadvantaged groups (Law, 1999). It was in this context that certain scholars began to question the gender-blindness of transport systems. Pioneering works identified the differential mobility patterns of men and women and public policy's duty to consider them (Giuliano, 1979; Rosenbloom, 1978) amidst a 'quiet revolution' (Goldin, 2006) that led to a massive increase in women's labor inclusion and changed intra-household dynamics. This setting kickstarted a strand of literature coined by Law (1999) as "women and transport", which focused on women's travel needs and behavior in urban settings in the developed world. In time, the academic work evolved into a broader scope of "gender and mobility". This approach dug into conceptual investigations of gender, more diverse mobility issues, and other regions of the world.

Overall, there is a substantial body of research studies about how gender shapes mobility, identifying gender gaps in travel behavior through data analysis. Most quantitative analyses, however, focus on a binary analysis of gender due to a lack of diversity in data. One of the conclusions is that women have smaller spatial ranges than men in everyday mobility (Hanson, 2010). Additionally, around the world, gender differentials seem to exist in terms of transport access, trip purpose, the number of daily trips, transport mode, trip chaining, trip company, and traveling time slots, among others (e.g. Ericksen, 1977; Fox, 1983; Hanson, 2010; Pas, 1984; Root et al., 2000; Rosenbloom, 2006; Sanchez de Madariaga, 2013). While some studies suggest a potential convergence in men's and women's travel patterns as more women join the labor force and incomes increase, the evidence reveals that the differentials persist (McGuckin & Nakamoto, 2005; Rosenbloom, 2006; Sanchez de Madariaga, 2013). These gaps are often not homogeneous but vary according to socioeconomic and demographic features such as age, ethnicity, income level, household composition, marital status, geographic area, location, and other characteristics (Rosenbloom, 2006; Uteng, 2011). This situation led many scholars to argue for an intersectional and gender-sensitive approach to mobility (Henriksson, 2019; Joelsson & Lindkvist Scholten, 2019).

While these gaps hold for both developed and developing countries, the latter register increased challenges in terms of gender differentials in mobility. As Uteng (2011) explains, developing countries usually depict high contrasts between rural and urban areas, as well as between low- and middle-income populations in cities. The author also highlights the deficits in public transport systems; the limited access to private means of transport; and the role that religious and cultural beliefs may play in society as factors intervening in mobility patterns in the Global South.

The literature draws on many determinants to explain these gaps, with many studies highlighting the importance of gender roles and norms as a critical factor (Casas et al., 2019; Ericksen, 1977; Law, 1999; Lee et al., 2018; Pas, 1984; Pickup, 1984; Root et al., 2000). As Hanson (2010) underscores, individual characteristics such as gender do not matter in isolation but in their interaction with the context, which includes the household, the family, the community, and society as a whole. Thus, as many variables are gendered, including household roles, labor participation, sense of safety, or income level, the role of gender in determining travel patterns is undeniable (Rosenbloom, 2006). Law (1999) pinpoints five channels through which gender shapes mobility choices, behaviors, perspectives, and experiences: the division of labor and activities; the access to resources (time, money, skills, technology), the built environment, the subject identity as an experience of embodiment, and the symbolic coding of the 'feminine and masculine'. These last two channels consider how the cultural and historical aspects of masculine and feminine identities code the experiences related to mobility in gendered terms. Sanchez de Madariaga (2013) outlines a different but compatible categorization of the main determinants of mobility identified in the literature, namely: safety and security; urban structure; race and ethnicity; employment locations; household structure; and stage of life.

Against this backdrop, many studies argue that despite the rapid rise in women's insertion in the labor market around the world during the last fifty years, they are still primarily responsible for the chores related to domestic and care work (Lee et al., 2018; Pickup, 1984). That leads to a dual role reflected in their mobility patterns, as women tend to take trips that are shorter and closer to home, travel more often with dependents, and undertake 'chains of tasks' (Sanchez de Madariaga, 2013). Turner & Niemeier (1997) suggest that household responsibilities often lead women to choose shorter commute times and distances than men. Fontenelle Siqueira et al. (2020) also find that the sexual division of labor impacts trip generation and time poverty in Brazil, affecting women's labor insertion. These gender differentials in mobility may increase in regions where zoning divides residential and commercial areas (Uteng, 2011). Sánchez de Madariaga (2009) calls this traveling the 'mobility of care', which she defines as all the trips related to home and caring responsibilities. This mobility encompasses daily shopping, escorting others, caregiving visits, administrative errands, home maintenance, and organization, among others.

Despite this wide array of existing research, the findings and insights have not translated into more gender-responsive transport systems and urban planning (Sánchez de Madariaga & Zucchini, 2019). Some studies attribute these flaws to the lack of women in policymaking positions and the failure to incorporate the views of women as users in participatory instances (Uteng, 2011). This absence, authors argue, leads to gender biases in transport systems that focus on productive work and motorized transport, which are male-dominated, disregarding the mobility of care and notions of intersectionality (Joelsson & Lindkvist Scholten, 2019; Levy, 2013). In this way, transport systems do not adequately respond to the needs of caregivers, who depict complex and often unpredictable mobility patterns to fulfill everyday tasks (Sanchez de Madariaga, 2013). Nonetheless, some scholars posit that even women's participation in decision-making does not ensure a feminist and gender-sensitive perspective in public policies, underscoring the need for a profound cultural change to ensure this approach (Díaz Langou et al., 2019).

The absence of a gender lens in transport is also visible in mobility statistics. Generally, daily mobility surveys do not include a specific category for care-related trips. Instead, this purpose of traveling ends up hidden under other tags, such as strolling, visits, and shopping, which can also be personal or leisure activities (Sánchez de Madariaga, 2009). As data is collected from the point of view of the male breadwinner with limited care responsibilities, activities for social reproduction appear only as a 'break' from paid work and only represent a modest share of total trips (Sánchez de Madariaga, 2009). Nonetheless, when care mobility is appropriately measured or approximated, estimates show that it represents a similar share of total trips as employment (Sanchez de Madariaga, 2013; Sánchez de Madariaga & Zucchini, 2019). Women make most of these care-related journeys.

In Latin America, an incipient but growing body of research diagnoses gender gaps in mobility and hypothesizes about its determinants in regional analyses (e.g. Allen et al., 2019; Casas et al., 2019; Granada et al., 2016; Jirón Martínez, 2007; Jirón & Zunino Singh, 2017; Pérez, 2019; Rico & Segovia, 2017). Many studies

have also focused on specific cities or countries with quantitative and qualitative methodologies (A. Gutiérrez & Reyes, 2017; Hernández, 2019; Íñiguez-Rueda & Pessoa de Oliveira, 2017; Lazo & Contreras, 2009; Soto Villagrán, 2013). In the case of Argentina, Gutiérrez & Pereyra (2019) and Dmuchowsky & Velazquez (2018) provide an initial examination of daily mobility that summarizes major trends in the largest population centers of the country. Overall, these studies generally validate the existence of gender differentials in diverse aspects of mobility. Still, a door remains open for intersectional research that tries to disentangle the relationship between mobility disparities and socioeconomic characteristics.

Accessibility

Alongside mobility, many studies from the field of transport research have centered their investigations around accessibility. While mobility is described as the potential for movement, Hansen (1959) first characterized accessibility as 'the potential of opportunities for interaction'. Both perspectives are related yet analyze different phenomena. Mobility focuses on a population's general ability to move around in a given space, whereas accessibility adds land-use patterns, network connectivity, and individual preferences to the equation. The latter approach facilitates measuring the impact of land use, transport developments, and policy plans on the functioning of society (Geurs & van Wee, 2004).

During recent decades, Hansen's definition has been widely used and adapted in further research. Scholars have highlighted the policy relevance of accessibility indexes to study inequalities between different regions and between populations with diverse characteristics. These indicators have also been valuable to assess the equity impacts of transport interventions and introduce social justice into transport planning (Martens et al., 2012; Oviedo & Bocarejo, 2011).

There is a variety of methodological approaches to measure and operationalize accessibility. Geurs & van Wee (2004) identify four strands: infrastructure-based, which studies the characteristics of transport facilities; location-based, which considers the activities distributed in space and time; people-based, which contemplates accessibility as an attribute of individuals; and utility-based, which examines the utility for individuals. Among the location-based approximations, the authors identify potential or gravity-based accessibility measures as models that estimate the accessibility of opportunities (i.e., shops, jobs, education, health, social and recreational facilities, etc.) from a given area to all other zones.

Notwithstanding this body of research, gender-disaggregated accessibility measures do not abound in the literature, a scarcity that extends to academic work for Latin America (Vecchio et al., 2020). Most studies have examined the accessibility of urban opportunities for men and women, especially in the developed world. Some papers combine GIS methodologies and surveys in small samples. These studies provide interesting insights but depict limited external validity. Pioneering work by Kwan (1999) considered space-time constraints and found significant gender gaps in individual access to urban opportunities in Ohio, USA. Using a similar methodology, Kim (2007) suggests that household responsibilities lead to accessibility differentials between men and women in Portland, USA. Kwan & Kotsev (2015) confirm these findings in an analysis for Sofia, Bulgaria, providing some evidence for developing countries.

Larger-scale studies have also focused on North America and Europe, using daily mobility surveys, census, and spatial data, although gender-sensitive research is also scarce. In Madrid and Barcelona, Matas et al. (2010) find that low job accessibility leads to worse employment outcomes for women. Cui & Levinson (2020) challenge common results; their study suggests that male workers do not have an advantage over female workers in accessing labor opportunities in Minneapolis-St Paul (USA). That said, they do find differences in the distribution of gender-specific jobs.

While the research on gender differences in daily mobility is taking a more important role in Latin America, the literature on job accessibility from a gender lens presents only a few examples. Many scholars have analyzed job accessibility, both in general or related to a specific means of transport. Overall, these studies provide valuable insights from a socioeconomic perspective yet lack a deep, gendered assessment (e.g. Baron et al., 2017; Bocarejo & Oviedo, 2012; Boisjoly et al., 2017; Falavigna & Hernandez, 2016; Girão et al., 2017; Guzman et al., 2017; Guzman & Hernandez, 2018; Hernandez, 2018; Hernandez et al., 2020; Oviedo et al., 2019; Pucci et al.,

2019; Slovic et al., 2019; Yomal, 2018). Nonetheless, some exceptions do focus on the gender aspects of accessibility. Martinez et al. (2018) confirm their hypothesis that two public transport interventions in Lima – bus rapid transit and elevated rail systems –improved job access for women, with no significant effect for men. In turn, Lecompte & Bocarejo (2017) reveal that, when considering the time and cost of traveling, women have lower accessibility than men in Bogota. This gap increases in lower-income areas. Finally, research conducted in the Metropolitan Area of Buenos Aires found that, when accounting for average commuting distances and times, men with children exhibit higher accessibility to jobs than women with children (Peralta Quiros et al., 2009).

In this context, while existing research for the region provides precious insights on gender gaps in daily mobility, some knowledge gaps still prevail. The contribution of this study to the body of evidence will be twofold. First, it will analyze gender gaps in mobility from an intersectional perspective, considering several sociodemographic characteristics that might amplify the differentials. Second, it will follow Lecompte & Bocarejo's (2017) measurement of potential accessibility to account for the relationship between travel distances and costs and job inclusion. In this way, this research will generate additional evidence on the linkages between mobility, accessibility, and labor participation that can support the need to promote more gender-sensitive urban and transport policies.

6.3 Data Sources

The study relies on three sources of data, which are used to explore gender differences in mobility patterns in the MABA: the Daily Mobility Survey, Argentina's Permanent Household Survey, and administrative records from the Unique System of Electronic Tickets.

First, this research employs the Daily Mobility Survey (ENMODO, for its acronym in Spanish). This database is the main source of information about mobility patterns in the metropolitan areas of Argentina. The National Institute of Statistics and Censuses (INDEC) conducts this survey at the request of the Ministry of Transport and the Ministry of Internal Affairs with no established frequency. Given some methodological problems with the 2014-15 survey, this study uses the 2009-10 edition of ENMODO.[1] On a typical working day, this survey selected a representative sample of one of every 150 households and interviewed all household members who had made a trip the previous day. The survey records information about daily journeys and activities in terms of transport mode; trip purpose; mean travel time; origin and destination; and costs, among others. It also gathers data about household composition, sociodemographic characteristics, and employment details.

While the ENMODO offers valuable data on mobility, its use in academic research has been limited (A. I. Gutiérrez & Pereyra, 2019). While the data allows us to shed light on traveling patterns from a gender lens, some limitations of ENMODO should be acknowledged. First, its focus is on *compulsory* mobility, i.e., trips related to paid work and education. Therefore, the survey does not include "care work" as a traveling category, so we have to build it based on certain assumptions. Second, as it analyzes trips, ENMODO does not consider immobility, which might be crucial from a gender perspective. Third, the ENMODO considers "sex" as a dichotomous variable. This indicator allows the comparative examination of the mobility of men and women but ignores non-binary gender categorizations. Bearing in mind these caveats, the ENMODO feeds the identification of gendered mobility patterns and the job accessibility index.

Furthermore, the study considers data on individual income from Argentina's Permanent Household Survey (EPH) to build an accessibility index, combined with data from ENMODO. This survey provides information about demographic, social, and economic characteristics of households and individuals in the 31 largest

1 The ENMODO 2014-15 has been removed from official statistical websites due to its statistical issues. While there is a newer ENMODO (2018-19), its results and microdata are not available publicly or at request.

conglomerates of the country. It covers more than 26,000 households per quarter, representing around 70% of the total urban population. To ensure comparability with ENMODO, we use data from the final quarter of 2010 for the City of Buenos Aires and the MABA districts. We consider the average income per gender declared in EPH and assign this information to the observations from ENMODO.

Finally, the study uses administrative records from the Unique System of Electronic Tickets (SUBE, for its acronym in Spanish), the main transport smart card employed in Argentine cities since 2011. While sex-disaggregated data from SUBE is not publicly available, we made a public information request that granted us access to this information. The datasets include 36 million records of card users of the MABA for 2015-2019. For each year, we have information on all the transactions that occurred on one working day of a typical month (November). This data provides details on transport mode; time slot; trip chaining; the number of transactions made with a single registered card at a given moment; origin and destination of the trip; and the type of transaction. Also, the datasets identify subsidy payments that cover more than half of the transport fee and RED SUBE discounts that offer cumulative fare reductions when combining more than one trip. The only sociodemographic variable available for this dataset is sex, which allows a binary analysis of mobility patterns. This database contributes to the identification of mobility patterns, providing a more updated picture than the ENMODO survey.

The use of SUBE records for research purposes does have some limitations. Registering the ownership of a SUBE card is an optional procedure that grants access to reduced fees based on specific requirements and to the recovery of funds in case of card loss. As sex-disaggregated information is available only for registered cards and some people may choose to avoid this formality, we cannot contemplate the totality of the transactions from a gender lens. Nonetheless, the observations in our dataset can be representative of all daily transactions in the MABA, as they account for around 78% of the total. In addition, SUBE does not include socioeconomic characteristics, which hinders its use in the accessibility index and intersectional analysis. Notwithstanding these restrictions, this research provides an innovative statistical exploration of SUBE data, as there are no published, gender-sensitive studies that employ this database to date.

6.4 Methodology

To start with, this chapter investigates the gender gaps in transport use in the MABA from an intersectional perspective. The analysis will assess the differences in daily mobility between men and women, considering different aspects of traveling and individual characteristics. To this end, the descriptive analysis will draw on two sources of information. The ENMODO data will provide a broad overview of mobility patterns, considering sex, income quintile, disability, and household composition, among other variables. SUBE is a source of more recent real-use data, offering additional updated insights on mobility.

After identifying the gaps in mobility patterns, we will build a potential accessibility model to explore job accessibility by gender in the MABA. The analysis will only consider public transport, given its potential role in improving access to opportunities for the most deprived and generating equity outcomes.

Accessibility indexes are a helpful tool to compare access to opportunities between areas, between populations, or before and after a given transport intervention. This method uses a given urban structure and individual restrictions to estimate access. Based on a given transport system and land-use scheme, the analysis will reveal how differential impediments in mobility might relate to labor inclusion and, consequently, to gender gaps in economic autonomy.

While causalities cannot be attributed, measuring accessibility can be relevant to make diagnoses, evaluate potential transport policies, and identify inequalities (Oviedo & Bocarejo, 2011). This information can be valuable to prioritize interventions in terms of areas, characteristics, and target populations (Oviedo & Bocarejo, 2011).

To measure gender differences in potential job accessibility, this study follows the approach first proposed by Hansen (1959) and modified by Oviedo & Bocarejo (2011) and Lecompte & Bocarejo (2017). These authors consider accessibility as the ease of reaching a desired destination given specific opportunities and impediments. Thus, measuring potential accessibility enables us to capture the efforts that citizens make to reach a given activity or place and reveal existing inequalities.

In this context, Hansen's (1959) equation defines accessibility as follows:

$$A_i = a_j f(d_{ij})$$

where A_i is the accessibility of origin zone i, a_j is the attractiveness of destination zone j and $f(d_{ij})$ is a function of the cost in terms of distance of traveling from i to j. This formula estimates the potential accessibility of individuals located in zone i to job opportunities in all other zones (n). Oviedo & Bocarejo (2011) modify this approach to consider the economic cost of traveling between the origin and destination, which can become a critical obstacle to accessing transport systems. Lecompte & Bocarejo (2017) further adapted this methodology to conduct a gender analysis.

Following this literature and the data available for the MABA, we define accessibility as:

$$A_i = \sum_j O_j f(C_{ij})$$

where A_i represents the potential accessibility of individuals residing in zone i to all jobs (expressed as a share of total opportunities), O_j is the number of work opportunities available in the different locations j, and $f(C_{ij})$ is a generalized cost function that represents the effect of the primary impediments on the attractiveness of the opportunities. Based on the literature and travel behavior theory (Handy & Niemeier, 1997), we assume a negative exponential decay cost function defined by three main factors: physical distance between the origin and destination locations (D_{ij}), the mean percentage of monthly individual income spent on traveling from origin to destination (in this case, related to the transport cost per work-related trip (I_{ij})), and the cost sensitivity parameter (β).

$$\mathrm{f}(C_{ij}) = \exp(-\beta C_{ij}) = \exp(-\beta_1 D_{ij} + \beta_2 I_{ij})$$

Based on the political division of the MABA, this study includes the 42 districts of Greater Buenos Aires and the 15 Communes of the city of Buenos Aires as 57 travel analysis zones. Following the approach of Pucci et al. (2019), we estimate job opportunities by the sum of workplaces –both formal and informal– obtained through the ENMODO survey, considering the weighted number of workers reaching a given zone for work-related reasons. The ENMODO survey also provided the average number of work-related trips by sex and the average transport cost. In the generalized cost function, the travel distance between each zone centroid was approximated in an RStudio environment using the *osrm* package (Giraud, 2020). This approach estimates the distance and travel time of the shortest path between two points using the Open-Source Routing Machine (OSRM) and OpenStreetMap. Regarding the sensitivity parameters, we follow the approach of M.P. Kwan (1998), who sets β_1 to 0.01 and β_2 to 2 based on the point where the function approaches zero and the changes in its decline rate. Finally, we estimate the average income of men and women in MABA with information from the National Household Survey and assign it to observations in ENMODO. Based on this data, the index provides the share of total job opportunities available to an individual residing in each specific zone.

This index, like other gravity-based accessibility models, offers advantages over simply measuring travel time to the closest opportunity. First, it considers the full distribution of activities, accounting for the fact that areas offering more jobs will attract people from farther away (Delmelle & Casas, 2012). Additionally, it evaluates the combined effect of land-use and transport elements and incorporates assumptions on individuals' perceptions using a cost decay function (Geurs & van Wee, 2004).

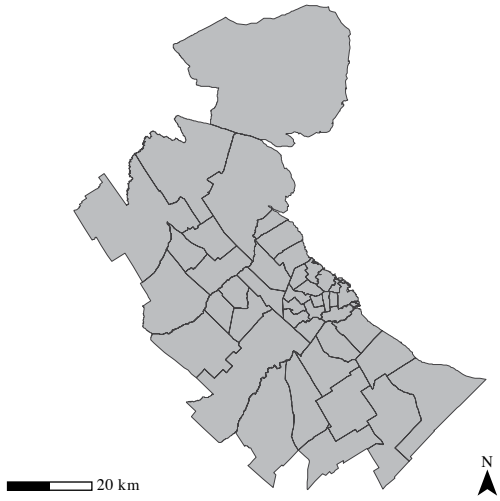
Although this methodology offers insightful knowledge about gender inequalities in job accessibility, there are some caveats to consider. First, due to data constraints, we cannot observe accessibility differences among different transport modes. Hence, we focus only on public transport due to its potential equity outcomes. Second, the data does not allow the disaggregation of relevant socioeconomic characteristics that matter from an intersectional perspective and can affect labor inclusion. We assume, given that distance and cost are not prohibitive, that individuals can access any job opportunity. This approach has the benefit of not restricting the fields available to men and women. Third, this study only considers spatial and economic restrictions to mobility and does not contemplate variables such as waiting times, sense of safety, flexibility, and others that might be important from a gender perspective. Fourth, we define the travel analysis zones according to local department divisions in MABA, where suburban areas tend to be larger and less dense than central areas. In this sense, the granular analysis of the distances between centroids declines the farther away you are from the center. This means the distance estimations might be less accurate for trips to or from the suburbs. Finally, the accessibility values for the MABA should not be compared to studies for other cities, as results may vary due to different approaches to measuring job opportunities and costs. The results of the index should be interpreted with these limitations in mind.

6.5 Case Study Context

A brief description of the MABA

The Metropolitan Area of Buenos Aires includes the Autonomous City of Buenos Aires and the forty-two surrounding districts[2] (Figure 6.1). This region is around 13,975 km^2 and had more than 14,800,000 inhabitants in 2010, according to the last census. While this represented around 37% of the total population (INDEC, 2010), it accounts for only 0.5% of Argentina's total area, leading to a high population density compared to the rest of the country.

Figure 6.1 Map of the districts of the MABA and the Communes of the City of Buenos Aires. Argentina.

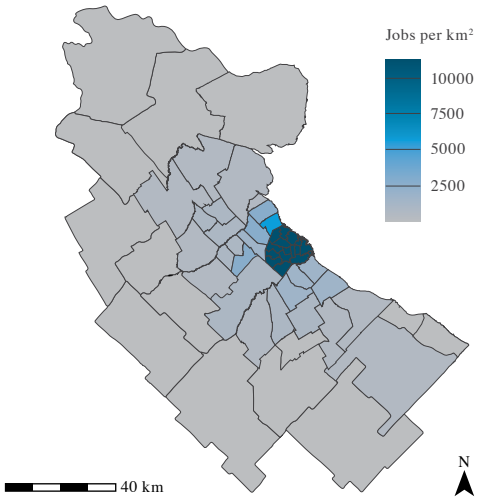


Source: *Open Street Maps*

2 While many definitions exist, in this study, we will follow the definition of ENMODO, which includes the city of Buenos Aires, the 24 districts conforming Greater Buenos Aires, and 18 adjacent districts.

At the same time, the MABA produces almost half of the country's total GDP (Muzzini et al., 2016). The region accounts for 44% of services, 45% of manufacturing activity, 38% of retail stores, and 34% of financial services (CAF, 2011). Nonetheless, these activities are not homogeneously distributed. There are significant differences between Buenos Aires City, which has the most economic opportunities, and the surrounding districts (Muzzini et al., 2016) (Figure 6.2).

Figure 6.2 Employment density by km2. Metropolitan Area of Buenos Aires. 2009-2010.



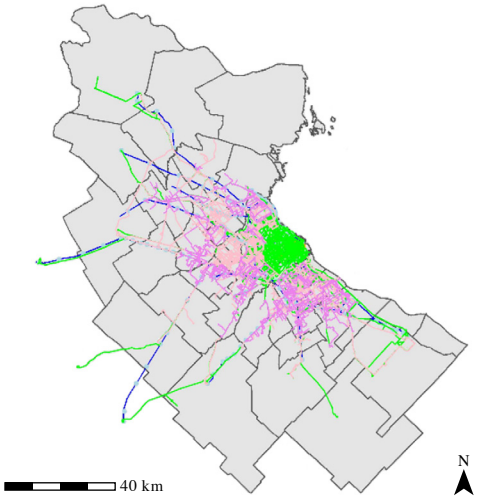
Source: *CIPPEC based on ENMODO (2009-10)*

In terms of mobility, the transport network is highly concentrated in this region (Figure 6.3). Traveling between the capital city and the periphery of Buenos Aires represents the main spatial movement of the country, which has increased in recent years (Muzzini et al., 2016). This phenomenon may be highly related to the fact that the MABA is home to the majority of economic opportunities. Investments in transport systems, however, have not accompanied this rise. The use of cars and motorized transport has increased while the use of public transportation has significantly declined (CAF, 2011). This situation poses challenges to the sustainable and inclusive development of mobility in the region.

