Abstract

Women's labor market participation in Chile ranks among the lowest in Latin America. In a country where over 90 percent of the population lives in segregated cities, where employment opportunities cluster in affluent neighborhoods, residential sorting has surprisingly been neglected as an explanatory factor. This article addresses this omission by calculating the effects of residential segregation on labor market participation among less-educated caregivers. Using an OLS fixed effects model, the study finds that segregation entails adverse spatial mismatch effects on labor market participation. No other sub-population is affected in this manner. Hence, residential segregation contributes to the consolidation of three types of inequalities. First, it reproduces gendered inequalities within less-educated households. Second, in the context of increasing labor market participation among more-educated women, residential segregation further increases inequalities between low-income and affluent households. Finally, it deepens geographical inequalities between marginalized and non-marginalized households.

I. Introduction

Every weekend, Gabriela walks Santa Rosa Avenue selling windows. She looks for homes with cracked or missing windows to approach. Her 31-year-old daughter, Marcela, has a cognitive disability and helps Gabriela in her rounds. *"We can only work on spacious avenues; otherwise, Marcela gets lost,"* Gabriela tells me. The two women live in La Pintana, the poorest municipal jurisdiction in Santiago, Chile. Because of Marcela's condition, Gabriela has had to find ways to provide for her family without moving too far away from home. The challenge, however, is that there are very few jobs in La Pintana.[1]

Many low-income caregivers in Santiago struggle much as Gabriela does. The lack of employment opportunities in low-income neighborhoods combined with a gendered allocation of unpaid care responsibilities severely constrains their labor supply. Jobless neighborhoods are a characteristic of the economic segregation of Chilean cities. In this article, we examine whether residential segregation negatively affects labor market participation among women caregivers in Santiago.

Chile ranks second to last in female labor market participation among South American countries (Serrano et al. 2019). Among the poorest 20% of the population, less than a third of working-age women participate in the labor force. Nearly half of non-participants attribute this to unpaid domestic and care labor responsibilities.[2] Economists and other social scientists have examined the determinants behind these low participation rates. However, they have not accounted for the impact of residential segregation. From the perspective of economic geography and feminist economics, this could be a serious oversight.

The spatial mismatch hypothesis posits that residential segregation interacts with labor market outcomes (Kain 1968; Fernandez and Su 2004; Gobillion et al. 2007). In segregated cities, employment opportunities cluster in affluent neighborhoods—far away from where the urban poor live. The long distance between job place and household is what economic

[1] I interviewed Gabriela in July 2019.

[2] These values were calculated using the 2017 CASEN (http://observatorio.ministeriodesarrollosocial.gob.cl/encuesta-casen-2017).

geographers call a *spatial* mismatch. As higher urban mobility entails greater access to the labor market, mobility constraints are particularly acute in the context of a spatial mismatch.

The relevance of mobility in labor market outcomes puts unpaid caregivers at a disadvantage. Many dependents face physical and cognitive constraints to mobility, thus limiting caregivers' mobility (Kwan 2000). Public transportation networks further accentuate caregivers' mobility constraints as they are not designed to balance paid and unpaid responsibilities (Loukaitou-Sideris 2016). Moreover, since patriarchal structures often determine the allocation of unpaid care, women's mobility is more frequently constrained by care responsibilities (Folbre 2021).

Using a representative and geo-located dataset (Origin-Destination Survey 2012),[3] this article shows that less-educated female caregivers' labor market participation is negatively affected by residential segregation. Neither men nor more-educated women are affected in this way. Hence, segregation fosters two types of inequality: Economic inequality between less- and more-educated households, and gender inequality within less educated households.

This article uses local job density to capture segregation's effects on labor market participation. Local job density is a measure of job positions to working-age residents in a given locality that is negatively associated with residential segregation (Hellerstein et al. 2008). I use historical and statistical analysis to show that self-selection problems associated to residential location among less-educated caregivers are unlikely. Hence, fixed effects ordinary least squares (OLS) estimates are not biased.

For robustness purposes, the calculations consider three different measures of local job density. These vary according to education and gender-based labor market segmentation. Nevertheless, every specification is positively associated to significantly higher labor force participation among less-educated caregivers. A caregiver of average education in La Pintana, Santiago's least job-dense jurisdiction, is 24% less likely to participate in the labor market than a woman of similar characteristics residing in downtown Santiago. These results are robust to winsorization of 1% and 5%, and more spatially flexible specifications of job density as well.

[3] This survey contains geo-referenced information for over 60,000 individuals and their households and more than 23,000 employment locations for the greater Santiago region.