Women's situation in the Greater Buenos Aires

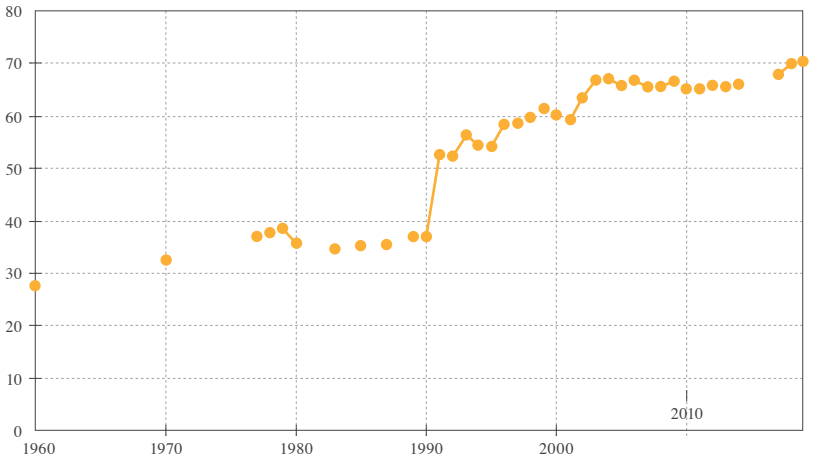
The massive rise in women's labor market participation has been one of the main socioeconomic phenomena of the last fifty years. Argentina has been no exception to this trend (Díaz Langou et al., 2019). While only 37% of women participated in the labor market in the mid-1970s in the MABA, this percentage soared to more than 60% in the early 2000s (Beccaria et al., 2017). In this period, the ratio of female-to-male labor participation increased from 37% to more than 70% (Figure 6.4). Since then, it has stagnated around these figures. (Díaz Langou et al., 2019).

Figure 6.3 Employment density by km2. Metropolitan Area of Buenos Aires. 2009-2010.



Source: *CIPPEC based on Ministry of Transport of Argentina.*

Figure 6.4 Ratio of female to male labor force participation rate. Argentina. 1960-2019.



Notes: *The plot shows average earnings as a function of the number of years since college enrollment.*

These gender disparities extend beyond participation in the workforce. For women participating in the Argentine labor market, the conditions of their inclusion are more precarious than those of their male counterparts. As Table 6.1 shows, in 2010[3], 53% of women were employed, compared to 77% of men. In contrast, they experienced higher levels of unemployment, sub-employment, and informal employment. In addition, the average monthly wage gap reached 23% and women are a minority in leadership roles, both in the private- and public sectors.

3 The analysis is conducted using 2010 data to allow comparison with the ENMODO survey. Nonetheless, labour indicators have remained generally stable for women during the last decade, indicating a stagnation of the improvements in gender gaps.

Table 6.1 Labor indicators by sex. Argentina. 4Q 2010

	Employment	Unemployment	Sub-employment	Informality	Average monthly wage
Women	53%	9.2%	11.3%	36%	$1899
Men	77%	6.4%	6.2%	31%	$2482

Source: *CIPPEC based on INDEC-EPH*

On the flip side, women were primarily in charge of the burden of unpaid domestic and care work. According to INDEC (2013), 89% of women declared undertaking these chores for an average of 6.4 hours daily, compared to 58% of men who reported doing this work, spending an average of 3.4 hours per day. Therefore, while women have lower participation in the labor market, this is correlated with higher involvement in reproductive work, an essential activity for sustaining our everyday lives. Some scholars have called this phenomenon "the asymmetric revolution", as women's impressive labor insertion has not been accompanied by a redistribution of domestic work among the genders (England, 2010). This sexual division of labor leads to increased time poverty for women, which is a barrier to full participation in the labor market.

The gender gaps described above have widened for some groups. Women of childbearing age, and especially women with children, face significant constraints to enter the labor market. At the same time, they usually bear a heavier burden of care responsibilities than men with children. Populations with lower income levels and educational attainment also show great contrasts between men and women in terms of labor inclusion, usually associated with the sexual division of labor and the obstacles to access childcare services. Disparities also arise when considering ethnicity, race, class, or disability. This context emphasizes the need for an intersectional approach to gender equality.

6.6 Gender gaps in daily mobility: A diagnosis

ENMODO analysis[4]

In 2010, inhabitants of the MABA performed more than 22,000,000 trips daily, which implied 2.6 trips per day considering the traveling population identified in ENMODO (Table 6.2). This figure includes trips made by private, public, and active transport modes to travel within and between municipalities and neighborhoods.

Table 6.2 Trip generation rate. MABA. 2009-2010

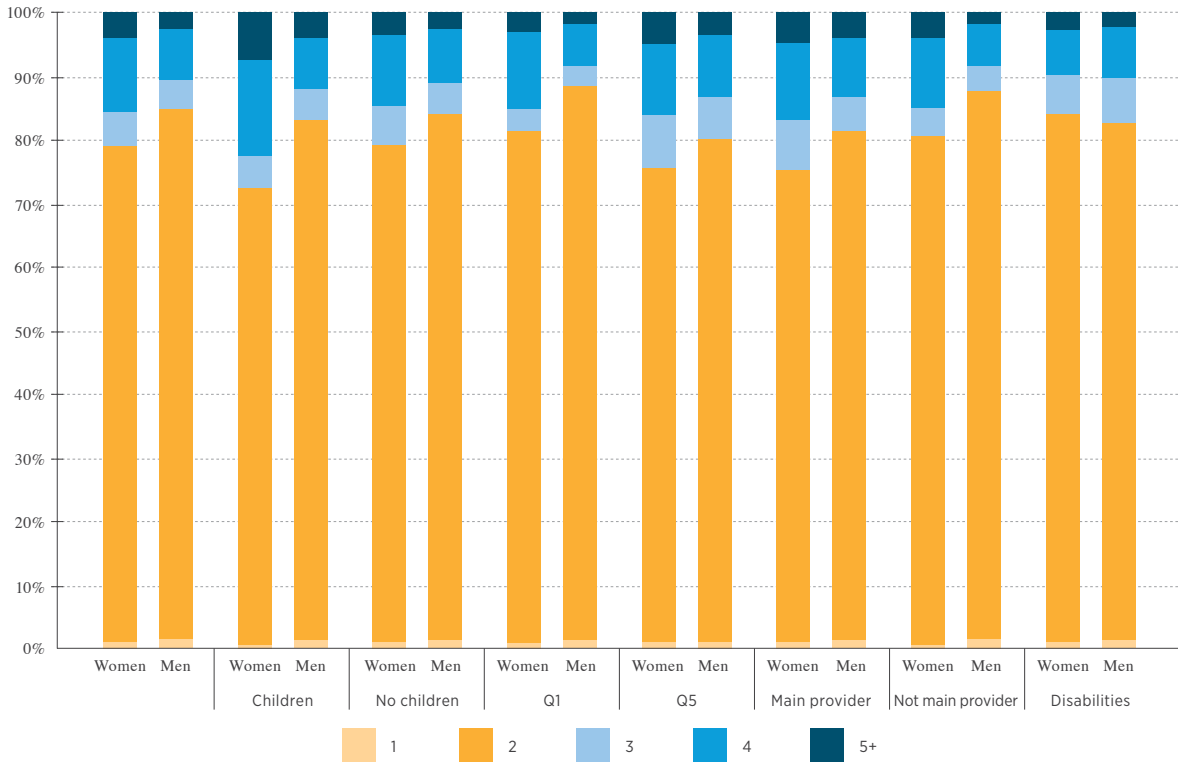
	Total	Rate
Total number of trips	22,414,513	-
MABA population	14,800,000	1.5
MABA's traveling population	8,689,104	2.6

Source: *CIPPEC based on ENMODO and INDEC-Census*

4 We conducted two-sample z-tests to determine the statistical significance of the relationships established in this section. All estimations are statistically significant with a p-value lower than 0.01 unless otherwise specified.

However, these figures masked heterogeneities between genders. While more than 21% of women made three or more trips per day, this percentage dropped to less than 15% for men (Figure 6.5). Among women with children, the share who made multiple trips increased to 27%. In contrast, it remained at 17% for men, a gap that could relate to women's role as caregivers. The gap lingered regardless of who was the head of the household but it diminished for those belonging to the richest quintile. Interestingly, people with disabilities registered no gender gap in the number of daily trips.

Figure 6.5 Number of daily trips by sex. MABA. 2009-2010

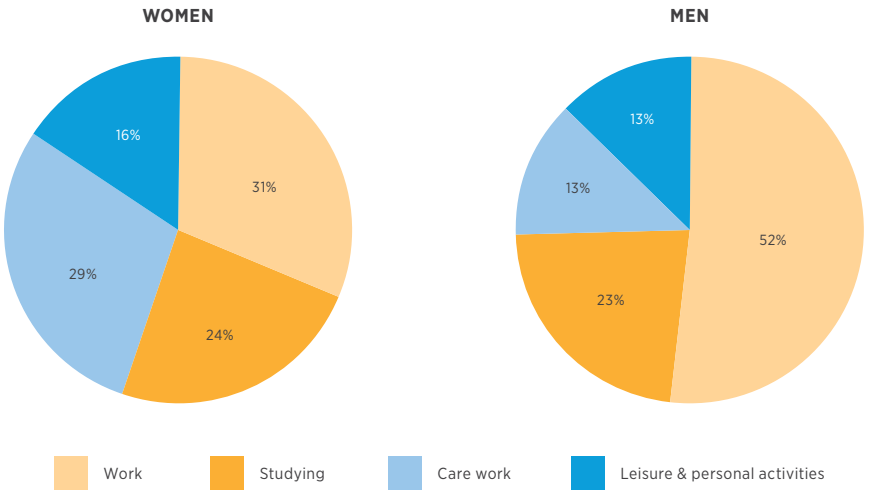


Source: *CIPPEC based on ENMODO*

When we consider the purpose of travel among men and women, differences emerge. The analysis uncovers that more than half of the trips performed by men were associated with labor activities, while only 13% were related to care[5] (Figure 6.6). In contrast, women portrayed a similar share of work and care-related trips, with each purpose representing around 30% of total traveling. The disaggregation of data by whether or not individuals live with children exhibits that when women had children, their share of care-related trips increased to 38% while staying at 30% for those without dependents. In turn, only 14% of trips conducted by adult males were for care work, regardless of their paternity status. Again, this is in line with the context provided in section 4.2, which described significant disparities in terms of labor participation and care work distribution.

5 As daily mobility surveys focus on compulsory trips, the identification of care-related trips is not straightforward (Sanchez de Madariaga, 2013). In this study, we group trips aimed at escorting others, shopping, and health care as "care work". In turn, we categorise trips related to sports, personal activities, religion, eating out, administrative procedures, and socializing as "leisure".

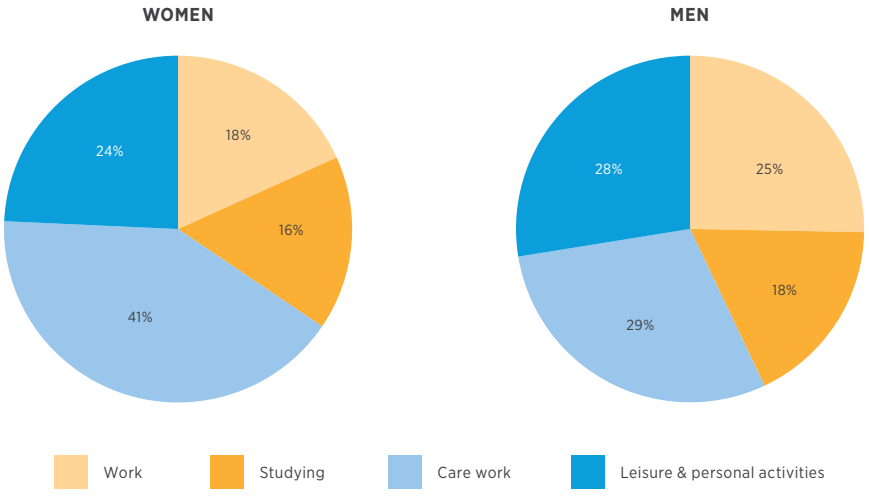
Figure 6.6 Purpose of trips by sex. MABA. 2009-10.



Source: *CIPPEC based on ENMODO*

Men and women with disabilities also depicted clear contrasts, as Figure 6.7 illustrates. In this case, the share of care work increased substantially for both sexes, which might be related to the categorization of trips employed in this study (including health-related travel within the 'care work' category). This population still displayed a gender gap in the share of care-related trips. The difference raises awareness of the role of women with disabilities, not only as care-receivers but also as caregivers.

Figure 6.7 Purpose of trips of people with disabilities by sex. MABA. 2009-10.

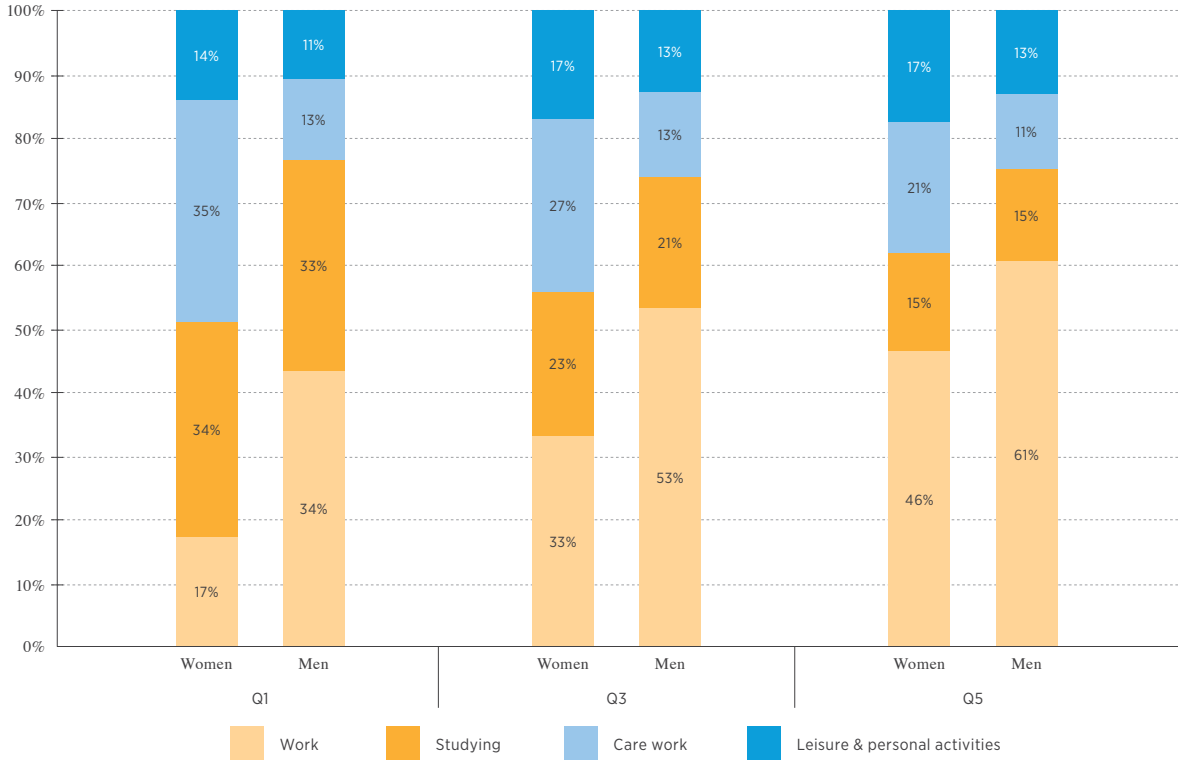


Source: *CIPPEC based on ENMODO*

The gaps also varied when considering the purposes of traveling by income level. While gender differentials were smaller in the wealthiest segments, disparities manifested within the female population: household income seemed negatively correlated with the share of trips associated with education and care but positively related to work and leisure trips (Figure 6.8). This finding is congruent with the fact that female labor force

participation grows the higher the quintile. Also, richer families may have the resources to hire caregivers, reducing women's burden of care work (Díaz Langou et al., 2019). In contrast, higher birth rates and fewer resources might translate into more care work in lower-income households.

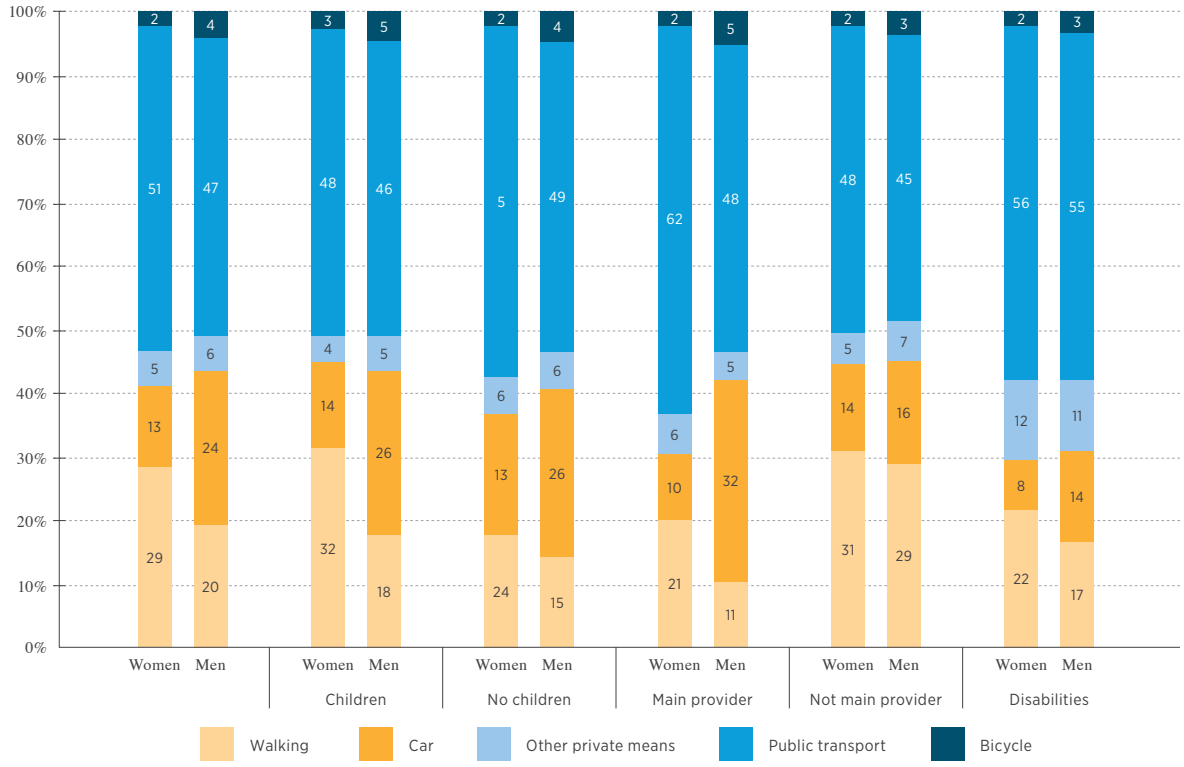
Figure 6.8 Purpose of trips by sex and quintile. MABA. 2009-10.



Source: *CIPPEC based on ENMODO*

Furthermore, another variable that reveals striking inequalities is the choice of transport mode, as Figure 6.9 exhibits. The use of motorized private means such as cars was significantly higher for men. This differential increased when comparing men and women who were the principal economic support of their household. Hence, even within families with private vehicles, women made less use of them. This disparity might suggest constraints both in terms of resources to buy assets but also in autonomy. On the flip side, women walked more often, with a broader gap emerging between men and women with children. This trend is consistent with the literature reviewed above that suggested smaller spatial ranges for women, which turns walking into a relevant mobility alternative. At the same time, while both sexes made extensive use of public transport, its choice was more frequent among women, who also traveled by bus at a higher rate.

Figure 6.9 Transport mode choice by sex, children dependence, household support, and disability condition. MABA. 2009-10.

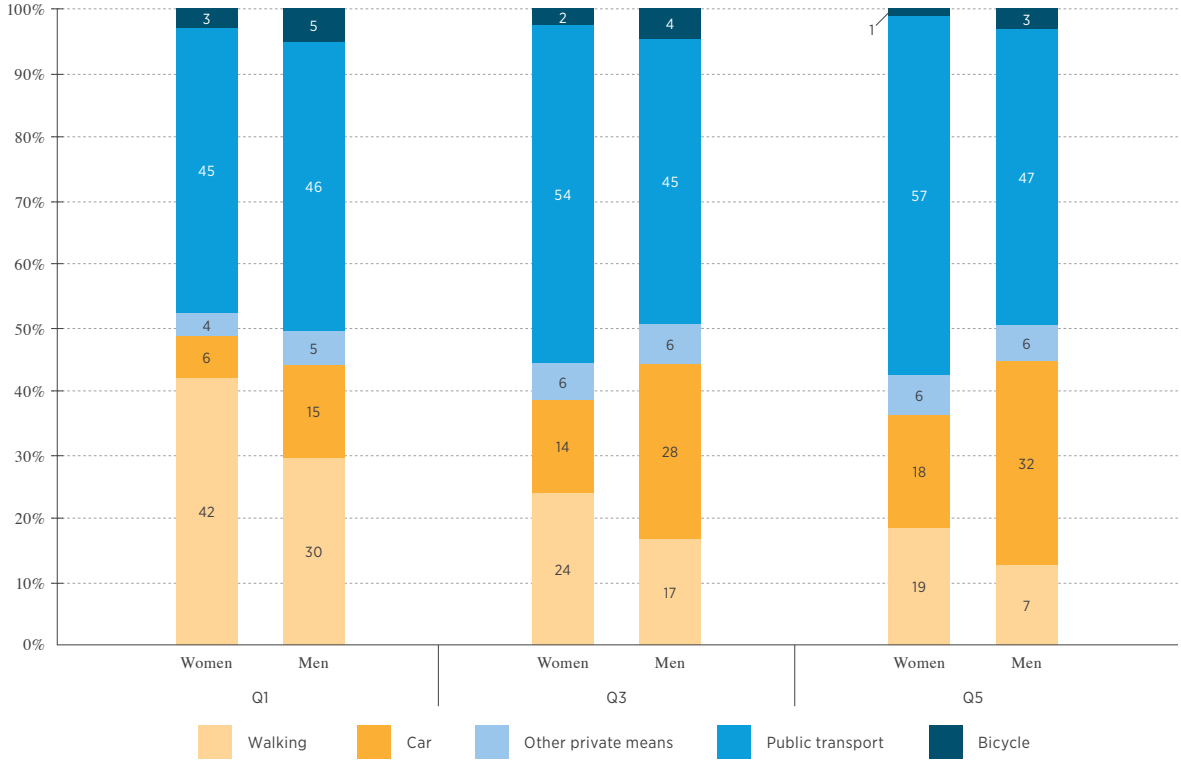


Source: *CIPPEC based on ENMODO*

In Figure 6.9, some differences become apparent in the modal split for people with disabilities. For them, the share of walking and car trips was smaller than the average. Instead, their use of public transport and other private means was higher. This choice might be related to specific constraints that restricted them from active traveling or driving vehicles.

The analysis of transport choice by socioeconomic level provides some evident but interesting insights: as income level increased, car use increased and walking decreased both for men and women, but public transport use increased only for women (Figure 6.10). This evidence might indicate two facts. On the one hand, as mentioned before, the higher share of walking trips in the poorer segments of the population might suggest a more reduced spatial range, especially for women. Both men and women invoked being unable or not wanting to pay as the main reason to walk, but it was a more prominent argument for men (38% vs 31%). In turn, the desire to walk and the long distance to the next stop were more frequent motivations for women (19% vs 16% and 13% vs 9%, respectively). On the other hand, the lower levels of motorization among women persisted even in the wealthiest quintile, revealing there might be more than economic arguments (i.e., lower wages that prevent women from buying and using cars) to explain this gap. This is also evident when observing the share of the population who had a car or motorbike driver's license: 19% of women vs 53% of men; this difference persisted when individuals had dependent children and when we compare male and female workers. While the gap decreased as income level increased, in quintile 5, the percentage of men with driver's licenses almost doubled the share of women (58% vs 29%). As some studies suggest, lower car use among women might also relate to gender roles, identities, and preferences shaped by patriarchal norms that affect the intra-household allocation and use of resources (Law, 1999; Pickup, 1984; Scheiner & Holz-Rau, 2012).

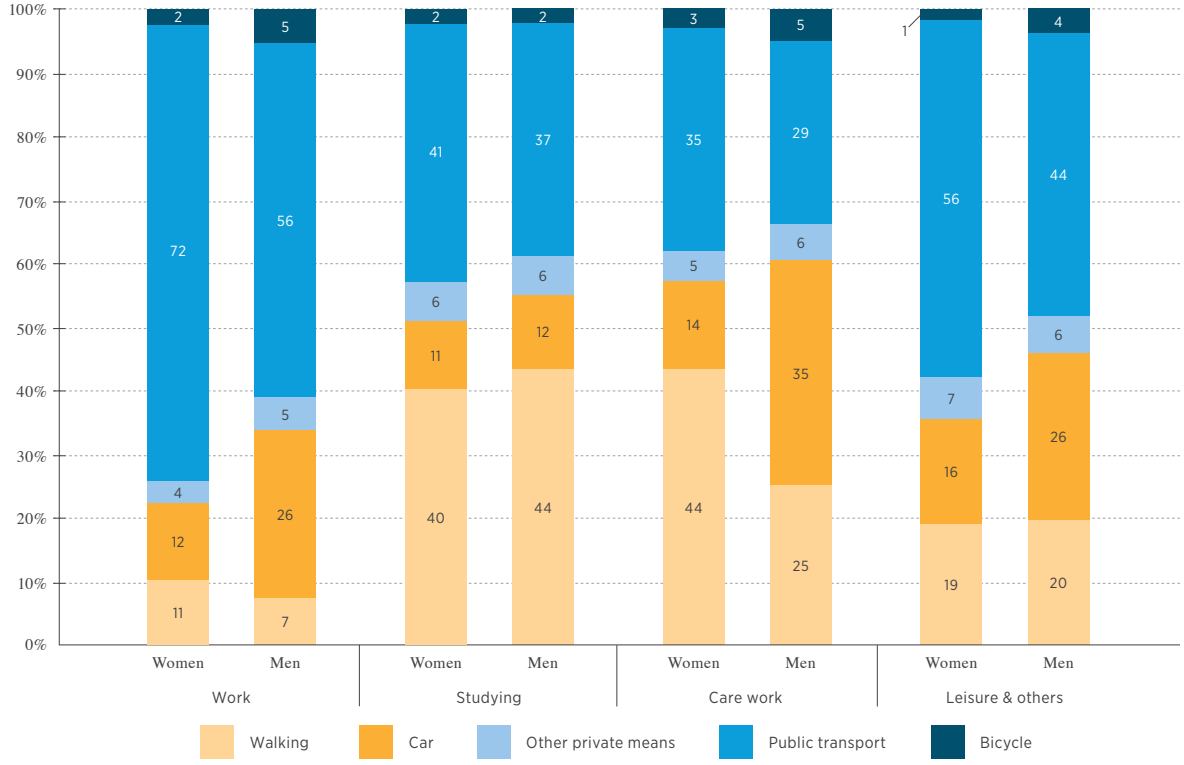
Figure 6.10 Transport mode choice by sex and income level. MABA. 2009-10



Source: *CIPPEC based on ENMODO*

When considering transport mode choice depending on the purpose of traveling, differential patterns also emerge. Both sexes chose public transport as the primary mode to go to work and to conduct leisure activities though men used cars more often (Figure 6.11). A clear contrast appears when examining transport mode choice for care-related trips. While 44% of women walked, 35% of the trips made by men involved cars. This contrast reinforces the evidence of constraints that women face in access to, and use of, private motorized vehicles.

Figure 6.11 Transport mode choice by sex and trip purpose. MABA. 2009-10

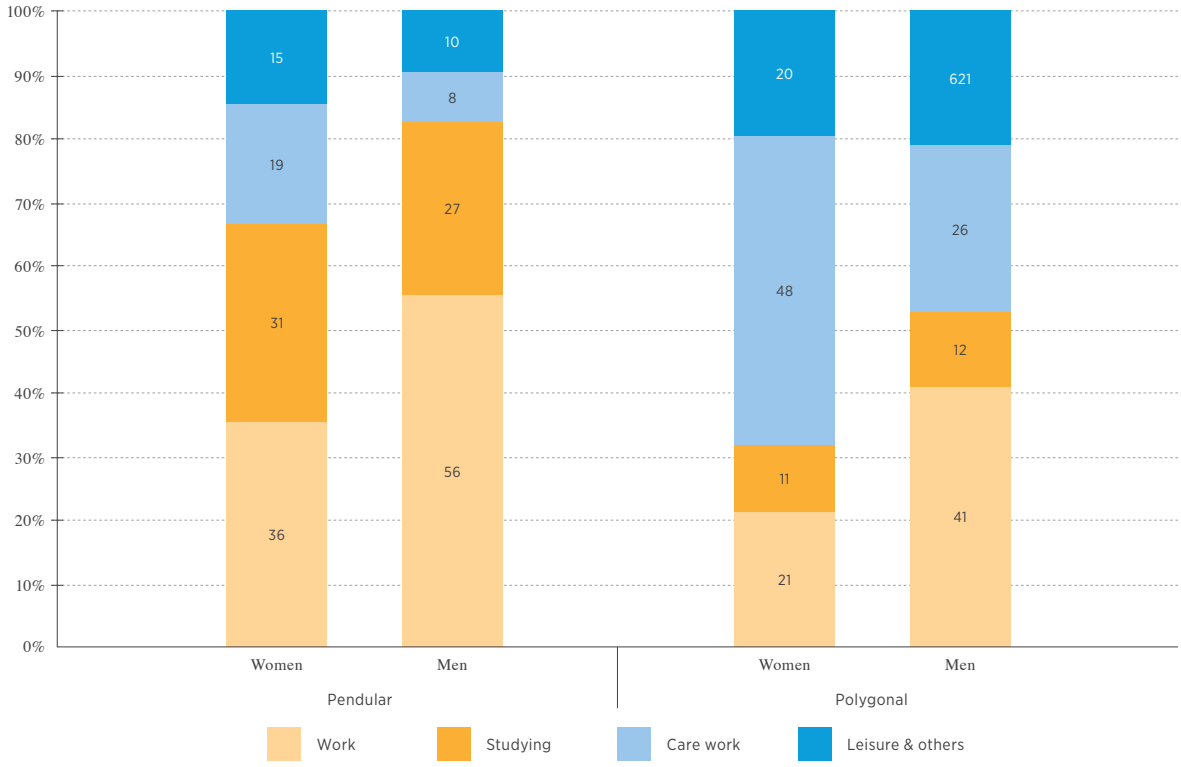


Source: *CIPPEC based on ENMODO*

Moreover, when examining the types of itineraries, differences arise that may relate to parental responsibilities. Among the general population, 78% of women and 83% of men performed daily pendular itineraries. The subsample of childless adults reveals no gender gap, as around 82% of itineraries were pendular for both men and women. In contrast, the observation of families with children reveals a different situation: on average, 75% of daily trips conducted by men were pendular movements, compared to 66% for women. That is, while the share of polygonal traveling increased for both sexes, the surge was more significant for women.

Additionally, the type of itinerary varied by gender depending on the purpose of traveling. As Figure 6.12 shows, when women made polygonal trips, their central motivation was undertaking care duties, whereas for men, these trips were generally related to paid work. When we look at pendular mobility by purpose, the share of labor-related trips for men was 20 percentage points (pp) higher than for women. Care work, again, had a more prominent role for women. These findings are aligned with the research that suggests that their role as primary caregivers is a critical determinant of women's mobility patterns.

Figure 6.12 Type of itinerary by sex and trip purpose. MABA. 2009-10

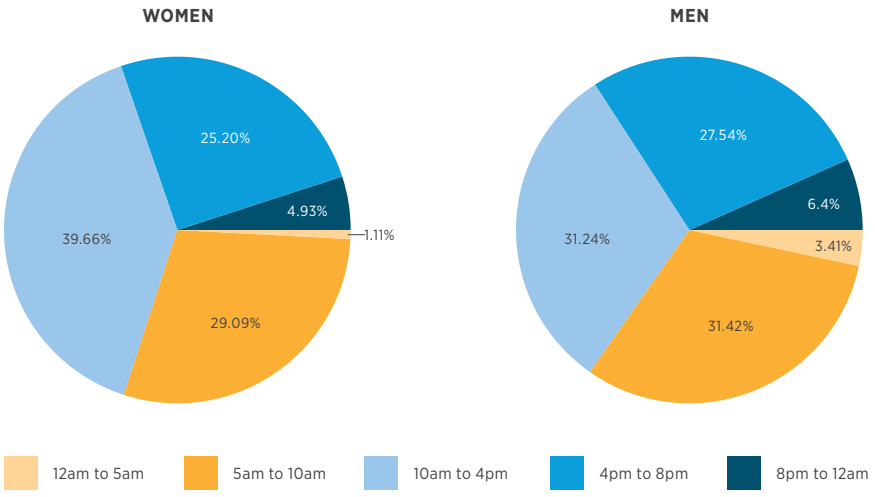


Source: *CIPPEC based on ENMODO*

The frequency at which people performed care-related trips also supports these findings. According to our estimates, on average, 44% of women conducted care-related traveling at least five times per week, while 45% of men did so less than once per week. When they had children, the regularity of care trips increased for all, but it was still women who assumed the heaviest burden: 58% engaged in care mobility five or more times per week, compared to 48% of men.

Men and women also traveled during different times of the day. As the ENMODO data reveals, women made more daytime trips outside of rush hour, while men spread their trips evenly throughout the day, with a more significant share during the night and in peak hours (Figure 6.13). Following the literature, this could be associated with the multi-purpose mobility of women due to their care responsibilities, which face fewer time constraints than paid work, and to the safety concerns women may have traveling at night. Even when individuals worked, 32% of women traveled from 10 am to 4 pm, compared to 24% of men. Nonetheless, we cannot observe whether they moved with dependents, as mobility during rush hour might also be related to escorting children to school or conducting other care-related movements.

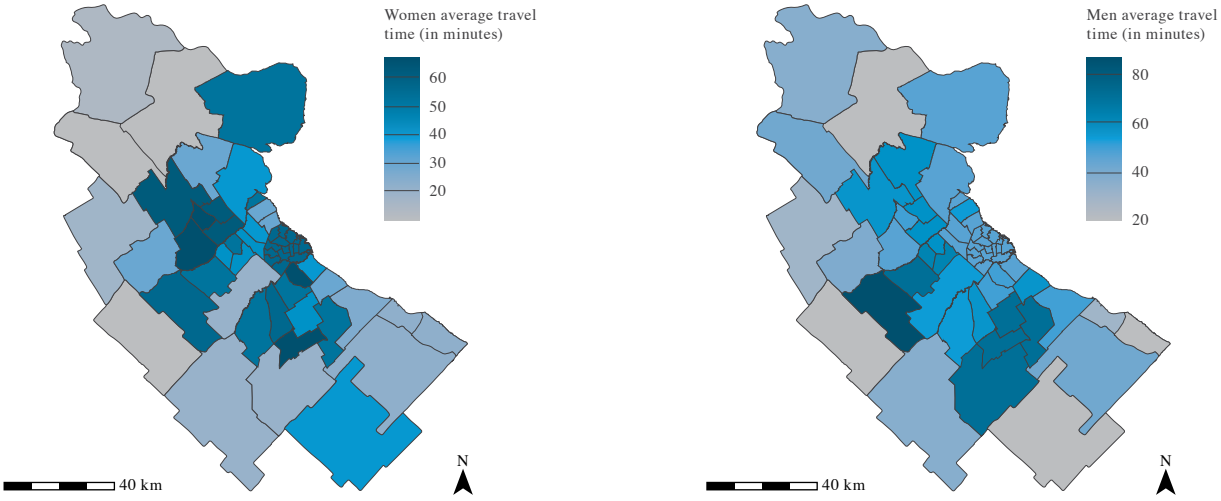
Figure 6.13 Traveling time slots by sex. MABA. 2009-10.



Source: *CIPPEC based on ENMODO*

Moreover, in most districts, trips took longer for women than for men (Figure 6.14). This gap occurred regardless of the district and the purpose of travel. One possible explanation is the higher use of private vehicles by men, which might reduce travel time, together with the effects of care responsibilities. While we cannot confirm this with the data available, according to the literature, women often travel with dependents, carry bulky loads, or even face more unforeseen circumstances, which can slow down their pace (Sánchez de Madariaga, 2016).

Figure 6.14 Travel time by sex in minutes. MABA. 2009-10



Source: *CIPPEC based on ENMODO.*

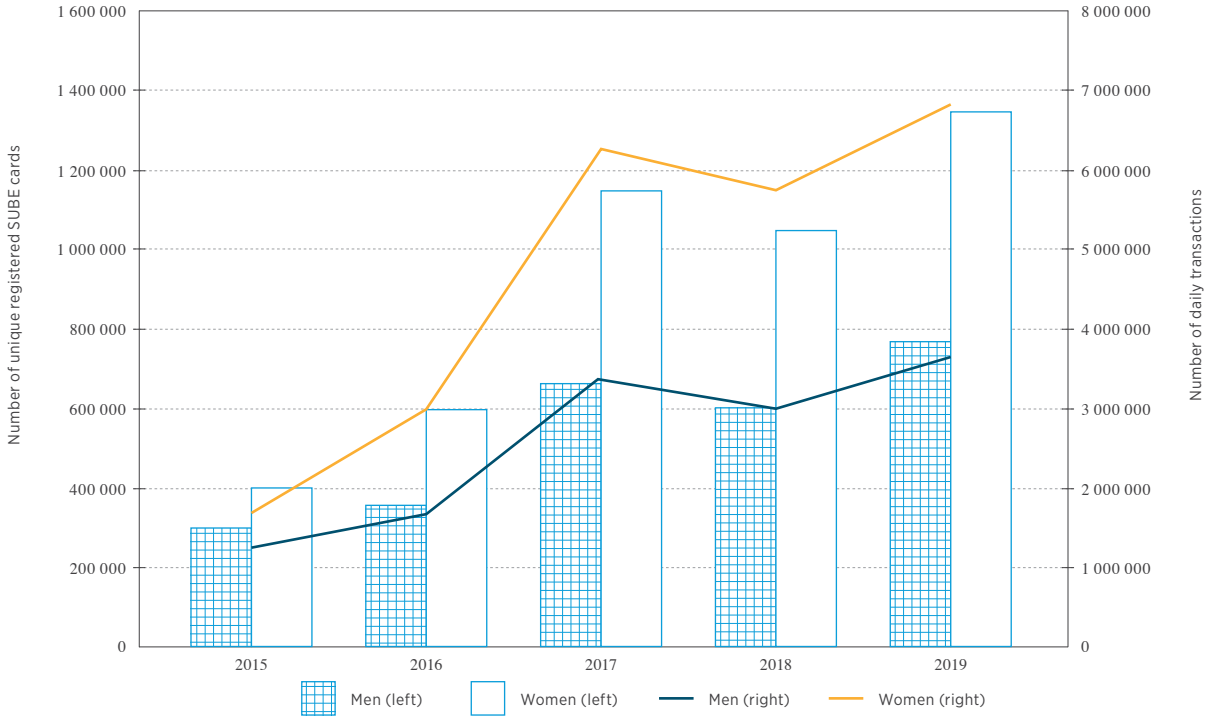
Overall, our analysis based on survey data reveals that Buenos Aires shares similarities with other cities around the world in terms of gender gaps in mobility. Women made more daily trips than men, traveled more outside of rush hour, walked or used more public transport, and had a significant share of trips devoted to care responsibilities. In turn, men took fewer trips, most of them work-related, and used motorized private vehicles more frequently. As the literature review cited, many studies have highlighted the link between these gaps and gender roles in the division of labor, which allocates care work primarily to women and reduces their access to resources. Moreover, some evidence reveals how perceptions of insecurity and fear may affect women's transport decisions and their autonomy more generally. These studies might provide hints at the reasons behind the existing gaps in the MABA, which may also occur in other Latin American cities.

SUBE Analysis

The SUBE information provides a complement to the survey-based diagnosis, given that it offers real-use data from daily public transport users in recent years.

A first observation exhibits that there has been a constant increase in the number of unique registered cards (i.e. cards that their users have inscribed under their name and ID) since 2015 (Figure 6.15). This rise has not been even: the increase in the number of cards registered by women has been threefold, almost doubling male cards. Several determinants might explain this gap. First, as shown before, women are more dependent on public transport while men use more private vehicles. Second, registration is a prerequisite to access reduced fees and women make more use of these discounts: 50% of women vs 23% of man with registered cards accessed fare reductions in the MABA in 2015-2019. Third, women tend to be more risk-averse than men (Harris & Glaser, 2006) and card registration is a way to avoid losing money if the card is lost. While these hypotheses have not been tested, they offer potential explanations for the higher number of cards registered to women.

Figure 6.15 Figure 6.15 Number of unique registered SUBE cards and daily transactions by sex. MABA. 2015-2019.

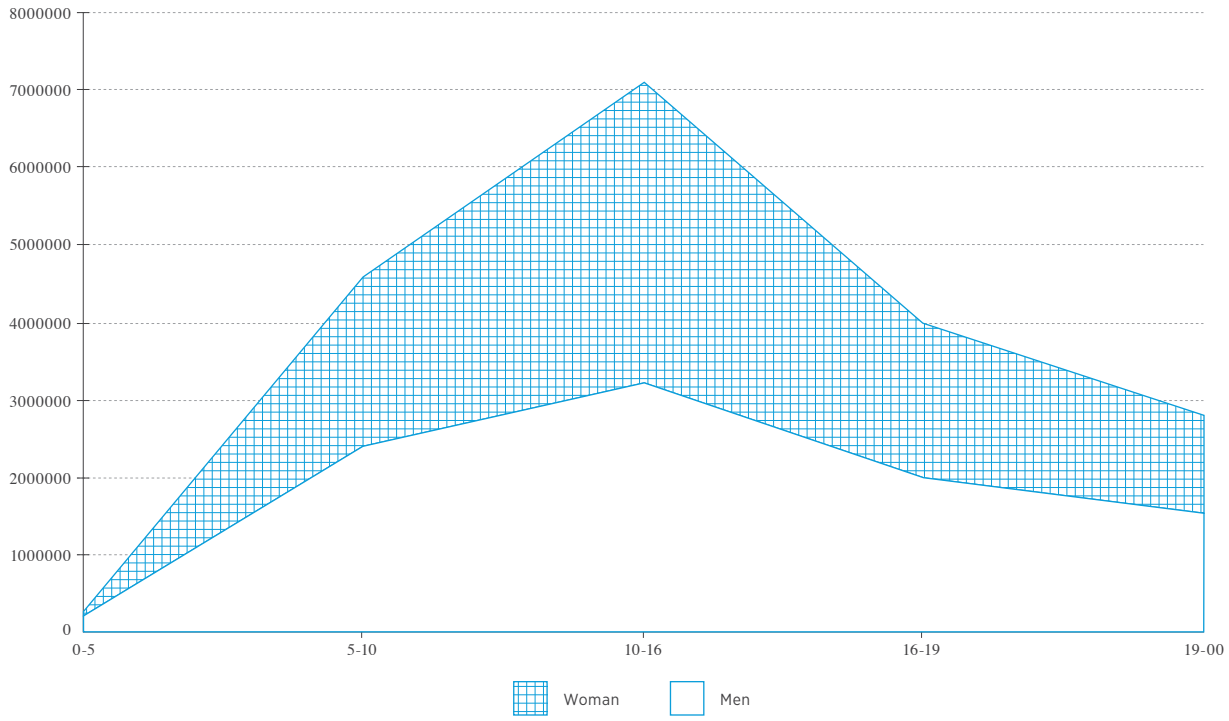


Source: *CIPPEC based on Ministry of Transport*

The administrative data from the SUBE smart card allows for georeferencing of the origins of trips and reveals that men and women have a similar share of interurban trips. Specifically, 78% of women start their trip in the districts surrounding the city of Buenos Aires, compared to 76% of men. Furthermore, four out of five women travel by bus, compared to three out of four men, supporting the survey analysis.

Regarding the travel time, SUBE data confirms that women tend to travel more often during daytime outside of rush hours (from 10 am to 4 pm). Nonetheless, as Figure 6.16 illustrates, the difference between genders is less evident than in ENMODO. While the data does not allow us to identify the full array of trips made with dependents, which might represent a significant share of peak-hour traveling, we can observe immediately consecutive transactions on a single card, which might be a proxy for escorting others.[6] Around 14% of individuals make two immediate transactions, with no variation between the genders. This data might seem to challenge the common assumption that escorting others is more often a female activity; however, it should be considered with caution because we cannot identify the dependents who have their own card, or if two consecutive payments were not related to a care activity.

Figure 6.16 Figure 6.16 Number of daily trips by sex and time slot. MABA. 2015-19



Source: *CIPPEC based on Ministry of Transport*

All in all, SUBE data allows a brief but complementary analysis by zooming in on public transport use during the last five years. However, this information exhibits certain limitations, as it does not allow socioeconomic disaggregation. It also displays gender biases for which a clear explanation has not been outlined. For these reasons, the following section will consider ENMODO data, as it offers more sociodemographic details that prove necessary for an accessibility study.

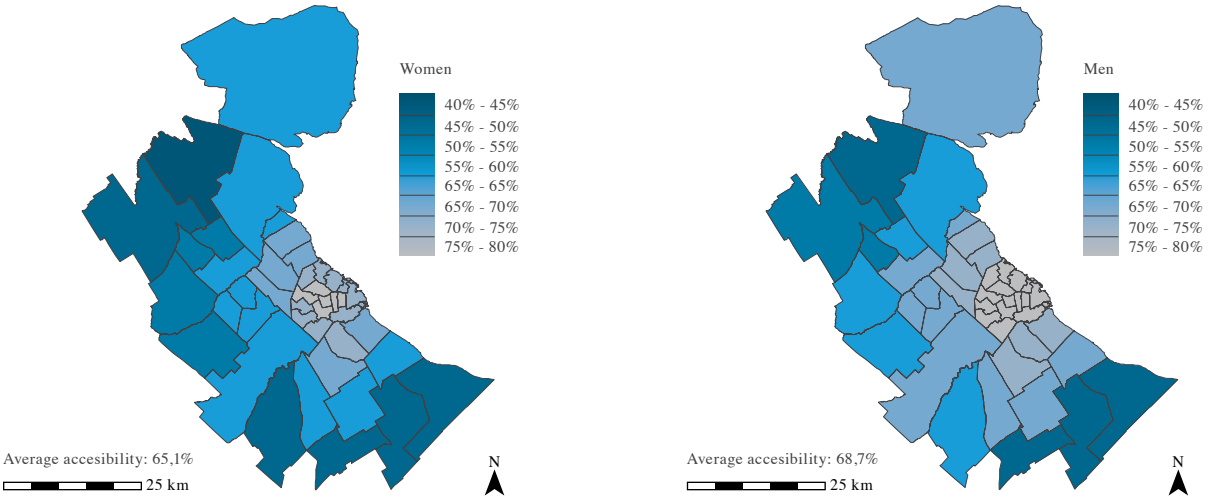
6 The SUBE system allows users to make two or more immediate transactions with the same card meaning two or more different people can travel with the same card.

6.7 Potential Access to Job Opportunities: Initial Findings

In a context of pervasive gender gaps in labor inclusion and mobility patterns that depict clear gender differentials, it becomes relevant to study whether there is any relationship between these phenomena in the MABA. Given that transport systems are crucial interventions that can enable or deter access to certain activities, they could, together with land-use policies, have a potential role in women's labor participation. To this end, we consider the spatial distribution of all work opportunities in the MABA, their distance to a given individual's location, and the share of income spent on transport fares, focusing on public transport due to its equalizing potential.

The synthesized results of the potential job accessibility index[7] are depicted in Figure 6.17. These findings exhibit clear gender and geographical divisions. On the one hand, the geographical examination reveals that proximity to the city of Buenos Aires is an indicator of greater job accessibility, which is in line with its higher employment density illustrated in Figure 6.2. In contrast, individuals in districts farther away from the capital city access fewer labor opportunities, given higher traveling costs in terms of money and distance. This phenomenon leads to most neighborhoods of Buenos Aires City depicting average potential accessibility above 78% of the total opportunities. In contrast, the municipality of Presidente Perón, which is located in the southernmost extreme of the MABA, registers potential access to only 54% of the jobs.

Figure 6.17 Job accessibility by sex. MABA. 2009-10



Source: *CIPPEC based on ENMODO and INDEC*

In terms of gender, women have a lower level of job accessibility than men in all districts and neighborhoods of Buenos Aires city: the weighted average for the whole region estimates a statistically significant gap of 65.1% of total opportunities available for women vs 68.7% for men. Disparities are smaller in districts such as Quilmes, Avellaneda, or Buenos Aires City, and greater in Merlo. These findings suggest a correlation between women's daily mobility patterns and their labor inclusion, with heterogeneous impacts depending on the location.

The accessibility analysis by socioeconomic level unveils even wider contrasts. The gender disaggregation in the wealthiest quintiles exhibits a minor gap between men and women. This result indicates that costs and travel distance might be minor hindrances to labor participation for the most affluent populations. Conversely, the lowest income quintile has access to fewer job opportunities and gender disparities in this segment

7 The mean values for the components of the decay function can be found in the appendix.

are much more pronounced: the gap in job accessibility between men and women is almost 20%. Individuals in quintile 1 depict lower incomes and, usually, live in peripheral areas. These characteristics translate into higher travel costs and longer distances, which can potentially explain the lower job accessibility for this segment. In addition, the fact that the gender pay gap is wider among the poor means that travel fees represent a heavier burden on women's total income.