Men's labor force participation is unaffected by job density. The same goes for more educated female caregivers. Hence, our results signal that residential segregation aggravates at least three forms of inequality. In line with the spatial mismatch hypothesis, we find a geographical inequality in labor market participation. Female caregivers in marginalized regions of the city are significantly less likely to participate. Consequently, spatial mismatch effects intensify gender inequalities within those households. Lastly, residential segregation deepens the economic inequality between more- and less-educated households.

The article is organized as follows. Section II discusses the existing empirical research on Chile's low female labor market participation rates. Then, Section III builds a theoretical framework articulating the effects of mobility constraints and spatial mismatch effects on caregivers' labor market participation. The discussion builds on economic geography, feminist geography, and feminist economics. Section IV presents the data and the main variables of interest. Section V discusses the identification strategy, analyzing the historical roots of Santiago's segregation and statistically testing whether less-educated female caregivers self-select into high-density regions. Section VI shows and analyzes the main results and findings of the article. Finally, Section VII offers some final remarks.

II. Chile's low female participation rates

Chile's female labor force participation has received a good deal of scholarly attention. It seems paradoxical that one of Latin America's richest countries has one of the lowest female participation rates in the region. Most scholars attribute this phenomenon to traditional patriarchal values and the gendered allocation of unpaid work. For instance, Larrañaga (2006) finds that declining fertility and marriage rates determined the increase in participation rates among middle- and upper-class women observed during the 1990s. Within lower-income households, Contreras and Plaza (2010) found that prevalent patriarchal norms associating womanhood to care work are a significant predictor for women's low participation rates in the 2000s. This normative effect is more substantial among older women, signaling that the country was undergoing a cultural transformation during the first decade of the 21st Century (Ferrada and Zarzoza 2010).

Nonetheless, care has continued to be a significant constraint in women's labor market participation. This is especially true within lower-income households.[4] Martinez and Perticara (2017) carried out a randomized control trial evaluating the impact of a public after-school program on female participation and employment. They found it increased participation by 7% and employment rates by 5%.

The effects of spatial constraints on labor force participation, and their interaction with care responsibilities, have received little attention in the literature. There are two exceptions. Puga and Soto (2018) found that the segmented nature of social space determines low-income and less educated women's labor participation. They conclude that unequal access to employment information networks (social capital) has reinforced the participation rate gap between women in different economic classes. Asahi (2015) underscores the roles of physical space and mobility in determining labor force participation. He finds that the expansion of Santiago's public transportation network favored less-educated women's participation. However, the study's attention to the impact of residential segregation is indirect at best.

III. Theoretical framework: Unpaid care and the spatial mismatch

There is abundant empirical evidence on the adverse effects of unpaid care work on women's labor force participation (Contreras & Plaza 2010; Atkinson 2012; Pande et al. 2020). Feminist economists have long underscored this issue. Patriarchal norms that associate caregiving to womanhood increase the cost of labor force participation (Agarwal 1997). Moreover, caregiving itself is an activity that reduces women's bargaining power in the distribution of all forms of unpaid work (Folbre 2021). Caregivers are thus often burdened with significant hours of unpaid work and have little time for waged employment.

Economic models of labor supply tend to focus on the temporal incompatibility between unpaid and paid work (Carmichael and Charles 1998). Time spent caregiving cannot be spent working for a wage. However, as feminist geographers point out, there is also a spatial incompatibility between caregiving and working for pay (Massey and McDowell 1984; Hanson and Pratt 1995). Unpaid care involves many activities that increase the household's

[4] Contreras et al. (2012) found that access to privately provided care significantly increased participation among more educated women.

centripetal power. Cooking, grocery shopping, and supervision, for instance, often take place near the home. Hence, as Hanson and Pratt (1995) observed, caregivers are likely to stay closer to home than non-caregivers and are less likely to find employment far from home. Their mobility is constrained.

How does residential segregation factor into the distribution of paid and unpaid work? The spatial mismatch hypothesis can provide some answers to this question.

III.a The spatial mismatch hypothesis and the caregiving's coupling constraints

The *spatial mismatch hypothesis* is a long-standing proposition in economic geography (Kain 1968; Fernandez and Su 2004; Gobillion et al. 2007). It suggests that residential sorting is associated to the spatial sorting of jobs. Neighborhoods that agglomerate more affluent and more educated individuals also agglomerate employment opportunities. The opposite is true for less-educated households as there is a spatial mismatch between their homes and suitable workplaces. These longer distances between home and labor markets increase the barriers to employment for the spatially mismatched. In other words, employment is costlier for marginalized communities.

Many cities (including Santiago) have public transportation systems that standardize user costs across the city.[5] However, this does not mean that everyone faces the same costs. Transportation costs also have a temporal component. Every hour spent commuting is an hour not spent doing anything else. This is why mobility is so important. Mobility reduces commuting costs by reducing the time spent in transit, thus reducing the barriers to employment (Brueckner 2000).

Consequently, differences in mobility constraints produce differences in spatial mismatch effects. Less mobile individuals are likely to be more adversely affected by long commuting distances. Caregivers, and especially female caregivers, probably face some of the most outstanding mobility constraints.

[5] In Santiago, the public transportation system allows users to make bus-to-bus or bus-to-metro transfers for the price of one ticket.

Care work takes place somewhere (spatial constraint), at a given time (temporal constraint), and with someone (associative constraint). The compounding of these three restrictions is known as a *coupling constraint* to mobility (Hägerstrand 1970). Much of the feminist geography literature has underscored care's coupling constraints as the most significant restriction on women's mobility (Kwan 2000; Ta et al. 2016).

The associative aspect of coupling constraints entails that caregivers' mobility is usually limited to the mobility of dependents, whom are often physically constrained due to age, disability or both. Additionally, caregiving trips usually entail more destinations than simply coming and going from work. These spatial logistics are seldom contemplated in the design of public transportation networks (Loukaitou-Sideris 2016). If that was not enough, masculine aggression in public spaces may further restrict female caregivers' mobility. Women often avoid specific places, refrain from traveling at particular times of the day, or adopt other tactics that increase their transportation time in order to avoid male aggression (Jiron 2007, Almahmood et al. 2017).

In the context of a spatial mismatch, coupling constraints entail distributional consequences. Unless men face other counter-balancing mobility constraints, they are more likely to overcome adverse the effects of a spatial mismatch. Moreover, since not all caregivers suffer from a spatial mismatch, coupling constraints may also explain inequalities between caregivers. Those that are further away from jobs are more likely to depend on male wages than those living in job-dense regions.

III.b A gendered geography of jobs? The distance aspect of the spatial mismatch in the context of occupational segregation

So far, I have underscored mobility constraints as a source of difference in spatial mismatch effects. However, the spatial mismatch hypothesis argues that distance also matters. Then, we must ask ourselves, is distance-to-work gendered? Gender is rarely at the basis of residential sorting. However, occupational segregation in the labor market could entail a gendered distribution of job places (Massey and McDowell 1984).

Stereotypes associating authority to masculinity contribute to the allocation of women to lower-paid and less secure jobs (Elson 1999). The *glass ceiling* metaphor refers to the barriers to women's rise within particular types of work. However, there is another form of occupational segregation. The gendering of particular occupations also creates *glass walls*, allocating similarly skilled men and women to different sectors.[6]

Industries in similar sectors tend to agglomerate in space to lessen transaction costs and take advantage of knowledge spillovers (Malmberg and Maskell 2002). If some sectors are male-dominated and other female-dominated, "women's jobs" could be geographically separate from "men's jobs." For instance, in an economically segregated city, paid domestic jobs—a female-dominated sector—are likely to agglomerate in affluent suburbs. Job opportunities for marginalized women may be even further away from home. If this was the case, distance would be an additional source of gender inequality emerging from spatial mismatch effects.

III.c *Methodological considerations for measuring spatial mismatch effects*

The calculation of spatial mismatch effects on labor force participation may suffer from self-selection issues. If some individuals have a higher predisposition to sell their labor than others, they could choose to locate their homes closer to employment opportunities. High labor market participation in regions closer to business districts could be a product of individual preferences rather than geographical location.

Self-selection is a problem insofar location is a choice. However, residential segregation is rarely the product of a perfectly competitive housing market. Low-income and marginalized communities do not have much choice over their residential location. External forces (e.g., the government) often determine their location (Rothstein 2017). Nevertheless, to effectively capture spatial mismatch effects, we must determine if the urban poor's housing location is a product of their preferences or if it arises from external forces.

[6] Women are more likely to be hired in sectors involving care work, education, and tourism. Male-dominated activities include economics, finance and the military (Johnson and Crum-Cano 2011; Nasser 2018).