Table 6.3 Job accessibility by sex and quintile income group. MABA. 2009-10

	Job accessibility in MABA							
	Mean		MIN		MAX		SD	
Income quintile	Women	Men	Women	Men	Women	Men	Women	Men
1	49.52%	60.62%	30.23%	35.34%	61.24%	71.57%	0.10	0.09
2	63.31%	68.27%	36.74%	38.80%	74.42%	78.60%	0.10	0.09
3	68.52%	69.73%	38.96%	39.42%	78.90%	79.83%	0.09	0.09
4	70.03%	71.07%	39.58%	39.99%	80.17%	81.00%	0.09	0.09
5	74.67%	75.02%	41.88%	42.00%	84.82%	85.08%	0.09	0.09

Source: *CIPPEC based on ENMODO and INDEC*

Overall, the findings suggest that when we consider the cost of using public transport and the distance to job opportunities, women face more restricted access to jobs than men. Hence, the interplay between land use, transport policies, and socioeconomic characteristics might be creating further gender inequalities.

The gender gap in job accessibility is in line with several disparities observed in mobility patterns in the MABA and in the evidence available for other countries. First, in most zones, it takes longer for women to reach their workplace than for men. This gap exists regardless of the proximity of the origin and destination of the trip. Second, on average, women earn less but make more daily trips and engage in more trip chaining due to care work than men. Thus, their relative cost of travel may be higher. Consequently, even though women make more use of public transport than men, this transport mode might not provide them with better access to work opportunities.

This gender gap seems almost exclusively driven by the fact that women need to spend a higher share of their income on public transport fees.[8] As the gender wage gap becomes wider for low-income groups, the potential job accessibility disparities increase. In turn, wealthier segments seem less affected by transport costs and might use private means of transport, which are excluded from the accessibility analysis, to bypass any transport deficits. As shown in the examination of SUBE data, in recent years, women's access to reduced fees has increased to reach half of the female population with registered cards. As this was not the case in the period of analysis, the role of transport fees in affecting job accessibility might have diminished. In this case, this study might suggest the relevance of fare reductions to improve job accessibility.

In turn, the average distance traveled reveals that women are not living in districts farther away than men are. Nonetheless, bearing in mind the caveat regarding the measurement of distances from centroids in suburban areas, there might be inequalities that we are not accounting for. The lower levels of job accessibility in the districts farther away from the City of Buenos Aires suggest potential challenges in terms of transport services and land use. As described before, both public transport infrastructure and job opportunities are concentrated in the City and its surroundings. Although we consider the whole distribution of job opportunities instead of only those closer to the trip origin, the costs of traveling from more distant areas make some of them inaccessible.

8 More data available in the Appendix.

While data constraints prevent a comprehensive intersectional analysis on potential job accessibility, these findings reveal the interaction between gender, socioeconomic level, and job accessibility. As women and more disadvantaged populations also show disparities in mobility, the interplay between mobility and job accessibility becomes evident.

It is critical to acknowledge that, as mentioned before, these results do not consider the socio-occupational profile of individuals to assess job accessibility. Instead, the analysis focuses on structural urban factors (i.e., location of opportunities and traveling costs) as determinants. For this study, while women are overrepresented in some sectors but underrepresented in others, job opportunities in all sectors are considered equally available to them. Although this assumption might overestimate the share of job opportunities they can access, it also challenges current horizontal segregation patterns, which is crucial to overcome some of the gender inequalities that prevail.

While these findings are far from exhaustive, they contribute to illustrating the existence and the overlap of territorial, socioeconomic, and gender gaps in job accessibility, adding to the evidence that shows the importance of considering gender variables in mobility and accessibility studies.

6.8 Policy Implications

While further research is needed to assess causal links between transport interventions and labor participation, these initial findings posit the existence of a relationship between impediments to mobility and job access. Thus, the study suggests that inclusive, gender-sensitive transport and urban policies might foster women's autonomy and labor inclusion. As new mobility data becomes available, it is crucial to consider further socioeconomic disaggregation that may amplify gender gaps.

Around the world, varied policy solutions have shown diverse levels of effectiveness, generating discussions on how to best address monetary limitations and the spatial mismatches between housing, employment, and transport (Delmelle & Casas, 2012). Most studies evaluating policies do not address the gender aspects of job accessibility, unveiling a knowledge gap about the utility of specific interventions to encourage women's labor participation. At the same time, to better inform policymaking in the MABA, it is necessary to further examine the time-varying interplay between travel demand and urban structure (Guzman & Bocarejo, 2017) through a gender lens.

This section analyzes some evidence regarding different transport and urban policies that have contributed to fostering labor inclusion. More precisely, the review focuses on three types of interventions that are complementary and intertwined: the expansion of transport networks, transport subsidies, and land-use policies. While we cannot draw out specific policy recommendations, these considerations can provide lessons learned and hints to move forward.

Best Practices for Improved Mobility: A Review of Existing Policies

Expanding transport networks

Many studies have diagnosed the lack or deficiency of existing public transport systems to cater to population needs as an obstacle towards higher employment, especially among the poor. This strand of research highlights the imperative of enhancing public transport services to improve job access and reduce inequalities.

In a cross-city comparison, Kawabata & Shen (2006) stress the crucial role that urban and transport structure play in better job accessibility, revealing the disparities between public transport- and auto-oriented cities, and the negative implications of the latter for lower-income groups. To improve their accessibility, some studies provide evidence to support the development of transport services in disadvantaged areas, tailoring interventions to their needs, and assessing the impacts in terms of equity (Slovic et al., 2019; Yomal, 2018). In a

similar vein, other authors also highlight the potential of expanding public transport networks to reduce informal employment and increase accessibility to formal jobs (Boisjoly et al., 2017; Oviedo-Dávila, 2017).

From a gender perspective, a few pieces of research consider how specific transport expansion policies can foster women's access to work opportunities. In Lima (Peru), new investments in Bus Rapid Transit (BRT) and elevated light rail improved employment and earnings only for women, as public transport became safer and more convenient (Martinez et al., 2018). Nonetheless, to bring about positive labor market outcomes for poor populations, BRT systems need to be integrated with non-motorized infrastructure and consider traveling costs (Oviedo et al., 2019). Also, door-to-door transport services might positively impact women's activity rate, especially when they are for women only (Field et al., 2020).

All in all, while these studies reveal a positive effect of expanded public transport on job accessibility, policymakers should contemplate the specificities of any given territory and its population to identify voids in transport infrastructure and tailor interventions accordingly. To avoid reinforcing inequalities, policies must consider these gender, socioeconomic, and demographic disparities in their design and implementation (Hernandez, 2018).

Transport subsidies

Alongside the availability and effectiveness of transport services, affordability matters to ensure equitable access to transportation and its potential to promote labor inclusion. In this sense, many scholars have focused on the monetary costs of using public transport and its relevance in improving job accessibility. This aspect is critical from a gender perspective due to the income gap between men and women.

In specific contexts, the extension of transport infrastructure has failed to improve usage and job accessibility among lower-income groups due to its cost (Oviedo et al., 2019). Therefore, previous research suggests the importance of implementing targeted fare reductions and fare integrations that reduce the cost of transferring between modes of public transport (Falavigna & Hernandez, 2016; Franklin, 2015; Oviedo et al., 2019). Some countries also grant supply-side subsidies to transport operators, though several studies have depicted a neutral or even regressive effect of this approach (Castro & Szenkman, 2012; Serebrisky et al., 2009). Nevertheless, evidence on different types of transport subsidies is still scarce.

As this study reveals, women make more daily trips, combine more transport modes, and travel more often with dependents, which can all increase their transport expenditure. The findings from the job accessibility index also indicate that costs are a significant impediment to women's mobility and their labor inclusion in the MABA. Consequently, addressing these barriers is key to enhancing job accessibility. Lecompte & Bocarejo (2017) underscore the potential of integrated public transport schemes and fare reductions for dependent populations to improve women's accessibility, as their share of income spent on transport would decrease.

During recent years, the MABA has progressed in this field. In addition to the social tariff available to low-income groups and the reduced fees for students and pension recipients, in 2018 the government implemented *Red SUBE*, an integrated fare system that reduces costs for travelers (Mehndiratta & Rodríguez, 2018). Still, evidence is needed to evaluate the effects of these interventions on accessibility from a gender perspective.

Land-use policies

In Latin American cities, including Buenos Aires, the literature has identified a tendency for job opportunities to be clustered in a few central areas where housing is either not available or is unaffordable for lower-income populations (CAF, 2011; da Cunha & Rodríguez Vignoli, 2009; Hernandez, 2018; Kaztman et al., 2004). Therefore, the combination of transport expansion and land-use policies can provide access to additional work opportunities.

While for many decades commercial and residential areas have tended to segregate, many authors posit that the creation of mixed-use zones might be a road to improving job accessibility. This process can imply both a decentralization of jobs to the periphery or the dispersion of affordable housing options to city centers with more economic opportunity (Boisjoly et al., 2017; Freeman, 2004; Korsu & Wenglenski, 2010; Slovic et al., 2019). In this way, disadvantaged populations would see a decrease in distance and commuting time to work.

Women, in particular, could benefit from this type of intervention. As argued before, they conduct more multi-purpose traveling and trip chaining, which leads to polygonal itineraries across a given territory. Decreasing distances among activities can be time-saving; hence, it could positively affect women's labor participation. In the City of Buenos Aires, the relocation of public offices to the Southern area, which is the most underserved was intended, among other goals, to foster its economic development.[9] Therefore, future research could explore whether this intervention had any effects on gender equality and employment.

For these policies to be successful, governments should play a role in regulating the use of space together with both public and private stakeholders. At the same time, mainstreaming gender in urban planning and housing policies is key to identifying gendered implications of new interventions.

6.9 Final Remarks

This chapter sheds further light on the need to introduce gender considerations in urban and transport policies. Our analysis showed that men and women experience mobility differently, which is in line with previous research for other geographical areas. Additionally, the potential accessibility model suggests that women have less access to employment opportunities, especially those belonging to disadvantaged populations. This phenomenon is related to the interaction between transport policies, land use, and socioeconomic characteristics. These accessibility gaps mean policymakers should consider measures that respond to the needs of different sociodemographic groups, as this can enhance gender equality and boost women's economic autonomy.

For decades, transportation data and policies have remained mostly gender blind. This situation has led to interventions designed and implemented for a "neuter commuter", which did not reflect the reality of women's experience (Law, 1999). A growing body of research, to which this chapter hopes to contribute, stresses the imperative of transforming this approach. To implement urban and transport interventions that are gender-responsive, policymaking needs to incorporate gendered experiences and outcomes during the whole policy cycle (UN Economic and Social Council, 1997). Additionally, as gender inequalities can be compounded by other sociodemographic characteristics, this approach requires an intersectional lens. Through this process, it would be possible to assess policy implications for men and women, which can, in turn, contribute to reducing disparities (Caro Sachetti & Petrone, n.d.).

Naturally, addressing the urban structure is only one side of the story. Easing access for women to job opportunities must be part of a broader, intersectional gender equality strategy that guarantees women economic autonomy. Such an approach should also analyze and tackle individual characteristics (e.g., level of education or care responsibilities) and gender norms which may create further obstacles towards full employment. In this sense, the recognition, reduction, and redistribution of unpaid care and domestic work prove vital to reducing women's time poverty, which could, in turn, increase their take up of available opportunities.

Additionally, improving access to opportunities in the labor market must consider the need to ensure decent work. Not every job is empowering: women's higher degree of informal employment is one of the manifestations of gender inequality in the workplace. Therefore, together with urban and transport policies that improve accessibility, it is necessary to ensure appropriate labor conditions in these opportunities.

All in all, as women's work-related mobility remains limited and their economic autonomy is not guaranteed, improving their access to quality job opportunities becomes paramount for their wellbeing. Labor inclusion is essential to obtain income, which can provide the goods and services needed to sustain life. At the

9 https://www.buenosaires.gob.ar/buenosaires2030/integracion-urbana/ciudad-los-barrios/relocalizacion-del-gobierno-en-el-sur

same time, it allows social interaction, which is vital for social cohesion and inclusion. In this context, transport and urban policies play a crucial role in making these opportunities readily available, especially for the most disadvantaged. This chapter intends to be one of the initial steps in analyzing these challenges in the MABA, planting a seed for future research that further disentangles the roots of uneven job accessibility between men and women.

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VIEW APPENDIX ONLINE

Foreign Influence
The International Transmission of Gender Equality

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Anecdotal evidence for several developing countries suggests that foreign direct investment and multinational enterprises (MNEs) may be an important conduit of cultural exchange. Recent work in economics has explored the role that MNEs play in transferring gender equality around the globe, but with mixed results. In this chapter, we consider the implications of increased foreign direct investment in Brazil on the transmission of high-quality gender policy and practice. In particular, we investigate whether workers with experience at multinational firms that are now employed in domestic firms with no foreign influence, help to change gender-specific outcomes at their Brazilian companies. We next ask whether it matters from where the foreign direct investment originates—that is, do workers with experience in MNEs with headquarters in relatively gender-equal countries transfer best practices toward women better than those with experience in MNEs from relatively more gender-unequal countries? As Brazil is a fairly gender-unequal country, we expect foreign direct investment from more gender-equal countries to encourage and spread higher earnings and increased employment opportunities for women. Increasing the share of workers with MNE experience modestly improves the gender earnings gap in some specifications. Additionally, workers in management positions offer the strongest positive contributions to closing gender gaps. However, despite the many theoretical reasons and suggestive empirical evidence from previous literature to expect differential implications across FDI-source countries, our data fails to support this notion. ¶

7.1 Introduction

AAnecdotal evidence for several developing countries suggests that foreign direct investment (FDI) and multinational enterprises (MNEs) may be an important conduit of cultural exchange. For example, anthropologists have long recognized the role that firms like McDonald's have played in other countries' acceptance of simple customer service practices, such as smiling and queuing (Watson, 2006). Multinational firms from more developed countries locating in industrializing nations have also been suspected of spreading good hygiene such as washing hands and attire e.g., 'neckties in the tropics', as in Rauch and Trindade (2005).

In this chapter, we consider the implications of increased foreign direct investment (FDI) in Brazil on the transmission of high-quality gender policy and practice as an important element of culture. There are several theoretical reasons to expect that increased FDI may enhance gender equality in the recipient nation. First, like international trade, FDI helps to increase average incomes and reduce poverty. As women tend to bear the burden of poverty and as income is positively associated with better working conditions for women, a simple income effect would predict better outcomes for women with increased FDI. Another potential mechanism relates to Becker's (1957) classic model of discrimination. As FDI increases competition in the local market, firms have weakened power to discriminate against equally productive workers (i.e., women). It is also plausible that multinational firms, facing consumer demands and reputational consequences,

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follow good regulatory practice in their host countries, just as they do in their home countries, transferring best-practice policy to the developing world.[1] Finally, while on the job at multinational firms, workers learn about production processes, such as the acquisition of intermediate inputs and new knowledge of export markets, that they may transfer when they leave the MNE and are hired in a domestically owned firm, enhancing local productivity and wages (Poole, 2013). Hypothetically, the same could be true for processes, practices, and policies related to women—workers learn about good practice in the MNE and transfer it to the domestic firm when they transition there.

Despite the various theoretical possibilities for the transfer of gender equality, mixed results have emerged from a recent body of work exploring the role that MNEs play in transmitting gender equality. In Japan, foreign affiliate firms tend to offer better opportunities for women than local Japanese firms (see Olcott and Oliver (2014) and Kodama, et al. (2016)). By contrast, the gender wage gap in foreign-owned firms is larger than similar domestically owned firms in Estonia (Prijt and Masso, 2018) and Poland (Magda and Salach, 2019). Our own previous research for the case of Brazil in the 1990s liberalization period also presents a less-than-rosy picture of the potential role of foreign ownership on supporting improvements in gender parity, as multinational firms employ fewer women and exhibit higher gender earnings gaps than their domestic-firm counterparts (Davis and Poole, 2020).

This literature places considerable importance on the relationship between local policies toward women and the policies in place in the FDI-source country. As an example, Tang and Zhang (2017) explore the relationship between foreign direct investment into China and "cultural spillovers". Their work demonstrates that affiliates in China from more gender-equal headquarter countries display more gender-equal practices including higher female employment shares and disproportionately more female managers. Similarly, in South Korea, Choi and Greaney (2020) note that MNEs from more gender-equal countries are also more supportive of high-quality gender practices than domestic firms. A main exception to this idea is Sharma's (2020) exploration of foreign direct investment in India; in that setting, the gender equality of the FDI-source country does not appear to be positively related to female employment in India.

The idea that the FDI-source country plays an integral role in the potential transmission of gender policy and practice is increasingly relevant in today's global economy, with China representing an intensifying share of global FDI inflows to the developing world, particularly to Latin America and Sub-Saharan Africa. In the Brazilian context, for example, China's share of total foreign direct investment inflows to the country rose from 1.4 percent in 2010 to 2.5 percent in 2016. At the same time, the share of FDI from more developed countries such as those on the European continent, fell from 55 percent in 2010 to 53 percent in 2016. Given Tang and Zhang's (2017) previous work on China, which is a relatively gender-unequal country relative to other major sources of FDI, this may give reason for policymakers to take serious pause in considering the influence of foreign direct investment on women versus men.

Our work offers several innovations over the previous literature. First, we explore a large, emerging economy in a different region of the world than has been studied before. To our knowledge, all previous research exploring the particular question of FDI-source country heterogeneity in cultural spillovers is focused on Asia. We note that Latin America falls in between South Asia and East Asia in terms of gender inequality, according to data from the United Nations Development Program (UNDP). Figure A. 7.1 in the Appendix shows that Latin America is more equal than South Asia, but not as equal as East Asia, as depicted by the UNDP's Gender Inequality Index, based on reproductive health, empowerment through education and parliament, and labor force participation (a lower number reflects higher equality). These differences are further supported in Figure A. 7.2 on female workforce composition across world regions, relying on aggregate data

1 Of course, the contrary is also a theoretical possibility, in a race-to-the-bottom mindset, but much of the evidence for general labor practice appears inconsistent with this view (Harrison and Scorse, 2010).

from the World Bank's *Enterprise Surveys*. Latin America is the only region of the world for which the share of female workers is, on average, lower at foreign firms than domestic firms. Together, these figures highlight the importance of studying a major Latin American economy, distinct from otherwise similar emerging economies in South and East Asia.

Next, Brazil is a large recipient of foreign capital inflows, including foreign direct investment. The country underwent a dramatic unilateral liberalization in the mid-1990s, significantly reducing restrictions on the inflow of FDI. Previous work in the Brazilian context has explored the positive effects of these investment inflows on the domestic economy wages (Poole, 2013) and gender equality (Davis and Poole, 2020). The main innovations in this chapter, as compared to our previous work in Davis and Poole (2020) are twofold. First, our previous work found no statistical difference in gender earnings gaps across domestic firms employing higher shares of former MNE workers. We questioned, as does the literature, whether this insignificant finding could be a function of the composition of the FDI inflows, and perhaps whether the foreign influence on gender equality might be related to the FDI country of origin. In this extension of our previous work, we can empirically assess this question using new data on the FDI headquarters country. A second main difference between this research and Davis and Poole (2020) is the period of analysis. In this chapter, we reflect on a significantly more recent time period, in which substantial debate exists on the role of Chinese investment in Latin America.

Finally, our work contributes to the existing literature by exploring not simply *whether* MNEs may transfer positive gender practices, but *how* they may do so. The analysis of our question of interest has two distinct stages. First, whether MNEs bring and implement the female-friendly culture from their headquarter nations to their subsidiaries in Brazil (the direct effect). Next, whether those MNEs can transmit that female-friendly culture to local Brazilian firms (the indirect effect). We chose to focus on the indirect spillovers to local firms for two main reasons: 1) we believe that the empirical strategy for identifying the indirect spillovers is on more solid ground econometrically, since firm-level foreign direct investment is an endogenous outcome; and 2) we believe that this is where our main contribution to the larger literature truly lies, since previous work by Tang and Zhang (2017), Choi and Greaney (2020), and Sharma (2020) have already explored the direct effects of multinationals on gender equality by country-of-origin for China, South Korea, and India, respectively. Nevertheless, we acknowledge that the direct spillovers are a necessary condition for the indirect spillovers to local Brazilian firms, effectively allowing for foreign influence on gender equality. Therefore, our chapter also provides some descriptive figures on the gender earnings gaps and female labor force composition for multinational firms, multinational firms from top-quartile gender-equal headquarters countries, and domestic firms to shed light on the possible first-stage direct effect, in order to better understand the plausibility of the second-stage transmission mechanism from MNEs to local firms.

Regarding the particular mechanism for transmission, we investigate the labor mobility channel, following the well-identified empirical strategy from Poole (2013) for the case of knowledge spillovers from FDI. Specifically, this research asks whether workers with experience at multinational firms, now employed in domestic firms with no foreign influence, help to change gender-specific outcomes at their Brazilian companies. The research further explores whether it matters from where the foreign direct investment originates—that is, do workers with experience in MNEs with headquarters in relatively gender-equal countries have a larger positive impact on gender gaps as compared to workers with experience in MNEs from relatively more gender-unequal countries? As Brazil has fairly high gender inequality, we expect foreign direct investment to encourage and spread higher wages and increase female employment opportunities for women.

For the rest of this chapter, we first present the baseline analysis, across all industries and FDI-source countries. Our results then explore the heterogeneity of the evidence by worker characteristics (e.g., women and managers) and firm characteristics (by industry and FDI-source country). We conclude with brief thoughts on policy interventions aimed at mitigating gender gaps in the developing world.

7.2 Data

Brazil dramatically liberalized its economic system throughout the latter half of the last century, offering a nice case study for market-oriented reforms like trade liberalization and foreign direct investment. Moreover, the Brazilian government collects and maintains a wealth of detailed data to study the questions at hand. We match these different databases based on common and unique identifiers, such as worker registration numbers, establishment tax identification codes, and municipal location.

Matched Employer-Employee Data

We exploit administrative data, collected by the Brazilian Ministry of Labor and Employment and reported in the *Relação Anual de Informações Sociais* (RAIS), to observe the formal labor market. Details on the RAIS data can be found in our previous work (e.g., Poole (2013) and Davis and Poole (2020)). The key benefit is the ability to follow workers throughout their employment history. Notably, when workers move between firms, we characterize these transitions as our main measures of labor mobility. For this chapter, we use data covering the years 2012 to 2016, when we also have complementary data on firm-specific foreign direct investment inflows.

Importantly, the data include many control characteristics for our estimation of gender earnings gaps. The main outcome is worker-level earnings. We identify the effects of labor mobility on the gender earnings gap by interacting an indicator for the worker's gender (denoted among RAIS' demographic characteristics) with our main variable of interest, the share of workers in the individual's firm with prior experience at a multinational firm.

For both substantive and computational reasons, we restrict our main estimation sample in four ways. First, due to the computational complexity of our estimation strategy, we sample the universe of formal-sector employment histories. To do so, we create a list of all individuals who ever appear in RAIS between 2012 and 2016 and randomly select five percent of those individuals. The final estimation sample includes the complete work histories for all sampled individuals. However, our main variable of interest (the share of workers in the individual's firm with prior experience at an MNE) is constructed using the entire database, before the five percent random sample is selected.

As elaborated below, the remaining sample restrictions help us to address concerns about limited mobility bias and endogeneity. The second sample restriction is to include only individuals who work for the same firm every time we observe them in the data. That is, we exclude workers who switch firms. Third, we exclusively consider 'domestic' firms that never received FDI as reported in our data. Finally, we include firms that have at least 5 workers in every year we observe the firm, as is customary in the literature.

Our main outcome measure from the data is monthly earnings in December. We consider job spells that were active as of December 31 in each year and, for individuals with multiple active spells, we keep the highest paying job spell under the assumption that any transitions would likely be made based on this employment.

Multinational Establishments

The Brazilian Central Bank (*Banco Central do Brasil*, BCB) publishes a detailed registry on its website of all foreign investment inflows into the country, as is required by Brazilian law. The *Registro Declaratório Eletrônico–Investimentos Externos Diretos* (RDE-IED) includes information on all Brazilian companies with positive foreign direct investment inflows by month from November 2011 to the present. According to the international standard definitions followed by the Brazilian Central Bank (see the International Monetary Fund Balance of Payments and International Investment Position Manual), "a direct investment relationship occurs when an investor from one economy holds voting power of 10 percent or more in an enterprise of another economy" (BCB 2018). Therefore, firm-specific foreign direct investment only enters our data when foreign ownership is at least 10 percent.[2] This is

2 Unfortunately, while we know that it is at least 10 percent, we have no further information about what share of the company is owned by foreigners. Furthermore, while it is a plausible hypothesis that the foreign influence on local policies and practices will be stronger for foreign investment for the purposes of greenfield investment than from investment associated with mergers and acquisitions, our data do not make this distinction, so we cannot test this hypothesis.

the same data used in Poole (2013) to estimate MNE wage spillovers from labor mobility, and the same data used in Davis and Poole (2020) to estimate the potential gender-equalizing effects of MNEs through worker mobility. There are, however, a few key differences.