IV. Data and variables of interest

IV.a The Data

I use the 2012 Origin-Destination Survey (ODS) for the greater Santiago region to capture spatial mismatch effects on labor market participation.[7] The ODS informs on household and job locations, as well as individual and socio-economic information. The dataset has a large sample size of over 60,000 individual observations, including more than 23,000 employment locations.[8] [9]

The 2012 census is also utilized for identification purposes. High omission rates in this census led to its repetition in 2017. However, omission was low in Santiago (lower than 10%) and no systematic bias was found regarding socioeconomic characteristics (Garreton et al. 2020). Therefore, at the very least, the 2012 census may be considered as a robust and reliable survey, accounting for over 90% of the city's population.

IV.b The spatial autocorrelation of labor market participation

The studies of Chilean female labor market participation mentioned in Section II share a methodological oversight: They fail to address the spatial autocorrelation of labor market participation. Spatial autocorrelation is the co-variation of some characteristics within a geographical region. In this case, labor market participation.

By itself, spatial autocorrelation may not a problem for econometric calculations. If the model's independent variables capture geographical variations, no identification problems should exist. However, if the model's residuals are spatially autocorrelated, the estimations may suffer from inconsistency and/or bias.[10]

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[7] Encuesta de Origen Destino, executed by the sub-Secretary of Transport in the Ministry of Transport and Telecommunications.

[8] Around 53,000 observations refer to residents of the greater Santiago area. The dataset is representative to census tracts, an area that is smaller than the municipal jurisdiction.

[9] See Annex 1 for comparison between weighted statistics in the ODS and the 2012 census.

[10] For an extensive discussion on these issues, see Gibbons, Overman and Pattacchini (2015), p. 124-136

Table 1 shows the degree of spatial autocorrelation in labor force participation in different subsamples of the population. Spatial autocorrelation is measured through Moran's I, a global indicator of spatial association that ranges between negative-one and one. A value of zero indicates no clustering. A value of one or negative one indicates perfect clustering. Since Moran's I is statistically different from zero, labor market participation is spatially autocorrelated.[11] The table also shows labor market participation rates for each group.

[INSERT TABLE 1 HERE]

According to Moran's I, the labor force participation of less-educated female caregivers is significantly autocorrelated in space.[12] This means that this group's participation is not randomly distributed across space. Additionally, less-educated female caregivers have the lowest participation rates in the ODS sample.

IV.c Operationalizing the spatial mismatch using job density

Following Hellerstein et al. (2008), I use local job density to capture spatial mismatch effects. Job density is the total number of job positions[13] in a locality relative to the sum of working-age residents in the same area.[14] Marginalized regions in economically segregated cities have a low ratio of jobs to residents. Therefore, they have a low job density. The opposite is true for business districts.

The ODS does not allow us to use this exact definition. Survey weights do not consider employment location in their calculation. In fact, unweighted employment locations minimize the difference between the ODS and the 2012 census in the municipal distribution of jobs (see Table 2).[15]

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[11] See Annex 2. for a more detailed explanation of Moran's I.

[12] Less-educated individuals are defined as having completed secondary education or less.

[13] In the ODS, job positions are held by surveyed individuals. We do not observe open job positions.

[14] People enrolled in educational institutions are not considered as potential competitors for local employment opportunities. This is because these people may appear as non-participants in the job market, but they are not necessarily spatially constrained to participate.

[15] The census offers employment location information at the municipal jurisdiction level, a higher geographical unit than that found in the ODS.

[INSERT TABLE 2]

Hence, after standardization, we calculate job density as the ratio between the sum of unweighted local job positions and the weighted sum of local working-age residents. Job density is measured for localities around each individual's residence. To avoid issues of mechanic endogeneity, we deduct one unit from the available pool of employment opportunities if the observed individual works within their locality.[16] Considering these qualifications, local job density for individual i residing in the local area A takes the following functional form:

Equation 1: Job density.

$$JD_{i,A} = \frac{(E_A - e_{i,A}) \Big/ SD\left(\sum_i^n (E_A - e_{i,A})\right)}{Rw_A \Big/ SD\left(\sum_i^n Rw_A\right)}$$

$$Where\ E_A\ is\ the\ sum\ of\ job\ positions\ in\ local\ area\ A,$$

$$e_{iA} = \begin{cases} 1, & If\ individual\ i\ resides\ and\ is\ employed\ in\ local\ area\ A \\ 0, & Otherwise \end{cases}$$

$$and\ Rw_A\ is\ the\ weighted\ sum\ of working\ age\ residens\ in\ local\ area\ A.$$

Besides the number of jobs and residents, job density will vary according to the size of the locality. Hence, we must provide a concrete definition of a locality and its boundaries.