First, as previously suggested, in this work, we focus our analysis on a more recent time period; our previous work explored the early liberalization period of 1996 through 2004. We are now better able to understand and reflect on the role of Chinese foreign direct investment in Latin America. According to the BCB, China is Brazil's 13th largest source of direct investment, quadrupling from $2.1 billion in 2014 to $10.9 billion in 2017 (BCB 2018).

Second, the data now include detailed source-country information. In our previous work, we only knew whether a firm received some positive flow of FDI. We now have information on from where the FDI flows to explore the possibility of differential effects across source countries. Figure A. 7.3 illustrates the map of Brazilian foreign direct investment counts, as reported by the BCB's RDE-IED across all years, with darker reds representing more FDI. The top countries by count of FDI inflow are the United States, Italy, Spain, the Netherlands, Portugal, and France, though clearly significant amounts of FDI also flow from China, Japan, Canada, Mexico, Chile, and neighbors Argentina and Uruguay.

Finally, in our previous work, we also had information on the firm-specific stocks of FDI, which is not included in this data. These BCB data include a list of all firm tax numbers with a positive inflow of FDI. Lacking direct information on a firm's FDI stock by year, we have identified two separate measures for multinational firms and the workers employed by them. As our primary metric, we define a firm to be foreign-owned for all periods after the first-observed foreign direct investment inflow. That is, if we observe the firm to have a positive FDI flow in 2014, and no FDI inflow in 2012 or 2013, this firm is characterized as an MNE in all years 2014 to 2016. By extension, all workers employed in that firm between 2014 and 2016 are considered to have multinational experience. We will refer to this as *post FDI*. Since we do not have data prior to 2011, and the firm may have investment inflows prior to 2014 that we simply cannot observe, we also consider a firm with positive foreign direct investment inflow (based on RDE-IED) at any point during our sample period as a multinational enterprise as a robustness check. In this case, all workers ever employed in that firm are forever considered to have multinational experience, regardless of when they worked there. We will refer to this metric as *ever FDI*.

These largely time-invariant measures help to mitigate concerns over the endogeneity of foreign direct investment flows. Our main estimations only consider domestically owned firms that never receive FDI inflows as reported in our data and their workers with no previous experience at an MNE, and, thus, are not subject to the selection bias in previous research on productivity spillovers (i.e., that foreign direct investment flows to already more productive firms). However, we remain cognizant of the differences between foreign and domestic firms. By employing a more time-invariant definition of FDI and incorporating firm-level fixed effects in the analysis, we are able to mitigate such endogeneity concerns. Moreover, any effect we do find is likely a lower-bound since some of the firms and workers we characterize as MNEs and workers with experience at MNEs, respectively, may not, in fact, have been subject to meaningful foreign influence.

Despite the advantages of our econometric strategy, it is still important to understand the differences between local Brazilian firms and firms receiving foreign direct investment in Brazil. Davis and Poole (2020) document that, for the 1996-2004 period, firms receiving FDI were larger, concentrated in male-dominated industries, and almost entirely absent from industries that tend to employ women. As illustrated in the figures that follow, which replicate the analyses in Davis and Poole (2020) for the more recent years, these statistics largely hold in the 2012 to 2016 time period, with some small but important differences.

Firms receiving FDI are still significantly larger in terms of employment, but are less concentrated in manufacturing than in the early liberalization years. The median domestic firm employed only 3 people, compared to 25 for multinational firms (see Figure A. 7.4). Roughly 40 percent of employment in MNEs is in manufacturing, which tends to employ more men (see Figure A. 7.5), as compared to almost two-thirds of employment in the previous period of analysis. Similar to the earlier time period, however, there is almost no MNE employment in the sector which accounts for almost half of all working women: public administration, health, and education. While female employment shares are still lower among firms receiving FDI, as compared to

domestic firms in Brazil (see Figure A. 7.6), the gap has narrowed considerably since the 1996 to 2004 period. In the earlier time period, we reported that the share of women employed in MNEs was about 15 percentage points lower than the share of women in domestic establishments. Between 2012 and 2016, that gap has narrowed to only about 5-8 percentage points between.[3]

Comparing the two different decades, the data seem to indicate a trend toward improving gender equality in Brazilian multinational affiliates, which are 1) no longer as strongly represented in male-dominated manufacturing, and 2) demonstrating more similar female employment ratios as compared to their domestic-firm counterparts. What then does this suggest about gender earnings gaps across firm types, which we reported to be far more severe in MNEs in the earlier decade of 1996-2004? Figure A. 7.7 illustrates the coefficient estimates on the year-by-female indicator from regressions of log December earnings on age, age-squared, and fixed effects for year, state, education, occupation, and industry, as well as the interaction of industry and occupation, across firm type. Comparing the blue dot (MNE firms) and the red dot (domestic firms), it appears the residual gender earnings gap is narrowing across both types of firms between 2012 and 2016. However, the narrowing of the gender earnings gap is stronger among multinational firms, which went from approximately 27 percent in 2012 to around 20 percent in 2016, than for domestic firms, which only narrowed from approximately 25 percent to 23 percent over the 5 years. Together, these statistics offer a more promising starting point (a first-order direct effect) from which to find evidence of a second-order labor mobility mechanism to transmit best practices in gender policy than did the baseline, first-order direct effect evidence in our earlier work.

Gender Inequality Index

The UNDP constructs measures of gender equality for many countries around the world over several years. The *Gender Inequality Index* (GII) reports information on three important aspects of human development: reproductive health (as evidenced by maternal mortality rates and adolescent birth rates), female empowerment (as represented by female parliamentary seats and shares of women with at least a secondary education), and female labor force participation rates. A higher GII indicates more inequality, while a lower GII is suggestive of greater equality.

We utilize data on the GII for 116 countries in 2010. In 2010, Brazil's GII was 0.446, largely because of high adolescent birth rates, a low share of parliamentary seats held by women, and low female labor force participation. By comparison, the United States reports a GII of 0.285, notably because of relatively high maternal mortality rates. Interestingly, China's GII was lower than the United States', at 0.209 in 2010. Sweden (0.050) is reported as the most gender-equal country in the world in 2010, while Yemen (0.743) was the most gender-unequal country in the same year. Figure A. 7.8 illustrates the UNDP's GII indices for all the countries from which Brazil receives foreign direct investment, with darker shades of purple representing more unequal countries. Brazil, with a GII of 0.446, would be the dark lavender color of the nearby countries Colombia, Paraguay, and Ecuador.

Though Brazil receives foreign direct investment from countries with varying degrees of gender equality, a large portion of total FDI counts is still from highly gender-equal countries such as those in Europe. Figure A. 7.9 depicts the total count of FDI inflows over our five-year period by gender inequality percentile. The bulk of FDI flowing into Brazil originates in highly gender-equal countries, while only a small sliver of FDI flows from countries in the bottom half of the GII percentiles. Given previous research, this should prove hopeful for foreign direct investment to serve as a mechanism of positive change for women.

With this in mind, we return to the descriptive evidence in Figures A. 7.4 through A. 7.7 and note the similarities between all firms receiving FDI and those firms receiving FDI from top-quartile gender-equal headquarters countries. It turns out there are no discernable differences across these firms. Interestingly, however,

3 Table A. 7.1 reports descriptive statistics across different types of establishments in a pre-period—those that would receive foreign investment inflows at some point in the future (2012 through 2016) and those that would never receive foreign investment, our measure of "*ever FDI*".

firms receiving FDI from the bottom 75th percentile of gender equality report slightly smaller gender earnings gaps, though these are not always statistically different. FDI flows from the United States would show up in this group, as would FDI flows from China. This may have important implications for the country-of-origin analysis that follows. As always, when conducting analyses on policies, we must remain cognizant of the differences between regulations and enforcement of the regulations (i.e., practice).

7.3 Empirical Strategy

Our main empirical strategy follows Poole (2013) and Davis and Poole (2020). We first explore whether workers moving between foreign-owned and Brazilian-owned firms are a means of transferring female-friendly labor practices including higher wages for women and reduced gender earnings gaps. Specifically, we relate a worker's earnings to the worker's own characteristics, as well as the characteristics of the firm in which the worker is employed. The key firm-level characteristic measures the share of workers in the firm with previous experience in a multinational enterprise. Do workers learn about equitable gender practices in multinational firms, and then transfer this knowledge to domestic firms when they are hired there?

The baseline estimating equation is as follows:

$$\ln earn_{ijt} = \gamma_M SM_{jt} + \mu_M SM_{jt} \times 1(Female_i) + \beta_1 X_{it} + \beta_2 Z_{jt} + \varphi_i + \theta_{j(i)} + \delta_t + \varepsilon_{ijt} \quad (7.1)$$

where i indexes the individual, j indexes the firm, and t indexes time. The main outcome of interest are individual-level log earnings in December. SM_{jt} refers to the share of the firm's workforce with previous experience in a multinational firm. We also include time-varying individual characteristics (X_{it}), such as tenure, age, age-squared, and education indicators; time-varying firm characteristics (Z_{jt}), such as whether the firm is privately-owned, individual fixed effects (ϕ_i); firm fixed effects ($\theta_{j(i)}$); and year dummies (δ_t). We cluster the standard errors at the firm level.

Though we report that our main estimating equation has both individual worker- and firm fixed effects, the reality is that the individual fixed effects are effectively match fixed effects; in other words, the match (job spell) fixed effect absorbs the individual fixed effect, since a worker is only matched with one firm in our sample. This is precisely because of the sampling restriction decision we made to include only "incumbent" domestic workers in the main estimating equation. We are interested in understanding how the share of former MNE workers in a domestic firm impacts the earnings of workers in that firm with no previous MNE experience. For this reason, we exclude all workers (former MNE or otherwise) from switching in and out of the firm. Therefore, we believe the issue of limited mobility bias in identifying the separate firm and worker fixed effects, as highlighted in Bonhomme, Lamadon, and Manresa (2019), is mitigated by our empirical strategy.

It is important to stress that we are not making comparisons between MNE and non-MNE firms. The baseline estimation in Equation (7.1) includes only incumbent workers at domestic firms. Because the sample is restricted to domestically owned firms and their employees, it is not subject to the estimation bias that FDI may flow to more gender-equal firms that is found in previous research. Rather, our goal is to understand whether workers formerly employed by a multinational may spread gender policy as they move into domestic firms. Equation (7.1) is identified by comparing the earnings of workers when they have many former MNE workers as colleagues to earnings of individuals that have few former MNE workers as colleagues, within the same firm over time. In order to explore the impact of these multinational spillovers on women differentially from men, we interact the main variable of interest with a dummy signaling the worker's gender. The main coefficient of interest, μ_M, is therefore identified by within-firm variation in the fraction of workers with prior MNE experience. Furthermore, because the estimating sample is only incumbent domestic workers and does

not include switchers (workers who have moved in or out of firms), our identification comes from the within-firm (and even within-match) variation in the fraction of workers with prior MNE experience.

The main hypothesis is that increases in the share of workers with MNE experience will be reflected in higher relative earnings for women. While on the job at multinational firms, workers learn about production processes, e.g., the acquisition of intermediate inputs and new knowledge of export markets, that they may transfer when they leave the MNE and are hired in the domestically owned firm, enhancing local productivity and wages (Poole 2013). The same could be true for processes, practices, and policies related to women—workers learn about practice in the MNE and transfer it to the domestic firm when they transition there.

The regression is not without some potential threats to the identification. For example, as highlighted in Davis and Poole (2020), domestic firms that hire many former MNE workers are also different from domestic firms that hire few former MNE workers. While we do a lot to control for these differences with firm fixed effects and time-varying firm-specific controls, we recognize that hiring decisions may be correlated with other factors contributing to earnings growth at the firm level. However, there are not immediate and obvious reasons to believe that the firm-specific shocks to hiring and earnings are specific to female earnings.

Heterogeneity

Despite the solid theoretical possibilities in favor of the positive transfer of gender-equalizing policies in the aftermath of increased investment, Davis and Poole (2020) found that increasing the share of workers with MNE experience modestly exacerbates the gender earnings gap for the early years post-liberalization, though the point estimate was statistically insignificant. This is not to say that MNEs do not support gender equality, but rather workforce turnover proves to be an elusive mechanism for the transfer. For this reason, we next consider the possible heterogeneous transmission of gender policy and practice across several different worker- and firm-level characteristics.

In terms of worker heterogeneity, following Davis and Poole (2020), we first consider the possibility that not all workers are equally positioned to transfer good policy. Women and men may be differentially impacted by some policies, and therefore experience the policies differently. In this particular setting, it is plausible that good gender policy would affect female workers more positively than male workers; hence, women have the motivation to encourage change in their new domestic employment. In order to test this hypothesis, we adapt Equation (7.1) in a small way, as follows:

$$\ln earn_{ijt} = \gamma_M SM_{jt} + \mu_M SM_{jt} \times 1(Female_{\mathrm{i}}) + \gamma_M^F SM_{jt}^F + \mu_M^F SM_{jt}^F \times 1(Female_{\mathrm{i}}) + \beta_1 X_{it} + \beta_2 Z_{jt} + \varphi_i + \theta_{j(i)} + \delta_t + \varepsilon_{ijt} \tag{7.2}$$

where all notation is the same as in Equation (7.1). In this adapted specification, SM_{jt}^F refers to the share of the firm's workforce with previous experience in a multinational firm who are also women. Here, the main coefficient of interest, μ_M^F, expresses the differential effect that former MNE female switchers have on the gender earnings gap.

We also explore similar regressions for workers with experience at a multinational firm who are managers. We hypothesize that managers have both the knowledge and power to make changes in policy when they are hired at domestic establishments.

In terms of firm heterogeneity, we consider two main sources. First, we expect the economy-wide effect may vary across broad sectors of the economy; some industries are more female-labor intensive and others require relatively more capital, skilled labor, or technology. With this in mind, we re-estimate our baseline specification (as in Equation (7.1)) across the seven 1-digit ISIC industries in our analysis.[4]

4 We exclude the agricultural sector and the public administration sector. Not only is labor adjustment in the public sector unlikely to respond to the same forces as in the private sector, but the Ministry of Labor and Employment also recognizes data quality challenges both there and in the agricultural sector.

Second, a key innovation in this chapter is the role that foreign investment from different source countries may have. We next ask whether it matters from where the foreign direct investment originates—that is, do workers with experience in MNEs with headquarters in relatively gender-equal countries transfer best practices towards women better than workers with experience in MNEs from relatively more gender-unequal countries? As Brazil is a fairly gender-unequal country, we expect FDI from more gender-equal countries to encourage and spread higher wages for women. At the same time, as FDI from less gender-equal countries in Asia has been amplified in recent years, perhaps positive gender norms will not result from increased foreign direct investment. Consequently, we adapt the baseline Equation (7.1) specification to test this hypothesis as follows:

$$\ln earn_{ijt} = \gamma_M SM_{jt} + \mu_M SM_{jt} \times 1(Female_{\mathrm{i}}) + \gamma_M^{Q1} SM_{jt}^{Q1} + \mu_M^{Q1} SM_{jt}^{Q1} \times 1(Female_{\mathrm{i}}) + \beta_1 X_{it} + \beta_2 Z_{jt} + \varphi_i + \theta_{j(i)} + \delta_t + \varepsilon_{ijt} \tag{7.3}$$

where, again, all notation is the same as in Equation (7.1), with the exception of SM_{jt}^{Q1}, which refers to the share of the firm's workforce with previous experience in a multinational firm with FDI inflows originating from a first-quartile country as reported by the UNDP's *Gender Inequality Index* in a pre-period of 2010. The countries in the top quartile of gender equality are mainly those in Europe, along with Canada and Australia. The United States and China are not in the top quartile.

7.4 Results

We begin our analysis with a replication of the exercises in Davis and Poole (2020), as we now focus on a new time period and rely on slightly different definitions of multinational enterprises. Table 7.1 reports coefficients from the ordinary least squares estimation of Equation (7.1). The main dependent variable in the individual-level regression is the logarithm of earnings in December. The main foreign direct investment variable is our definition of *post FDI* where we define MNE experience as working at a firm at any time after it receives foreign direct investment. In addition to the main regressors of interest, we also include tenure, age, age-squared, education indicators, a firm-level private ownership indicator (the coefficients on these variables are available by request), and fixed effects for the firm, individual, and year. The standard errors are clustered at the firm level.

Table 7.1 FDI and the Gender Earnings Gap

		Robustness Checks	
Dep. Variable: Log (December Earnings)	**Post FDI**	**Ever FDI**	**Sector-by-Year**
Share of Employees with MNE Experience	0.046 (0.035)	0.086*** (0.016)	0.093*** (0.025)
Female*Share of Employees with MNE Experience	0.074* (0.034)	0.002 (0.018)	0.035 (0.034)
Observations	4,871,355	4,871,355	4,871,355

Source: *RAIS, BCB.*

Notes: *This table reports coefficients of individual-level log earnings on the listed variables plus tenure, age, age-squared, education indicators, a firm-level private-ownership indicator, and fixed effects for the firm, individual, and year. *** denotes significance at the 1% level; ** denotes significance at the 5% level; * denotes significance at the 10% level. Robust standard errors, clustered at the firm level, are reported in parentheses.*

Concentrating the interpretation first on the level effect of a domestic firm's exposure to multinational workers (the first row), we observe a positive but insignificant coefficient. That is to say, controlling for several observable and unobservable characteristics, firms with higher shares of former multinational workers also report higher earnings on average. This result seems to be in line with much of the literature on the impact of foreign ownership on wages and, by extension, the spillovers of those higher earnings to domestically oriented firms (see, for example, Poole (2013) for the case of Brazil).

Interestingly, and in contrast to the analysis in Davis and Poole (2020) for the 1990s, in this later period the movement of workers from multinational to domestic enterprises has a small, positive, and statistically significant effect on labor market outcomes for women. As shown in the first column of Table 7.1, increasing the share of workers with MNE experience modestly improves the gender earnings gap (differentially increasing the earnings of women employed in these firms as compared to otherwise identical men). While these positive effects are uplifting, as policymakers consider the implications of expanding socially-responsible multinational enterprises in order to reinforce the advances of women over the last half-century, we should take care to note that the economic effects are small. While the coefficient estimates themselves are not small, when scaled by the variation in the fraction of workers with MNE experience, the results suggest that the changes in female labor market outcomes are minor.

Robustness

In columns 2 and 3 of Table 7.1, we report two small robustness checks on the main analysis using the *post FDI* measure of foreign direct investment. First, we provide a check on the data using the secondary *ever FDI* measure for multinational firms. On the one hand, this purely time-invariant measure of FDI further mitigates any bias associated with where foreign direct investment flows and when, but it also may reduce the precision of our estimates since we are possibly capturing firms and workers before they are ever receiving the treatment of foreign investment. Recall also that this change is indirect in terms of how we classify domestic workers' co-workers' prior experience at an MNE. In fact, using the secondary *ever FDI* measure, we no longer find any significant impact on the gender earnings gap at domestic firms with higher shares of former MNE workers.

Next, we experiment with sector-specific shocks to earnings by incorporating 1-digit industry-by-year fixed effects into the analysis. Neither metric of FDI reports a statistically significant impact of the share of workers with prior experience at an MNE on the gender earnings gap. Nevertheless, as the primary purpose of foreign investment is not to support gender equality, it is at least nice to learn that the effects do not differentially harm women.

Heterogeneity

In Table 7.2, we report coefficient estimates from Equation (7.2), in which the main variable of interest is the share of workers in the domestic firm with experience at a multinational who are also women. In line with Table 7.1, we note that increases in the share of workers in the firm with multinational experience improves the gender earnings gap (second row). However, it appears that these transfers can be largely attributed to the male former MNE switchers, contrary to our hypothesis. In the final row, we see a statistically significant negative effect of the share of female former MNE workers in the firm on the gender earnings gap.

Table 7.2 FDI and the Gender Earnings Gap, Female Switchers

Dep. Variable: Log (December Earnings)	Post FDI	Ever FDI
Share of Employees with MNE Experience	0.014 (0.039)	0.098*** (0.019)
Female*Share of Employees with MNE Experience	0.117** (0.044)	-0.006 (0.023)
Share of Employees who are Female and with MNE Experience	0.117* (0.055)	-0.045 (0.025)
Female*Share of Employees who are Female and with MNE Experience	-0.139** (0.061)	0.038 (0.030)
Observations	4,871,355	4,871,355

Source: *RAIS, BCB.*

Notes: *This table reports coefficients of individual-level log earnings on the listed variables plus tenure, age, age-squared, education indicators, a firm-level private-ownership indicator, and fixed effects for the firm, individual, and year. *** denotes significance at the 1% level; ** denotes significance at the 5% level; * denotes significance at the 10% level. Robust standard errors, clustered at the firm level, are reported in parentheses.*

In Table 7.3, we re-estimate Equation (7.2) with switchers who become managers in the domestic firm. That is, the main variable of interest is the share of workers in the domestic firm with experience at a multinational who are also employed in managerial positions. For the multinational firm metric of *ever FDI*, we report a positive and marginally significant impact of managers with MNE experience on the gender earnings gap, as hypothesized. Outside the scope of the current analysis, it would be interesting to explore the impact of female manager switchers, though we begin to arrive at a very small number of qualifying individuals, suggesting that estimated effects would be identified by few observations.

Table 7.3 FDI and the Gender Earnings Gap, Manager Switchers

Dep. Variable: Log (December Earnings)	Post FDI	Ever FDI
Share of Employees with MNE Experience	0.045 (0.035)	0.089*** (0.016)
Female*Share of Employees with MNE Experience	0.068 (0.035)	-0.002 (0.018)
Share of Employees who are Managers and with MNE Experience	0.026 (0.130)	-0.117 (0.071)
Female*Share of Employees who are Managers and with MNE Exp.	0.125 (0.169)	0.172* (0.087)
Observations	4,871,355	4,871,355

Source: *RAIS, BCB.*

Notes: *This table reports coefficients of individual-level log earnings on the listed variables plus tenure, age, age-squared, education indicators, a firm-level private-ownership indicator, and fixed effects for the firm, individual, and year. *** denotes significance at the 1% level; ** denotes significance at the 5% level; * denotes significance at the 10% level. Robust standard errors, clustered at the firm level, are reported in parentheses.*

In Table 7.4, we re-estimate the baseline specification (as in Equation (7.1)), separately for each of the seven different 1-digit ISIC industries in our analysis (we exclude the agricultural and the public administration sectors) for the *post FDI* metric of foreign investment (results for *ever FDI* are available by request). The positive impact of increasing the share of former MNE workers on reducing the gender earnings gap we noted in Table 7.1, appears to be driven largely by the finance and business sector. By contrast, the gender earnings gap appears to widen in the wholesale and retail sector with increased MNE worker mobility.

Table 7.4 FDI and the Gender Earnings Gap, by Broad Sector (Post FDI)

Dep. Variable: Log (December Earnings)	Mining	Manufact.	Utilities	Construct.	Wholesale / Retail	Trans. / Comm.	Finance / Bus.
Share of Employees with MNE Experience	-0.343 (0.230)	0.133** (0.050)	0.128 (0.790)	0.283*** (0.071)	0.126*** (0.024)	-0.021 (0.070)	0.005 (0.064)
Female*Share of Employees with MNE Exp.	0.488 (0.343)	0.099 (0.063)	0.134 (0.715)	0.047 (0.080)	-0.088** (0.034)	0.138 (0.079)	0.263** (0.082)
Observations	29,330	867,605	23,800	253,468	866,445	276,814	355,109

Source: *RAIS, BCB.*

Notes: *This table reports coefficients of individual-level log earnings on the listed variables plus tenure, age, age-squared, education indicators, a firm-level private-ownership indicator, and fixed effects for the firm, individual, and year. *** denotes significance at the 1% level; ** denotes significance at the 5% level; * denotes significance at the 10% level. Robust standard errors, clustered at the firm level, are reported in parentheses.*

While our data do not allow us to explore the exact mechanisms, this evidence is important for two main reasons. First, services industries in Brazil receive the largest share of foreign direct investment inflows. According to the BCB, the service sector received 45 percent of all FDI inflows in 2010, rising to 55 percent in 2016. The share of FDI flowing to the manufacturing sector declined over the same period, from 39 percent in 2010 to 37 percent in 2016 (BCB 2018). Therefore, the positive implications of foreign direct investment on narrowing the gender earnings gaps are occurring exactly where we see large flows of FDI.

Second, women occupy a large share of administrative positions in the service sector. In their work on Bangladesh, Fernandes and Kee (2020) remark that the employment benefits of FDI are strongest for women in administrative positions. They hint that since administrative workers are engaged in more firm-to-firm interaction than production workers or management, this partly explains why the gender-equalizing spillovers are concentrated in these positions. By hiring more female administrative workers, the presence of FDI firms (in the case of Bangladesh) may have created a more gender-conducive environment that encouraged domestic firms to also hire more female administrative workers, perhaps because those workers are more comfortable dealing with other female administrative workers in related firms. These ideas of firm-to-firm interaction, together with the relative advantage that women have in communication-intensive tasks, provide a plausible explanation for the findings in the finance and business sectors.

The evidence from the previous literature places a lot of weight on the FDI-source country in terms of the magnitude of the potential cultural spillovers (see, for example, Tang and Zhang (2017) and Choi and Greaney (2020)). Next, in Table 7.5, we explore this idea in our framework of gender-equalizing spillovers through labor mobility. That is, do workers with experience at a multinational from a highly gender-equal country spread positive gender policy more than workers with experience at multinational firms from less gender-equal countries? Despite the theoretical possibilities for this idea to hold and earlier empirical evidence on the direct effect that more gender-equal headquarters FDI has on local affiliate wages, we find no statistical evidence to support the notion that there is an indirect effect from top-quartile gender-equal affiliates to local Brazilian firms. However, the point estimates are still positive, reflecting some potential support for the concept.

Table 7.5 FDI and the Gender Earnings Gap, By Source Country

Dep. Variable: Log (December Earnings)	Post FDI	Ever FDI
Share of Employees with MNE Experience	0.085 (0.058)	0.083*** (0.024)
Female*Share of Employees with MNE Experience	0.106 (0.065)	-0.028 (0.031)
Share of Employees with MNE Experience from a Q1 Gender-Equal Country	-0.047 (0.061)	0.004 (0.026)
Female*Share of Employees with MNE Experience from a Q1 Gender-Equal Country	-0.039 (0.070)	0.038 (0.034)
Observations	4,871,355	4,871,355

Source: *RAIS, BCB.*

Notes: *This table reports coefficients of individual-level log earnings on the listed variables plus tenure, age, age-squared, education indicators, a firm-level private-ownership indicator, and fixed effects for the firm, individual, and year. *** denotes significance at the 1% level; ** denotes significance at the 5% level; * denotes significance at the 10% level. Robust standard errors, clustered at the firm level, are reported in parentheses.*

Interestingly, Norwegian companies in Brazil expressed that they tend to adapt to the local culture rather than transmitting the high-quality Norwegian gender policy (UNCTAD 2020b). Thoughts like these may be why we fail to find strong support for the country-of-origin effect. Moreover, recall that policies and practices are different. Even the strongest regulations may not always be enforced, and the enforcement of policies and regulations is really what matters for gender equality. Finally, the fact that countries like the United States are mixed with China among the less-gender-equal countries may be another potential explanation for the weak findings.

7.5 Conclusions and Policy

In this chapter, we consider the implications of increased foreign direct investment in Brazil on the transmission of high-quality gender policy and practice as an important element of workplace culture that could have strong consequences for female labor market outcomes and close global gender gaps. Despite all the positive theoretical possibilities for the international transfer of gender equality by multinational enterprises, a recent body of work exploring the role that MNEs play in transmitting gender equality around the world has offered mixed results. This literature places considerable importance on the relationship between local policies toward women and the policies in place in the FDI-source country. This is our key innovation in this chapter; we explore not only whether there are heterogeneous effects across source countries, but how they may materialize through worker mobility.

Our results suggest that increasing the share of workers with MNE experience modestly improves the gender earnings gap, with stronger effects for workers employed in managerial positions. The effects, though, are not driven by FDI flowing from highly gender-equal economies. Anecdotal evidence hints that firms from highly gender-equal countries may still attempt to adapt to the local culture, thus limiting the amount of change they bring to domestic firms. Nevertheless, the effects do not differentially harm women.

While these positive effects are uplifting, as policymakers consider the implications of expanding socially-responsible multinational enterprises to reinforce the advances of women, we should take care to note that the economic effects are small. This indicates that countries should not rely on FDI as a significant source of improvement to gender equality. In order to fully support the advances of women over the last century, policymakers must continue to prioritize domestic policies to promote the education and employment of women.

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VIEW APPENDIX ONLINE

Labor Costs and Female Formal Entrepreneurship

Evidence from Brazil

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This chapter uses rich individual-level data to understand how a nationwide formalization program (the MEI program) impacts men and women differently. The MEI program began in 2009 to reduce formalization costs for micro-entrepreneurs. The identification strategy exploits the staggered rollout of MEI implementation across states and the exogeneity of eligible industries to identify the impacts on the formalization of micro-enterprises. Our findings show that women entrepreneurs drove the formalization of pre-existing micro-businesses, which might be due to increased access to social protection through the program. We find no evidence that the MEI program is a way out of unemployment or inactivity for women, or that employers changed their employees' contracts due to the program. ¶

8.1 Introduction

Informality is remarkably high in Brazil, representing 38% of all workers in the 2006-2012 period and 44% of women.[1] Informality leads to productivity losses while constraining workers' access to credit markets and social security benefits. To address this, the Brazilian government has stimulated the formalization of micro-enterprises[2] by reducing entry and ongoing costs in recent decades. Formal micro-entrepreneurship brings more independence and flexibility to entrepreneurs than other formal jobs while keeping similar social security rights. These advantages tend to be more valued by women as they can access more generous benefits, including maternity leave. However, the literature on formality costs, formalization, and micro-entrepreneurship for women remains scant.

This chapter uses a rich individual-level dataset to study whether and how a nationwide micro-entrepreneurship formalization program impacts men and women differently. The Individual Micro-Entrepreneur Program (*Micro Emprendedor Individual*), or MEI program, was adopted in 2009 to reduce formalization costs. The program has two main phases: Phase 1, when entry costs and registration costs were reduced (from July 2009 on); and Phase 2, when monthly taxes were reduced from 11% to 5% of the minimum wage[3] (from May 2011 on). The cost reduction in Phase 2 might have different effects by gender, as the average revenues of male and female firms are different.[4] MEI micro-entrepreneurs have access to the same rights as formal employees, such as retirement and disability benefits. In particular, female micro-entrepreneurs may receive paid maternity leave for four months (one minimum wage per month), while male micro-entrepreneurs have five days of paternity leave.

We use the Brazilian Monthly Employment Survey (PME) 2006-2012, a rotating panel of individuals covering Brazil's six most significant metropolitan areas. PME allows us to follow individuals for up to 16 months and collects data from both formal and informal workers, as well as unemployed and inactive individuals. The

* Institute of Economic Research Foundation (Fipe). All researchers are members of the Brazilian Women in Economics (BWE) research group. BWE was created in 2017 to study the various dimensions of the gender gap in Brazil http://www.usp.br/bwe/

1 Own calculations using PME 2006-2012/IBGE data for a sample of individuals aged 21 to 65 years.

2 As there is no single definition of micro-enterprise or entrepreneur, we use micro or small enterprises/entrepreneurs interchangeably to refer to the pool of small firms affected by the Brazilian government stimulus program.

3 The minimum wage in Brazil is determined by Law 12.382/2011 and refers to a monthly value updated annually. No formal worker within the country can be paid less than this minimum wage.

4 In Section 3, we show that, in Phase 2, more eligible female entrepreneurs perceived an actual tax reduction than men.

richness in terms of individual characteristics and its panel structure allows us to analyze the transitions that explain our results and identify those most affected by the MEI program.

Our identification strategy follows Rocha et al. (2018) and exploits the staggered rollout of the program implementation across states, including many layers of fixed effects. We also consider the initial list of eligible sectors, based on the SIMPLES'[5] list of activities defined by the government more than a decade before the MEI program. To avoid confounding the effect of the MEI, which would happen if the selection and implementation across sectors is a response to sector-specific trends in labor market outcomes, we estimate the effect of the program using an event study research design that is capable of testing for such trends and recovering any dynamics of the program's impact.

Our results show that the MEI program successfully increased formalization, especially among women, due to a reduction in red tape costs. In particular, our results do not show that this comes from firms hiring their existing informal employees as "vendors", i.e., just by changing the contract arrangement.[6] Instead, our findings suggest that the MEI program formalized existing informal female self-employed or micro-entrepreneurs with up to one employee.

We find that the formalization rate of treated self-employed or micro-entrepreneurs (under average treatment intensity) increases by 9.5 percentage points relative to untreated self-employed or micro-entrepreneurs. To the extent that most self-employed are informal (78% on average and 81% among women), a policy that attracts these individuals to the formal sector has a great potential to reduce overall informality significantly. We also find evidence that the effects vary according to women's demographic variables, with larger effects for those previously working in the informal sector as self-employed and aged 41-50 (for Phase 2 effects) and aged 31-50 (for Phase 1 effects). The heterogeneous results by age suggest that women formalize as they seek more social security benefits. Finally, formalization under the MEI program was also higher for women earning at the upper two income quartiles due to the selection of relatively high-income individuals into sectors more affected by the MEI program (high intensity).

Our results are consistent with literature showing that women formalize more than men due to the social security benefits that formality provides (Babbitt et al., 2015, and Ashraf et al., 2019), likely because women are more risk-averse than men (Niederle and Vesterlund, 2007, Dohmen and Falk, 2011, and Dohmen et al., 2011)[7]. The MEI program allows workers to access social protection benefits such as maternity leave, which is probably an important reason women become formal entrepreneurs. However, if formalization is not bringing any valuable benefits for women in other contexts, male business owners may be significantly more likely to formalize than female business owners (Benhassine et al., 2018).[8]

Finally, this chapter also adds to the literature that evaluates the average effects of reducing entry- and ongoing costs on formalization. In Brazil, Fajnzylber et al. (2011) and Monteiro and Assunção (2012) analyze the effects of the SIMPLES program using cross-sectional data. Building from their results, Piza (2018)

5 In 1996, the Brazilian government launched the Integrated System for the Payment of Taxes and Social Security Contributions of Micro and Small Firms (Sistema Integrado de Pagamento de Impostos e Contribuições das Microempresas e Empresas de Pequeno Porte - SIMPLES). The program, aimed at micro-, small- and medium- enterprises, consolidated several taxes and social security contributions into a single tax payment, decreasing red tape and the overall tax burden. The procedures to register firms, however, did not change.

6 This form of hiring is known as "pejotizacao" and has become frequent in Brazil since the introduction of the SIMPLES regime. Hired as firms, workers directly benefit from paying lower tax rates than they would incur under personal income taxation, and firms generally reduce labor costs.

7 This literature uses experimental evidence or survey results to document that women are less willing to take risks over tournaments.

8 This result comes from a multi-intervention program in Benin that included an information campaign and workshops to facilitate the paperwork, opening a business bank account, and tax mediation services. From this experiment, it is not clear that there were direct monetary incentives or any differential treatment for women to formalize, such as the one provided by the MEI in Brazil.

concludes that SIMPLES did not affect formalization rates, indicating that costs were still high in Brazil after the SIMPLES program. Rocha et al. (2018) evaluate the MEI program and find no effect of the reduction of entry costs on formalization rates (Phase 1), but they find an impact of the lower tax burden (Phase 2). Other papers find significant results of reforms to encourage formalization in Latin American countries (Bruhn, 2011, Kaplan et al., 2011, Bruhn, 2013, for Mexico[9], and Mullainathan and Schnabl, 2010, for Peru[10]). We contribute to this literature by decomposing the formalization effects by gender and considering demographic variables of female micro-entrepreneurs in Brazil.

8.2 The Individual Micro-Entrepreneur (MEI) Program

As part of the agenda to facilitate new businesses and increase formalization, the Brazilian government launched the MEI program in July 2009. The program's primary goal is to provide a formal alternative with low costs and reduced procedures to individuals who already work in the informal economy or want to start their own business.

By formalizing micro-enterprises, the program provides social protection to micro-entrepreneurs. Those who become formal micro-entrepreneurs, or MEI firms, are entitled to retirement pensions due to old age or disability. They can also take parental[11] and sick leave, which are benefits provided by the social security system in Brazil. In addition, if the MEI beneficiary dies, the entrepreneur's family is eligible for governmental pension payments.

To become an MEI entrepreneur, the individual must be 18 years old or above,[12] cannot have a stake in any other company, and can have at most one employee. The criteria established to be an MEI entrepreneur also include an annual revenue cap initially set at R$36,000[13]. The revenue cap increased over time following inflation adjustments. In 2012, the annual revenue cap changed to R$60,000. An increase in the real value of the revenue cap over time stimulates other small micro-entrepreneurs, who were first out of the eligibility criteria of the MEI program, to become MEI entrepreneurs. The revenue cap remained unchanged throughout our period of analysis (2009-2012).

To enroll in the MEI program, the firm should also belong to one of the nearly 400 eligible industries (at the 7-digit industry level). The initial list of eligible industries followed the one introduced 13 years before

9 In May 2002, Mexico started the Rapid Business Opening System (SARE), which simplified local business registration through the reduction of the number of days, procedures, and office visits required to register a firm (Bruhn (2011), Bruhn (2013)). Mexico, however, did not reduce taxes, as Brazil did. According to Bruhn (2011) and Kaplan et al. (2011), most of the increase in registered firms was due to the registration by new firms instead of formalizing existing informal firms. Most of the formalization was observed just after the adoption of the program. The authors find that the impact on employment was small.
10 Mullainathan and Schnabl (2010) analyze a reform of municipal licensing procedures in Lima, Peru. They find evidence that the reform had an important impact, as the time to get a license decreased by 60% and the average licensing cost fell by 42%. The number of newly licensed firms increased four times (by 400%) after the reform, revealing a huge impact on formalization.
11 Paternity leave consists of 5 days of leave credits with full pay, while maternity leave consists of 4 months of leave credits with full pay.
12 Individuals above 16 years old and under 18 years old should legally emancipate to enroll in the program. Federal employees are not allowed to enroll in the program at all.
13 For an entrepreneur that enters the MEI program after January, the revenue cap is proportional to the number of months the business remains active until December of that year.

by SIMPLES[14]. There is no evidence that the government hand-picked specific industries based on past performance or observable characteristics (Rocha et al., 2018). Moreover, the regulation on eligible industries within the MEI program has undergone few changes over the analyzed period (see Figure A.8.1 for the changes over time and Appendix A.8 for a more detailed discussion on those changes).

Initially, the program had two distinct phases. In the first phase (July 2009 to April 2011), there was a significant decrease in both monetary and non-monetary entry costs, and a potential reduction in red tape costs depending on the firm's revenue. Since the first phase, the procedure to register a firm at the MEI program is relatively straightforward. Entrepreneurs can do it online and provide just a few pieces of information as they complete the registration procedure, including their name, social security number (CPF), birth date, and the firm's sector. Registration is free of charge. However, to maintain formal status, the firm must pay a monthly fixed-price tax, including social contributions and small fees related to state and municipal sectoral contributions. At the beginning of the program, the monthly tax was 11% of the minimum wage (τ), which represented approximately 2.2% of the micro-entrepreneur's average income.[15] During the second phase of the program (from May 2011 on), the federal government reduced the social security contribution to 5% of the minimum wage, leading to a considerable reduction in the cost of remaining formal.

During the first phase of the program, the online registration platform was not simultaneously implemented in all Brazilian states due to technical constraints. According to the Ministry of Development, the limitations were due to the lack of integration of the state platforms with the federal government platform (different systems) and the overload caused by users' demand for the program. Therefore, between July 2009 and February 2010, access to the program varied across states. Table 8.1 summarizes the program's implementation across states and the main rules applied to each phase.

Table 8.1 Timeline of the Implementation of MEI Program, 2009-2012

Phase	Period	Regional coverage	Program rules
1	July 2009	DF, SP, RJ, MG	Entry Costs = 0, τ = 11% of the minimum wage
	September 2009	+ SC, PR, RS, CE, ES	
	February 2010	Full Coverage	
2	May 2011	Full Coverage	τ = 5% of the minimum wage

Source: *Ministry of Development.*

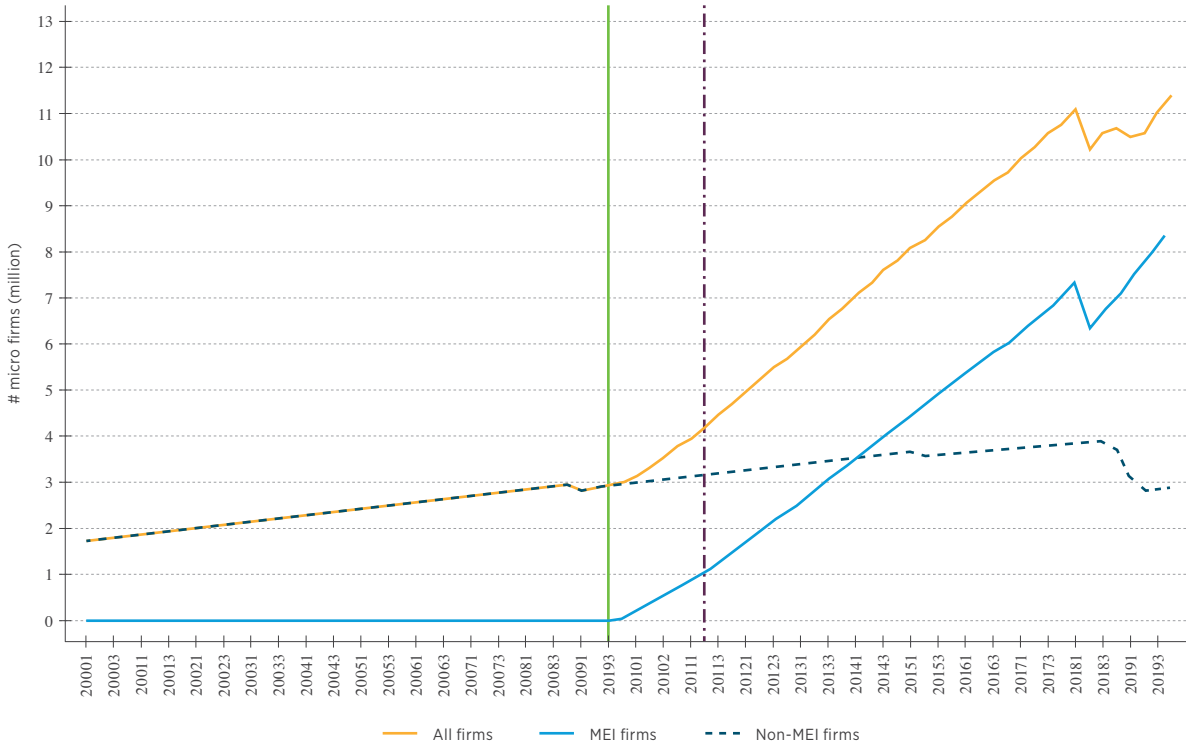
Notes: *Coverage of the program during Phase 1: July 1st, 2009: Federal District (DF); July 24th, 2009: Minas Gerais (MG), Rio de Janeiro (RJ), and São Paulo (SP); September 2009: Santa Catarina (SC), Paraná (PR), Rio Grande do Sul (RS), Ceará (CE), and Espírito Santo (ES); and February 2010: remaining states.*

14 The list of eligible activities for SIMPLES included activities from the services, construction, commerce, and manufacturing sectors. The list excluded professional activities and regulated occupations (e.g, physicians, engineers, dentists, architects, etc.). However, as the definition of professional activities was not straightforward, the eligibility status was not clear for firms operating in some activities. Other exclusions from SIMPLES were government-owned companies, establishments with foreign owners, incorporated companies, and excluded specific industries (real state companies, financial services, warehousing, private security, manufacturing of tobacco and alcoholic beverages, developers, advertising agencies, cleaning service firms, and outsourcing companies) (Fajnzylber et al., 2011, Monteiro and Assunção, 2012, Piza, 2018).

15 In 2009, the monthly minimum wage was R$465 and the average monthly income of formal micro-firms, was R$2,335, based on PME survey data. The list of eligible activities for SIMPLES included activities from the services, construction, commerce, and manufacturing sectors. The list excluded professional activities and regulated occupations (e.g, physicians, engineers, dentists, architects, etc.). However, as the definition of professional activities was not straightforward, the eligibility status was not clear for firms operating in some activities. Other exclusions from SIMPLES were government-owned companies, establishments with foreign owners, incorporated companies, and excluded specific industries (real state companies, financial services, warehousing, private security, manufacturing of tobacco and alcoholic beverages, developers, advertising agencies, cleaning service firms, and outsourcing companies) (Fajnzylber et al., 2011, Monteiro and Assunção, 2012, Piza, 2018).

Figure 8.1 shows the number of Brazilian legal micro-enterprises from 2000 to 2019[16]. Before the program implementation (2000-2009), the total number of micro-enterprises increased, but at a lower rate, moving from 5.8% per year from 2000-2009 to 13.9% per year after 2009. As we would expect, before the MEI program, the number of MEI firms was zero. After the program, there was a substantial jump in the number of micro-enterprises driven by firms in the MEI program reaching 8 million firms in 2019.

Figure 8.1 Number of Brazilian Micro Firms, 2000-2019

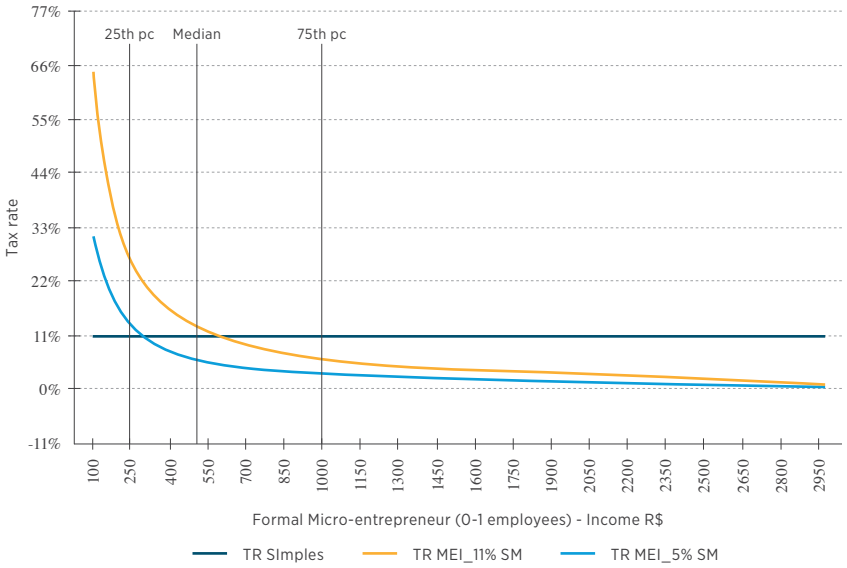


Source: *CNPJ Data from Brazilian Revenue Service.*
Notes: *The vertical green line indicates the quarter when the MEI program began (Phase 1). The vertical purple dash-dotted line represents the second phase of the program (tax burden reduction).*

As stated before, the monthly social security contribution became the main component of the monthly tax. These taxes were higher than the previous flat rate of 11% on total income under SIMPLES. Therefore, a reduction in the tax rate was initially perceived only by entrepreneurs at the highest percentiles of the income distribution. Figure 8.2 plots the tax schedules and the entrepreneurs' earning distribution to compare the MEI program monthly costs (Phase 1 in yellow and Phase 2 in orange) with the pre-MEI monthly costs of SIMPLES firms (in black). Note that only 50% of micro-entrepreneurs faced a lower tax rate during the program's first phase, compared to 75% in the second phase.

16 We use data from the CNPJ dataset, gathered by the Brazilian Revenue Service (*Receita Federal do Brasil* - RFB). The CNPJ is an available administrative dataset that holds registration information on all firms that have operated formally in Brazil since 1998. We consider as "micro-enterprises" individual entrepreneurs or firms with a single owner.

Figure 8.2 Monthly Tax Payments by Income of Micro-Entrepreneurs: Comparison of MEI Ongoing Costs – SIMPLES (Before MEI Program) and Phases 1 And 2



Source: *MEI and SIMPLES rules and income distribution in 2011 from PNAD for entrepreneurs with at most one employee.*
Notes: *Monthly tax payments of Phase 1 are in yellow, Phase 2 in orange, and SIMPLES (before MEI program) in black. Income values for micro-entrepreneurs are 25th percentile R$250, Median R$500, and 75th percentile R$1,000.*

8.3 MEI and Gender Differences

As shown before, the MEI program drove a significant increase in the number of micro-entrepreneurs in Brazil. From July 2009 to December 2018, the program had an average of around 1 million registrants per year. The micro-entrepreneurs' profiles are undoubtedly heterogeneous, and we are interested in identifying gender differences in the size and importance of the program.

We first ask if the incentives to enroll in the program differ by gender. Figure 8.3 shows the ongoing costs along with the income distribution of male- and female-owned micro firms. Only female entrepreneurs above the median of the earnings distribution perceived a lower tax rate in Phase 1. On the other hand, male entrepreneurs above the 25th percentile perceived an actual reduction in tax rates. It was only in Phase 2 that most male *and* female entrepreneurs perceived an actual tax reduction.[17]

17 The gender difference in between phases occurs primarily because male entrepreneurs earn, on average, more than women.

Figure 8.3 Monthly Tax Payments by Income: Comparison of MEI Ongoing Costs – SIMPLES (Before MEI Program) and Phases 1 And 2

Figure 8.3a Female micro-entrepreneurs

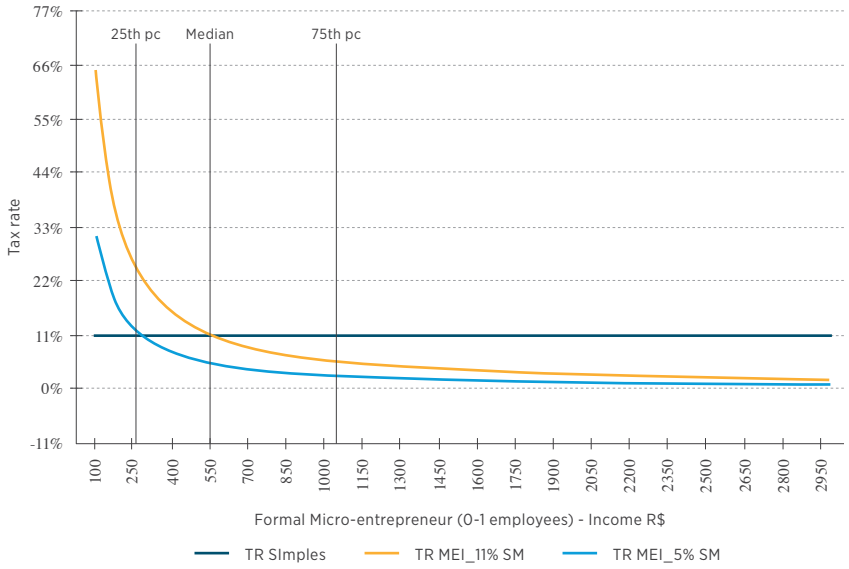
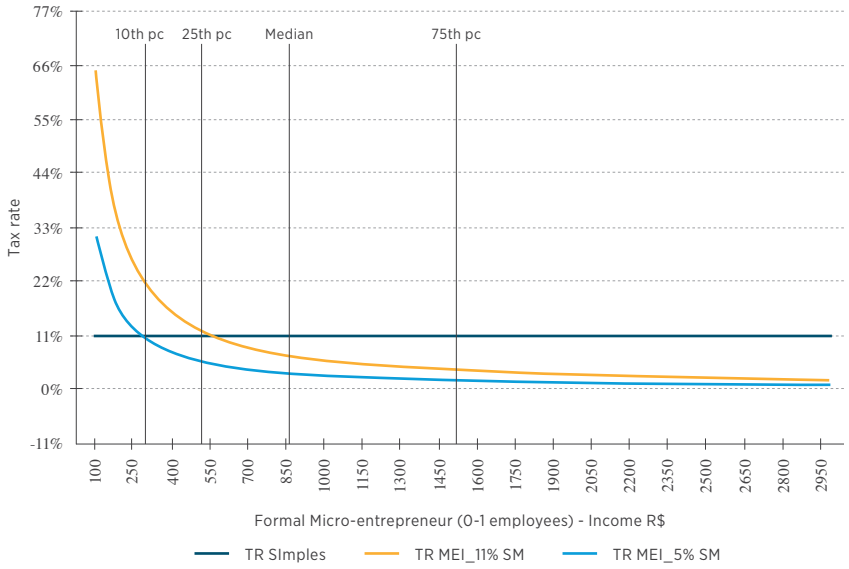


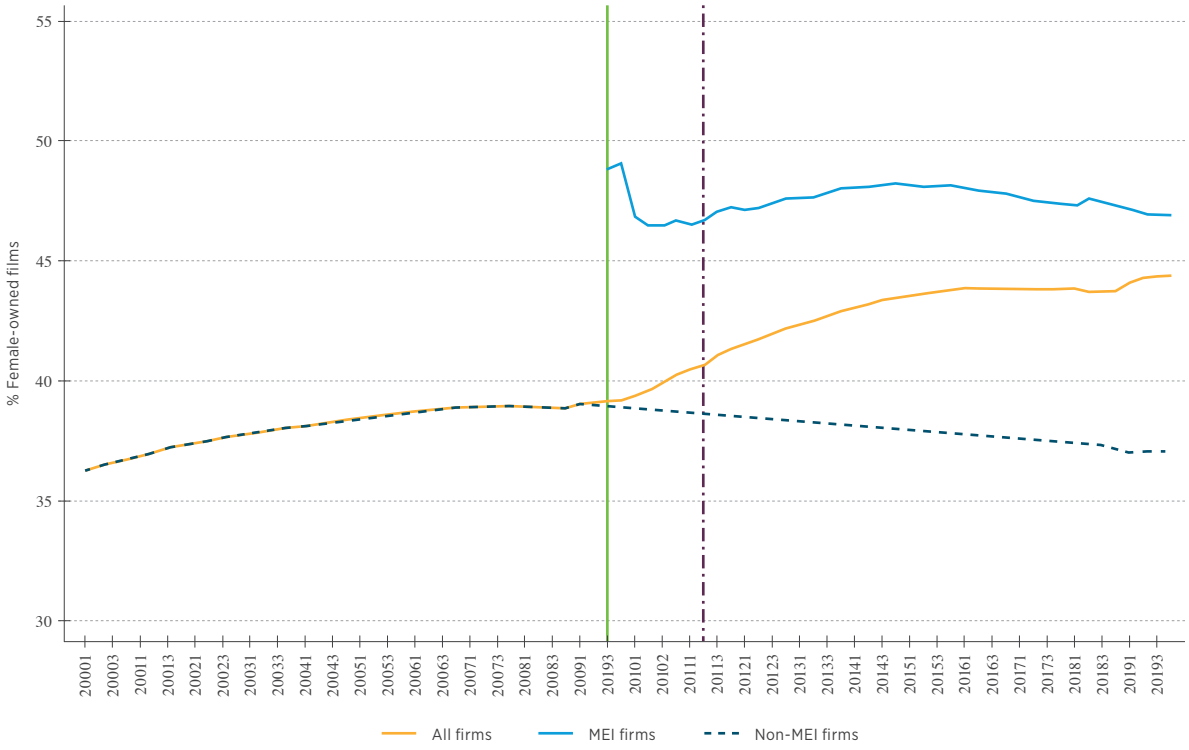
Figure 8.3b Male micro-entrepreneurs



Source: *MEI and SIMPLES rules and income distribution in 2011 from PNAD for entrepreneurs with at most one employee by gender.*
Notes: *Monthly tax payments of Phase 1 are in yellow, Phase 2 in orange, and SIMPLES (before MEI program) in black). Income values for female/male micro-entrepreneurs are 10th percentile -/R$200, 25th percentile R$250/R$500, Median R$550/R$850, and 75th percentile R$1,050/R$1,500.*

Figure 8.4 presents the share of female-owned micro-firms in Brazil from 2000 - 2019[18]. Before the MEI program, there was a slightly positive trend in the share of female-owned companies, increasing from 36% to 39% of total firms. We observe an increase in the share of female formal micro-entrepreneurs after the program (2009-2019), as the share of female-owned establishments among MEI firms (red dashed line) is much higher than in other small companies.

Figure 8.4 Share of Female-Owned Brazilian Small Firms, 2000-2019

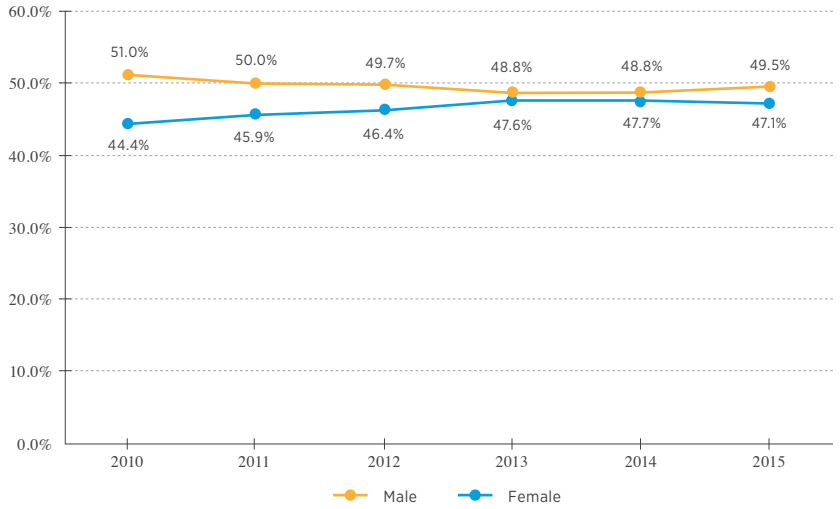


Source: *CNPJ Data from Brazilian Revenue Service.*
Notes: *The vertical green line indicates the quarter when the MEI program began (Phase 1). The vertical purple dash-dotted line represents the second phase of the program (tax burden reduction).*

Figure 8.5 shows the share of micro-entrepreneurs enrolled in the MEI program by gender and year of enrollment. From 2010 to 2015, there was a slightly higher share of male entrepreneurs. The share of male entrepreneurs enrolling in the program decreases until 2013/2014 when they reach their minimum (48.8%). On the other hand, the share of women entrepreneurs increased over the period, reaching its maximum of 47.7% in 2014. When we consider that the average participation in the labor force is much higher for men (69-72% in 2009-2015) than for women (50-53% in 2009-2015)[19], the similar shares for men and women that we find in the MEI program reveal that women are much more represented in MEI firms than in the average labor market in Brazil.[20]

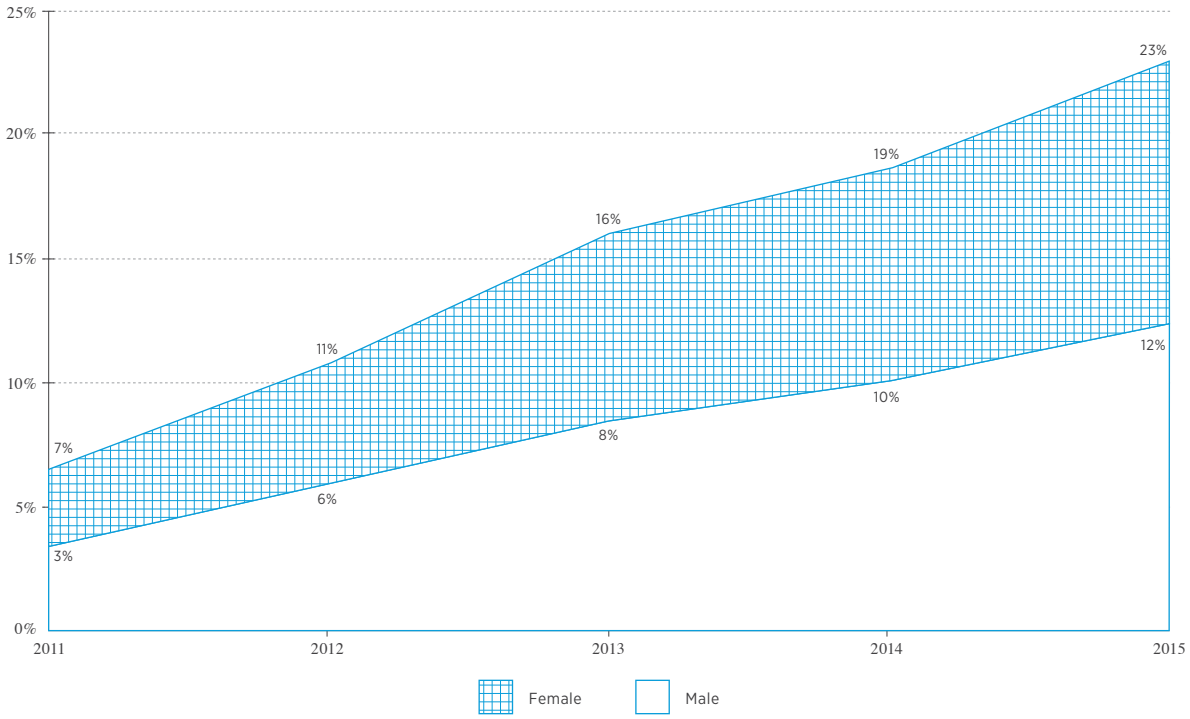
18 Data from the CNPJ dataset.
19 Participation in the labor force (the ratio between the economically active population and the total labor force) was calculated using annual data from PNAD 2009-2015.
20 There is not much difference in the share of women enrolled in the program by region (Figure A.8.2). The country's northern region has the smallest share of female micro-entrepreneurs under the program (44%), while the Southeast region has the highest (48%).

Figure 8.5 Share of Micro-Entrepreneurs Enrolled in the MEI Program by Gender and Enrollment Year, 2010 to 2015



Source: *CNPJ database.*
Notes: *We've excluded from our sample non-eligible industries. We do not plot the share of micro-entrepreneurs without gender identification.*

Figure 8.6 Coverage of the MEI Program in Comparison to the Number of Self-Employed Individuals, 2011 to 2015



Source: *For the number of individuals enrolled in the MEI program, we use the data from the CNPJ dataset from the Brazilian Revenue Service, and for self-employed individuals we use the annual PNAD database.*
Notes: *Coverage of the MEI program is the ratio between the number of individuals enrolled in the MEI program and self-employed individuals.*

Women's and men's behavior also differ in other dimensions of the data. Since most MEI firms do not have employees, most of them would be classified as self-employed by IBGE.[21] In this sense, we can define MEI's coverage as the number of MEI divided by the total number of self-employed. This simple ratio gives an idea of the program's success measured by the percentage of the potential targeted population that became formal.

Figure 8.6 shows the program coverage from 2010 to 2015. The coverage for women was 7% and 23% in 2010 and 2015, respectively. The coverage for men, on the other hand, was 3% and 12% in the same period. The coverage rate for women was always higher than the one observed for men.

There are important differences concerning sectors of activity. Most eligible industries are service-related, represented mainly by sales, food, and beauty care, which are traditionally linked to women. As Table 8.2 shows, the most common sector in MEI is "Hairdressers, manicures, and pedicures", which is dominated by women. Moreover, among the top ten industries, which represent 38% of all micro-entrepreneurs, only two have a share of women owners below 46%.

Another important question is whether the effects of MEI came from formalization or substitution of previous formal activities. Figure 8.7 presents the estimates of formalization[22] by year and gender. The results show that, in 2010, 85% of the MEI registrations by women were due to the program, and they would not be formal employees without it. The estimates of formalization systematically decline over the period. The magnitudes for men are always smaller than those observed for women, although they also show the same decreasing pattern. The gender difference in formalization is statistically significant.[23]

Table 8.2 Top 10 Industries on MEI by Total Firms in December of 2020

Rank	7-digit Industry	# MEIs	Total	Female-Owned
1	Hairdressers, manicures and pedicures	839,031	7.8%	76.3%
2	Retail sales of apparel and accessories	835,935	7.7%	76.7%
3	Masonry works	499,286	4.6%	3.4%
4	Sales promotion	405,704	3.8%	49.2%
5	Providing food prepared mainly for household consumption	316,753	2.9%	72.6%
6	Snack stores, tea houses, juices and similar	305,668	2.8%	54.1%
7	Retail sales of general merchandise, predominantly food products	259,245	2.4%	47.3%
8	Aesthetics activities and other beauty care services	235,085	2.2%	95.8%
9	Electrical installation and maintenance	209,122	1.9%	9.8%
10	Food mobile services	207,864	1.9%	46.4%
Total		**11,316,853**		**46.6%**

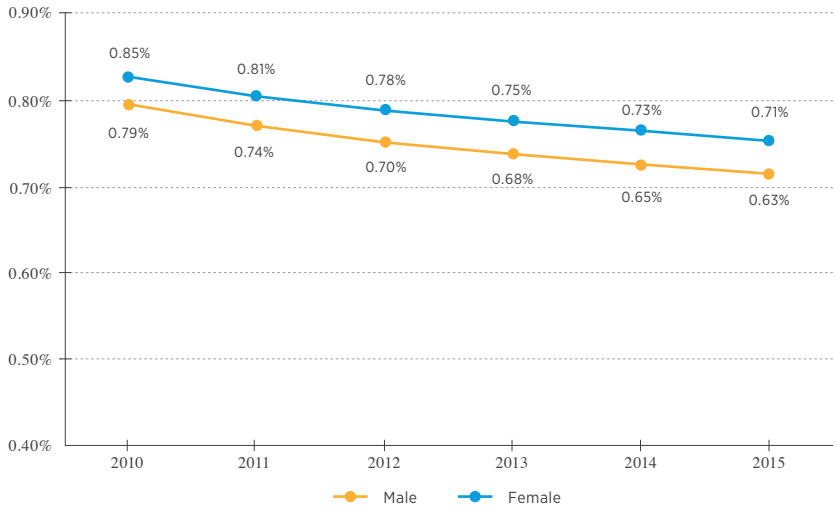
Source: *Elaborated by the authors based on MEI (2020).*

21 According to IBGE, "self-employed is a person who works exploring his/her own undertaking, alone or with a partner, and has no employees". At the same time, those self-employed who do not have CNPJ or any partners would be potential candidates for MEI.

22 Using the individual taxpayer number (CPF), we can track the MEI entrepreneur into the formal labor market, RAIS (*Registro Anual de Informações Sociais*) data from the Ministry of Labor. It is an administrative data set that contains the universe of formal employees and information on their labor contracts.

23 See Table A.8.1.

Figure 8.7 Estimates of Formalization by Year and Gender 2010 to 2015



Source: *CNPJ data and RAIS data.*

Notes: *We define formalized micro-entrepreneurs as those who were not previously registered in the formal market and remained active as MEI for at least one year. Our sample is composed of all micro-entrepreneurs that registered as MEI between January 2010 and December 2015 for whom we have a valid social security number in the administrative records and could identify the gender.*

8.4 Data and Empirical Strategy

Data

We use data from the Brazilian Monthly Employment Survey (PME), a rotating panel at the individual level that covers the six largest metropolitan areas in Brazil[24]. It tracks each household for four consecutive months, pauses for eight months, and then the household is re-interviewed for four additional months, allowing us to follow individuals for up to 16 months. Although PME was discontinued in 2016, it has been one of the primary data sources for monitoring the labor market in Brazil, encompassing both formal and informal workers and unemployed and inactive individuals. It is a rich database in terms of individual characteristics as well as occupational and household features.

Using PME, we can assess the effects of MEI phases by gender group and identify the individual transitions from any status to formal micro-entrepreneurship. Our main analysis comprises the period from January 2006 to August 2012, or 79 months. We restrict the sample to individuals aged 21-65 in their first interview, and exclude those in agriculture and extracting activities; the public sector; international organizations and other extraterritorial institutions; unspecified; and domestic activities[25]. Moreover, we exclude individuals with only one interview, top 1% wages, and top 1% working hours. Table 8.3 shows the sample construction with each step of observations' exclusions (Panel A), as well as the final sample composition by gender (Panel B).

A disadvantage of PME data is that they only contain a 2-digit industry classification, whereas MEI eligibility is defined at the 7-digit level. We follow Rocha et al. (2018) and create a *potential of treatment*

24 Belo Horizonte, Rio de Janeiro, São Paulo, Porto Alegre, Recife, and Salvador, comprising around 26% of the total Brazilian population.

25 These activities are subject to specific labor laws, including public sector employees and the military, or fall into particular activities not comparable in the labor market, such as agriculture, mining, and domestic workers. The remaining cases involve ill-defined activities.

intensity by using additional information from the 2009 National Household Survey (PNAD)[26]. This variable is the *pre-program* share of entrepreneurs in eligible industries within each 2-digit industry, given by:

$$\text{Intense}_s = \frac{\sum_{k \in s}(\text{I[Sub-industry k is eligible]} \times N_{ks})}{\sum_{k \in s} N_{ks}} \quad (8.1)$$

where N_{ks} denotes the number of entrepreneurs that belong to sub-industry k within the 2-digit industry s in 2009.

We merge the variable $Intense_s$ at the industry s level with the monthly panel of individuals in PME. We exclude industries that changed eligibility status over time, leaving us with 48 industries.[27] As this treatment variable is not a *dummy*, the assessment is based on the fact that individuals located in industries with high treatment potential are more likely to benefit from the program than those in industries with low potential. The more polarized the distribution of this variable, the closer to a treatment-control approach.[28]

Table 8.3 Sample Construction with PME Data, January 2006 to July 2012

	Observations		Loss	
	Absolute (1)	% (2)	Absolute (3)	% (4)
Total PME sample	**7,675,737**	**100.0%**		
Panel A - Excluded individuals				
Workers under specific labor laws[a]	7,261,649	94.6%	414,088	5.4%
Excluded sectors (agriculture, domestic workers, others)	6,929,986	90.3%	331,663	4.3%
Missing data (age and schooling years)	5,850,988	76.2%	1,078,998	14.1%
Top 1% hours worked	5,809,133	75.7%	41,855	0.5%
Top 1% wages	5,751,044	74.9%	58,089	0.8%
Aged below 21 and above 65	3,825,524	49.8%	1,925,520	25.1%
Only one interview	3,644,214	47.5%	181,310	2.4%
Out of the labor force	2,428,746	31.6%	1,215,468	15.8%
Industries with eligibility change	2,344,224	30.5%	84,522	1.1%
Final Sample composition	**2,344,224**	**30.5%**		
Panel B - Final sample by gender				
Women	959,606	40.9%		
Men	1,384,618	59.1%		

Source: *Data from PME data.*
Notes: [a] *Comprises the public sector and military workers.*

26 PNAD data (also from the National Statistics Office, IBGE) is an annual cross-section survey representative of the entire country for which we have information that allows conversion of 7-digit to 2-digit industry classification.
27 Two out of 60 industries in PME data have changed eligibility and 12 have been withdrawn for referring to the excluded industries in the construction of the sample, namely: agriculture and extracting activities; the public sector; international organizations and other extraterritorial institutions; unspecified; and domestic activities.
28 As Figure A.8.3 shows, before the program, we have a slight increase in the number of formal micro-entrepreneurs mainly driven by industries with higher treatment intensity (above 50%). In the first year of MEI implementation (Phase 1), the number of firms is steady; however, the growth is accelerated in the periods following Phase 2, almost entirely driven by industries with higher treatment intensity. A similar pattern occurs in the share of formal micro-entrepreneurs and separately for both genders (Figure A.8.4). For males in industries with lower treatment intensity, this share also increases after Phase 2 implementation.

We define entrepreneurs as those who are self-employed or employers. They are considered formal if they contribute to the social security system. Micro-entrepreneurs are those with at most one employee, following the MEI eligibility criteria. Formal employees are those individuals who report having a formal employment contract, known as a signed record in their employment register (*Carteira de Trabalho e Previdência Social* - CTPS).

Empirical Strategy

Using individual-level data, we intend to examine the effects on job formalization under the MEI micro-entrepreneurship program. In particular, our main sample focuses on transitions from being an informal micro-entrepreneur or self-employed. In a difference-in-differences (DID) analysis, the program effect is estimated by the interaction between the potential treatment variable, $Intense_s$, and the post-period dummies (related to each MEI phase).

The sample only includes individuals with at least one observation before and after the start date of each phase. Given the structure of the PME, i.e., the samples do not overlap, it is possible to estimate the effects of both phases in the same equation, and we can interpret the coefficients of each phase independently of each other. Formally, we estimate the effects by the following equation:

$$Y_{isrt} = \beta_1(Post1_{rt} \times Intense_s) + \beta_2(Post2_t \times Intense_s) + \gamma_1 Post1_{rt} + (Post1_t \times Intense_s)'\gamma_2 + \delta_t + \phi_i + Trends'_{srt}\theta + X'_{isrt}\psi + \epsilon_{isrt} \quad (8.2)$$

where Y_{isrt} = 1 if individual i is a formal micro-entrepreneur at industry s, region r in month t. $Post1_{rt}$ = 1 indicates whether access to Phase 1 was available in region r at month $t \geq Aug09$; $Post2_t$ = 1 for all $t \geq May11$ as, in this case, all regions start at the same time. Thus, β_1 captures the effects of the incentives for formalization with the launch of the MEI program, while β_2 captures the effects of reducing the tax burden for micro-enterprises.

The matrix $Post1_t$ is a set of three indicator variables for the different start dates of Phase 1, I[t ≥ Aug09], I[t ≥ Sept09] and I[t ≥ Feb10]. We interact it with the potential treatment variable to capture any possible effect coming from the program's existence that is common across regions. Both γ_1 and γ_2 are relevant controls in this context to allow us to access the net effects. Finally, δ_t and ϕ_i are time and individual fixed-effects, and X_{isrt} are time-varying characteristics at the individual level (age, age squared, and years of schooling).

We include the term $Trends_{srt}$ containing time-varying economic variables at the industry-by-region level – the average monthly wage and the total employment – as well as their square, cubic, and quadratic terms. In addition, we control for convergence across industries and regions with interaction terms between the dependent variable computed at the baseline (the average of the dependent variable at the industry-region cell over the period from January 2006 to December 2006) and linear, square, cubic, and quartic time trends.

By using a continuous instead of a dummy for the treatment variable, the identification strategy relies on the fact that individuals in industries with high-intensity treatment levels are more likely to benefit from the program and, therefore, experience a greater effect on formalization. The more concentrated the potential treatment variable $Intense_s$, the closer our estimate is to a traditional DID estimation.

To address our central question about whether the MEI effects differ by gender, we estimate Equation (8.2) separately by gender. Then, we test for any gender differences in the MEI program impacts by running a separate regression in which we include an interaction for each explanatory variable (including the fixed-effects) with a gender dummy. This specification did not change the results obtained in separate samples, and we report the F-Statistics of the test in the tables' notes.

To precisely estimate the formalization effect, we consider only individuals who did not change industries over time. However, we relax this assumption later in a robustness analysis. Finally, in the analysis for employed individuals, we consider only those who work more than 20 hours/week.[29] Table A.8.2 shows the

29 With this restriction, we seek to focus only on regular workers.

descriptive statistics for our main estimation sample in the pre-program years 2006-2008. Around 36% of informal micro-enterprises are headed by women. Female-led firms are in industries with higher levels of treatment intensity, with a treatment indicator of 78% versus 42% for men.

Finally, to analyze whether the effects remain over time or if there are pre-trend effects[30], we replace the interaction terms for each phase in Equation (8.2) by interactions between $Intense_s$ and dummies for the periods before and after the program's implementation (the set of dummies for each timing d), indicating 12 months before and after the start of each MEI phase. The ending point restriction for Phase 1 is necessary to avoid overlap in the sample with the period pre-Phase 2. For this case, it is possible to extend the period pre-Phase 1 and go beyond 12 months after Phase 2 implementation. We investigate the impacts 12 months both before and after the start of Phase 1 of the MEI program and normalize β_{-1}, the coefficient for the period just before MEI enactment to zero. We also impose endpoint restrictions: $\beta_{-12} = \beta, \forall d \leq -12$ and $\beta_{12} = \beta, \forall d \geq 12$.

8.5 MEI Impact on Formalization of Micro-Entrepreneurs

Main effects

We investigate the effects on the formalization of micro-entrepreneurs by restricting our sample to those individuals who report being informal entrepreneurs with up to one employee at their first interview.[31] Table 8.4 reports the results in different panels for the total sample (A) and by gender (B-C). All columns include time, industry, and individual fixed effects, the controls for fluctuation in economic variables[32] and convergence in the dependent variable at industry-region level, using the full specification in Equation (8.2).

We first test the possible effect of the MEI program as a whole, not differentiating its implementation phases, considering it as unique and occurring in February 2010 (column 1). This test is a starting point for understanding each phase since they had different focuses. As previously described, Phase 1 was implemented on different dates, according to the geographic region, between July 2009 and February 2010. In the PME metropolitan areas, Phase 1 occurred in August 2009, September 2009, and February 2010. However, one can assume that the proximity between Phase 1 dates does not justify a more complex approach. Our second result (column 2) separates the program into two phases, considering the unified Phase 1 in February 2010 and Phase 2 in April 2011. Finally, Model 3 considers both phases, including the staggered implementation of Phase 1. This last exercise follows our benchmark specification.

Our main parameters of interest are β_1 and β_2 related to the triple interaction between time, region, and treatment intensity in each phase of the program. In Model 3, the coefficient for Phase 1's average effect is a combination of eliminating registration costs, decreasing tax rates for higher-income entrepreneurs, and increasing tax rates for lower-income ones. The coefficient for Phase 2 captures the effect of reducing taxes on formalization, given that entry costs had been previously eliminated.

The results showed that Phase 1 had a positive and significant effect only before considering its staggered implementation, independent of the sample used. In our benchmark specification, the results by gender tell a different story, as the effects of both phases for male micro-entrepreneurs become not statistically significant. In contrast, the effects on female micro-entrepreneurs' formalization remain significant for Phase 2. In fact, the effects for females are almost twice as large as for the full sample. Considering the average of the

29 With this restriction, we seek to focus only on regular workers.
30 Pre-trend effects refer to effects before the program's implementation, which can be understood as anticipation effects or might indicate that there are confounding variables that can mislead the results.
31 Appendix Table 5 shows the comparison of our results with those from Rocha et al. (2018).
32 Comprised of the average monthly wage and total employment, as well as their square, cubic and quadratic terms. The results proved to be robust even using different degrees of polynomials for these variables.

potential treatment variable in the female sample at the baseline ($E[Intense_s]$ = 0.64), the point estimate in column 3 implies that Phase 2 leads to an increase of 9.5 percentage points in entrepreneurs' formalization rate, for a baseline of 17%[33].

Our tests for gender differences in the MEI program impacts suggest that they are not statistically significant across genders. The F-Statistics related to the test for each coefficient are very small, as reported in the notes from Table 8.4: Effects on Formalization of Informal Micro-Entrepreneurs.[34]

Table 8.4 Effects on Formalization of Informal Micro-Entrepreneurs

	Model 1 (1)	Model 2 (2)	Model 3 (3)
A. Total			
$Post_{1rt} \times Intense_s$	0.057 (0.017)***	0.058 (0.016)***	0.012 (0.031)
$Post_{2rt} \times Intense_s$		0.056 (0.018)***	0.055 (0.019)***
Observations	29,085	27,339	26,719
R-squared	0.063	0.065	0.067
Number of ind	5,040	5,040	5,040
B. Male-owned			
$Post_{1rt} \times Intense_s$	0.064 (0.035)*	0.065 (0.036)*	0.002 (0.050)
$Post_{2rt} \times Intense_s$		0.047 (0.044)	0.043 (0.044)
Observations	17,878	16,785	16,363
R-squared	0.063	0.064	0.068
Number of ind	3,106	3,106	3,106
C. Female-owned			
$Post_{1rt} \times Intense_s$	0.067 (0.025)**	0.071 (0.026)**	0.012 (0.118)
$Post_{2rt} \times Intense_s$		0.146 (0.075)*	0.148 (0.075)*
Observations	11,207	10,554	10,356
R-squared	0.076	0.080	0.083
Number of ind	1,934	1,934	1,934
Basic Specification	Yes	Yes	Yes
Economic Fluctuation	Yes	Yes	Yes
Convergence	Yes	Yes	Yes

Notes: *Dependent Variable: Formal Micro Entrepreneur (0/1). Robust standard errors clustered at the industry level. The different specifications are the following: Model 1 consider the start of the program in February 2010 as a unique implementation; Model 2 divided the two phases with Phase 1 in February 2010 and Phase 2 in April 2011; Model 3 is the benchmark specification with two phases being Phase 1 a staggered implementation in three dates (August/2009, September/2009 and February/2010). All models include time and entrepreneur fixed effects, time-varying observables at the entrepreneur level, adds controls for fluctuations in economic activity; and controls for convergence in formalization rates, as described in regression 8.2. Gender differences in impact are not statistically significant (F-statistics are 0.00 for β_1 and 0.45 for β_2) in Model 3. P-values: * p<0.10, ** p<0.05, *** p<0.01.*

33 Average baseline level for the period 2006-2008.

34 In Appendix B, we perform falsification and anticipation tests changing the dates of the MEI implementation. We also explore the consistency of the results across different samples. We show that the results are robust to all those changes.

The positive effect on the formalization of women but not men raises a question about the profile of micro-entrepreneurs. As the literature points out, formalizing businesses is viewed differently by men and women, and they have different motivations. To deepen the analysis on this point, we explored the heterogeneous effects from the characteristics of the female entrepreneurs, such as age, the presence of children, marital status, and the partner's position in the labor market.

Table 8.5 replicates the result of the benchmark model (i.e., column 3 of Table 8.4) and presents the effects by age intervals. We observe that, for women, the positive effect of Phase 2 on formalization is concentrated in the age group of 41-50 years old and is almost as twice (0.289) as that observed for the average estimate (0.148). A potential reason is that women of these ages might highly value the benefits of formalization such as unemployment insurance, paid sick leave, and retirement.

However, we do not see an effect for women ages 51-60 even though the statutory age of retirement for women is 60-62, and we might expect them to formalize to count towards retirement pensions.[35] This may be due to the complex retirement rules in Brazil, and the fact that you need many years of formal contribution to qualify.

This exercise also reveals that in some age groups Phase 1 also has positive and significant effects. This pattern occurs among women 31 - 40 and 41 - 50 years old, with coefficients of 0.289 and 0.456 respectively. Again, we argue that the social security benefits might be driving these results, especially the paid maternity leave for age groups within the fertility age.

Table 8.5 Heterogeneous Effects on Formalization of Female Informal Micro-Entrepreneurs, by Age

	Benchmark (1)	21 to 30 (2)	31 to 40 (3)	41 to 50 (4)	51 to 60 (5)	Above 60 (6)
Female-owned						
$Post_{1rt} \times Intense_s$	0.012 (0.118)	-0.311 (0.190)	0.289 (0.099)***	0.456 (0.199)**	-0.311 (0.335)	0.093 (0.756)
$Post_{2rt} \times Intense_s$	0.148 (0.075)*	0.014 (0.136)	0.030 (0.105)	0.289 (0.110)**	0.214 (0.155)	0.068 (0.148)
Observations	10,356	1,403	2,877	3,198	2,224	654
R-squared	0.083	0.191	0.139	0.123	0.148	0.290
Number of ind	1,934	291	541	579	406	117

Notes: *Dependent Variable: Formal Micro Entrepreneur (0/1). Robust standard errors clustered at the industry level. All models include time and entrepreneur fixed effects, time-varying observables at the entrepreneur level, adds controls for fluctuations in economic activity, and controls for convergence in formalization rates, as described in regression 2. Gender differences in impact are not statistically significant in any age subgroup. Coefficients tests are available upon request. P-values: * p<0.10, ** p<0.05, *** p<0.01.*

We now focus on further investigating the effects on women with two additional exercises. The first exercise concerns the existence of children in the household. Since individuals can access paid maternity leave after ten months as a formal micro-entrepreneur, the presence of children could relate to an interest in this benefit. Although it is not possible to directly associate the decision to formalize the business with the possibility of enjoying this benefit, we wonder if the results we find for women are linked to the presence and age of children.

Table 8.6 shows the estimation results for the sample of women considering different interactions with the variables that denote the effect of each phase of the MEI. In column (2), we interact each variable of interest with a dummy that identifies if the household does not have children up to 14 years old. From columns

35 MEI participants are entitled to retirement pensions according to age (at least 60) if they can show at least 15 years of contribution in the case of women. For more details, see https://www.gov.br/empresas-e-negocios/pt-br/empreendedor/perguntas-frequentes.

(3) and (6), the interaction occurs with the number of children in each age group. Almost the entire MEI effect observed in Phase 2 is driven by women with children ages 0-14, as column (2) shows, and there are no significant differences across having children at different ages, as columns (3) to (6) show. The higher formalization rates for women with children up to 14 are presumably because they seek greater social security benefits for their families.

In our last heterogeneity exercise, we want to know whether women's formalization rates resulting from MEI differ according to their family structure. We re-estimated the main model interacting each phase of the program with marital status and partner's employment status (Table 8.7).[36] Marital status does not influence the MEI program's impact in either phase, which does not support evidence that women seek better work arrangements to become more independent or even to improve their bargaining power within the household in case of marriage. Having partners who are employed or unemployed (compared to having a partner who is out of the labor force) is associated with a higher impact of MEI in Phase 1, though the overall effect of this phase is virtually zero. On the other hand, the effect of Phase 2 is stronger for women with unemployed partners. Although not statistically significant, this effect reaches 0.164, higher than the average effect of 0.148.

Table 8.6 Heterogeneous Effects on Formalization of Informal Micro-Entrepreneurs, by The Presence of Children

			With Child by age groups:			
	Benchmark (1)	**w/o Child (2)**	**0 to 1 (3)**	**0 to 6 (4)**	**7 to 14 (5)**	**0 to 14 (6)**
Female-owned						
$Post_{1rt} \times Intense_s$	0.012 (0.118)	0.026 (0.117)	0.011 (0.118)	0.010 (0.119)	0.018 (0.117)	0.015 (0.119)
$Post_{1rt} \times Intense_s \times$ w/o child		-0.017 (0.018)				
$Post_{2rt} \times Intense_s$	0.148 (0.075)*	0.129 (0.069)*	0.145 (0.074)*	0.149 (0.077)*	0.156 (0.078)*	0.160 (0.080)*
$Post_{2rt} \times Intense_s \times$ w/o child		0.028 (0.023)				
Observations	10,356	10,356	10,356	10,356	10,356	10,356
R-squared	0.083	0.083	0.083	0.083	0.083	0.085
Number of individuals	1,934	1,934	1,934	1,934	1,934	1,934
Interaction with # of children	No	No	Yes	Yes	Yes	Yes

Notes: *Dependent Variable: Formal Micro Entrepreneur (0/1). Robust standard errors clustered at the industry level. The results in column (2) consider an additional interaction with a dummy = 1 if without children up to 14 years old in the household. From (3) to (6) we add interaction terms with the number of children in each age group. The coefficients from the interaction terms are omitted due to space restrictions but are available upon request. Gender differences in impact are not statistically significant in any age subgroup. Coefficients tests are available upon request. P-values: * p<0.10, ** p<0.05, *** p<0.01.*

Finally, we complement our previous analysis by using different dependent variables for the sample of women. Our main estimates consider small businesses where the entrepreneur employs at most one worker, which is exactly the MEI requirement. We analyze the effect of being a formal entrepreneur without employees and with one employee separately. The results are shown in Table A. 8.3 where we see that Phase 2 impacts are larger for businesses without employees.

36 Employed, unemployed, or out of the labor force; the latter being the omitted category.

Table 8.7 Heterogeneous Effects on Formalization of Informal Micro-Entrepreneurs, by Marital Status and the Position of the Partner in the Labor Market

	Benchmark (1)	Marital status (2)	Partner position (3)
Female-owned			
$Post_{1rt} \times Intense_s$	0.012 (0.118)	-0.009 (0.118)	-0.083 (0.122)
$Post_{1rt} \times Intense_s \times$ Married		0.032 (0.019)	
$Post_{1rt} \times Intense_s \times$ Partner employed			0.050 (0.020)**
$Post_{1rt} \times Intense_s \times$ Partner in the LF			0.061 (0.033)*
$Post_{2rt} \times Intense_s$	0.148 (0.075)*	0.172 (0.083)**	0.122 (0.072)
$Post_{2rt} \times Intense_s \times$ Married		-0.036 (0.038)	
$Post_{2rt} \times Intense_s \times$ Partner employed			-0.022 (0.040)
$Post_{2rt} \times Intense_s \times$ Partner in the LF			0.042 (0.028)
Observations	10,356	10,356	10,356
R-squared	0.083	0.083	0.085
Number of ind	1,934	1,934	1,934

Notes: *Dependent Variable: Formal Micro-Entrepreneur (0/1). Robust standard errors clustered at the industry level. P-values: * p<0.10, ** p<0.05, *** p<0.01. Base levels are single and partner out of the workforce. Gender differences in impact are not statistically significant. Coefficients tests are available upon request. P-values: * p<0.10, ** p<0.05, *** p<0.01.*

The MEI program was officially introduced as means to promote job creation in the formal sector. Despite having achieved a significant impact for women, its costs regarding potential forgone tax were substantial. It is argued that MEI implied a subsidy to social security contributions as workers would otherwise pay 11% of the minimum wage (R$121) as formal self-employed outside MEI, which is 2.2 times more than what MEI entrepreneurs currently pay. For instance, Rocha et al. (2018) perform a back-of-the-envelope calculation by simulating the stocks of formal and informal workers using reduced-form effects and show that the program did not lead to higher tax revenue. Instead, they find a 20% loss in revenue in the long run. It is possible, however, that the revenues raised from attracting women to the formal sector might have been enough to revert potential revenue losses, as we find that the effects of Phase 2 for women, when social security contribution was reduced, are more than twice as large for the full sample.

Heterogeneous effects on women by income levels

We explore heterogeneous effects of reducing entry costs and reducing taxes by entrepreneurs' income levels. The assumption is that reducing entry costs should ease the barriers for low-income individuals to enter the formal sector. Likewise, since MEI taxes are a fixed amount, low-income entrepreneurs would benefit the most from the second phase of the program, when taxes were reduced. However, there could be a selection of relatively high-income individuals into sectors that are more affected by the MEI program (high intensity). In such a case, impacts should be more pronounced among higher-income individuals.

We divide the female sample into quartiles of entrepreneurs' annual income and re-estimate the benchmark model for each quartile.[37] As Table 8.8 shows, regardless of the income quartile, Phase 1 has no significant effect on the formalization of informal entrepreneurs.

In contrast, we find that most MEI effects in Phase 2 are driven by previously informal entrepreneurs earning at the two highest income quartiles, though the fourth one is imprecisely estimated. We also find a negative but small effect for the second quartile. These results confirm that the average effect is driven by entrepreneurs in higher-income quartiles, consistent with the selection argument.

Table 8.8 Heterogeneous Effects on Formalization of Informal Micro-Entrepreneurs, Across Income Levels

	Benchmark (1)	Q1 (2)	Q2 (3)	Q3 (4)	Q4 (5)
Female-owned					
$Post_{1rt} \times Intense_s$	0.012 (0.118)	-0.197 (0.180)	0.121 (0.111)	-0.040 (0.234)	-0.100 (0.155)
$Post_{2rt} \times Intense_s$	0.148 (0.075)*	-0.008 (0.074)	-0.082 (0.045)*	0.223 (0.126)*	0.260 (0.160)
Observations	10,356	2,442	2,588	2,655	2,671
R-squared	0.083	0.117	0.099	0.114	0.159
Number of ind	1,934	484	484	484	482
Mean ($Intense_s$)	0.764	0.679	0.822	0.822	0.731

Notes: *Dependent Variable: Formal Micro Entrepreneur (0/1). Robust standard errors clustered at the industry level. The median income of the unconditional distribution is R$852.37. The median income values for each quartile are R$467.24 (1st quartile), R$702.08 (2nd quartile), R$932.12 (3rd quartile) and R$1895.8 (4th quartile). P-values: * p<0.10, ** p<0.05, *** p<0.01.*

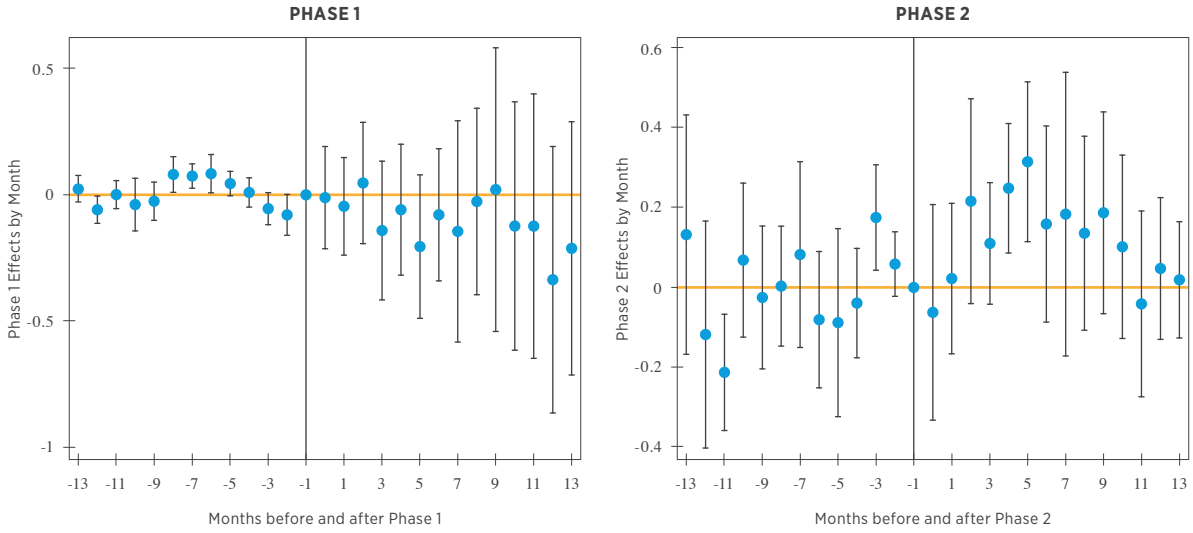
Timing of formalization effects among female-led businesses

We are also interested in the dynamic effects of the MEI program on the formalization of female entrepreneurs. Are the effects short-lived? We follow Rocha et al. (2018) and conduct an event study analysis.

Figure 8.8 displays the effects for each phase of the program. In the first panel, we observe that after the beginning of Phase 1, the effects oscillate around zero, consistent with the absence of effect in the DID analysis. As for Phase 2, the effect is significant in the fourth and fifth months after implementation but then starts to decrease and lose statistical significance, returning to being close to zero or negative.

37 For this exercise, we follow the strategy of Rocha et al. (2018) and compute the income quartiles, using only pre-program observations. We use the residuals from a regression of log wages on time, region, and industry dummies to remove any systematic variation across time, industries, and regions to obtain the income quartiles. In our study, we focus only on the subsample of women.

Figure 8.8 Timing of Formalization Effects, Female Micro-Entrepreneurs Sample



Notes: Phase 1 Effects. *Values of the estimated coefficients,* $\beta_{1,d}$*'s and their respective standard errors from the interaction terms* $\sum_{d=-12}^{12} \beta_{1,d} D_{1,r,d} \times Intense_S$*, normalized in* $\beta_{-1} = 0$.

Phase 2 Effects. *Values of the estimated coefficients,* $\beta_{2,d}$*'s and their respective standard errors from the interaction terms* $\sum_{d=-12}^{12} \beta_{2,d} D_{2,d} \times Intense_S$*, normalized in* $\beta_{-1} = 0$.

Other transitions into formal entrepreneurship and firm survival among women

Up until now, we found that the reduction of costs to remain formal after the introduction of the MEI program (Phase 2) has a positive effect on the formalization of previously informal female entrepreneurs, i.e., those in self-employment or employing at most one employee and who do not contribute to social security. But did the MEI program also attract workers from other jobs?

We expand our analysis by investigating different groups of individuals according to employment status.[38] Table 8.9 shows the results for seven different groups of women, according to their status at baseline. We generally find insignificant effects of the MEI program across all groups of female workers, except for those in informal micro-entrepreneurship or inactivity in the labor market.

Although the MEI program improved the incentives to become a formal small entrepreneur and includes more generous benefits to women (e.g., maternity leave), we do not find it to be a way out of unemployment or inactivity. For unemployed females, column (6) shows that the effect is positive but insignificant. Column (7) shows a statistically significant, but small, negative effect for women out of the labor force.

38 Appendix Table 4 shows the descriptive analysis of females across different employment statuses in the labor market. Each transition is estimated as a different sample, according to the status in the first interview.

Table 8.9 Transitions into Formal Micro-Entrepreneurship

Transition from:	Formal wage workers (1)	All other states (2)	Informal wage workers (3)	Informal entrepreneurs (all sizes) (4)	Informal micro-entrep. (benchmark) (5)	Unemployed (6)	Inactives (7)
Female sample							
$Post_{1rt} \times Intense_s$	0.001 (0.006)	-0.005 (0.056)	0.022 (0.062)	0.018 (0.093)	0.012 (0.118)	0.018 (0.033)	-0.033 (0.063)
$Post_{2rt} \times Intense_s$	0.002 (0.002)	0.006 (0.021)	-0.041 (0.025)	0.081 (0.055)	0.148 (0.075)*	0.038 (0.026)	-0.020 (0.011)*
Observations	35,391	32,897	7,874	14,724	10,356	2,062	8,237
R-squared	0.004	0.023	0.030	0.042	0.083	0.172	0.027
Number of ind	6,405	8,415	1,485	2,881	1,934	689	3,360

Notes: *Dependent Variable: Small Formal Entrepreneur (0/1). Robust standard errors clustered at the industry level. All regressions use our preferred specification used in the third column of Table 8.4. The sample is restricted by the state in the first interview as follows: (1) formal employee; (2) all individuals with no formal states (formal wage earners or formal entrepreneurs), including unemployed and those out of the labor force; (3) informal wage earners; (4) informal entrepreneur regardless their firm size; (5) small informal entrepreneur, our benchmark result; (6) unemployed; (7) Out of the labor force. Gender differences in impact are not statistically significant. Coefficients tests are available upon request. P-values: * p<0.10, ** p<0.05, *** p<0.01.*

8.6 Conclusion

This study explores a rich individual-level dataset to understand the MEI program's impacts on the Brazilian labor market, focusing on gender differences. Our findings show that women drive the formalization effect of the MEI program. We find no evidence that the MEI program is a way out of unemployment or inactivity for women. Our findings are consistent with the literature finding that women value benefits more than men and seek more social security for the family. We find larger effects for women with children and women ages 41-50. This pattern is likely due to formalization giving them access to maternity leave and other social security benefits.

Our results suggest that former informal entrepreneurs without employees drive the formalization effects by becoming MEI. As female entrepreneurs earn less income on average than male entrepreneurs, the result is in line with the fact that the reduced tax from Phase 2 caused more women to open or formalize their businesses. If programs are looking to encourage the formalization of female entrepreneurs, the incentives should be structured to provide benefits to those in all income quartiles and provide increased access to social security and other benefits.

Understanding the motivations of women to formalize, including risk mitigation and access to greater family security, can inform the design of future programs. While the reduction of the tax burden was key to the success of the program, it does entail a substantial amount of reduced revenue, perhaps as much as a 20% loss overall (Rocha et al., 2018). MEI benefits to women and the overall economy must be weighed against these costs.

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