IV.d Defining locality

[16] The observation would signal participation on the left-hand side of the econometric equation (labor market participation). Moreover, the local job that the individual holds would marginally increase job density on the right-hand side of the equation. For every locally employed individual, this marginal increase in job density would always be associated with participation, thus leading to biased coefficients.

Local boundaries must bear actual consequences on employment decisions. If not, Modifiable Areal Unit Problems (MAUP) may bias the spatial mismatch analysis (Wong 2004). The MAUP arises when using artificial boundaries to capture a geographical effect. This is a common problem in spatial mismatch analysis. For example, prior works often rely on census tracts to define local markets (e.g., Hellerstein et al. 2008). However, census boundaries do not generally affect the likelihood of finding employment.[17]

For this article, locality thresholds are defined as the radial distance between the household and the average point of indifference between motored (private vehicles or public transportation) and non-motored travel (walking or cycling).[18] For simplicy, I'll call this radial distance *the indifference radius*. Since not all individuals have access to the same means transportation, I calculate a different indifference radius for people who own private vehicles and those who do not.

There are theoretical and empirical reasons for using the indifference radius to define employment localities. The monetary costs of commuting increase significantly when driving or taking the bus.[19] Additionally, the opportunity costs of commuting increase when using motored means of travel. As mentioned earlier, this is especially true for female caregivers who rely on public transportation.

According to the ODS, on average, people who own automobiles are equally likely (i.e., indifferent) to walk or drive to destinations that are one kilometer away from the household. The indifference point for people relying on public transportation, on the other hand, is 1.4 kilometers away from their homes.[20] According to these thresholds, nearly 20% of employed people in Santiago work within their local boundaries. Less-educated women are, by far, the

[17] Imagine a household located in a census tract that is adjacent to a commercial zip code area. Since the household's census tract area is mostly residential, the calculated job density for that observation would be relatively low. However, a household located at the edge of the tract nearest to the business district would have access to more local jobs than a household at tract's center.
[18] This entails that we have as many localities as we have households and that localities overlap with each other.
[19] A hike in public transportation costs in Santiago sparked massive outrage in October 2019.
[20] For adults between 18 and 65 years of age. For greater detail in how these averages were calculated, please refer to Annex 3.

likeliest group to work within local boundaries. Over 27% of them work within their locality radius.[21]

IV.e Three job density models

Not all job places are suitable job places. Due to labor market segmentation, some jobs are only available for people who meet a particular criterion. Considering this, and for robustness purposes, we calculate job density according to three labor market segmentations.

IV.e.1. *Economic activity model*

The economic activity model of job density model does not consider segmentation. It considers all local job positions and working-age residents, following directly from Equation 1, regardless of education level and gender. The rationale behind this model is that overall economic activity may generate employment opportunities for all workers in the form of multiplier effects (Moretti 2010).

IV.e.2. Education stratification model

One alternative to the economic activity model is to divide the labor market into two educational categories. This way, we define two distinct labor markets. The *more educated* labor market is suitable for people with at least some tertiary education. The *less educated* labor market is suitable for individuals with no tertiary education. Job density for individual i, residing in locality A, of educational attainment s, takes the following form:

Equation 2: Job density stratified by educational level.

$$JD_{i,A,s} = \frac{(E_{A,s} - e_{i,A,s}) \Big/ SD\left(\sum_i^n (E_{A,s} - e_{i,A,s})\right)}{Rw_{A,s} \Big/ SD\left(\sum_i^n Rw_{A,s}\right)}$$

[21] These numbers do not consider live-in domestic workers.

$$with\ s = \begin{cases} 0 = & Less\ educated \\ 1 = & More\ educated \end{cases}$$

IV.e.3. Education and gender stratification model

Due to gendered occupational segregation in the labor market, job location for men and women may differ. I discussed this possibility in a prior section.

We account for this by introducing gender into job density calculations. The education and gender stratification model calculates job density for individual i, residing in locality A, of educational attainment s, and gender g, in the following manner:

Equation 3: Job density stratified by educational level and gender.

$$JD_{i,A,s,g} = \frac{(E_{A,s,g} - e_{i,A,s,g}) \Big/ SD\left(\sum_i^n (E_{A,s,g} - e_{i,A,s,g})\right)}{Rw_{A,s,g} \Big/ SD\left(\sum_i^n Rw_{A,s,g}\right)}$$

$$with\ g = \begin{cases} 0 = & Woman \\ 1 = & Man \end{cases}$$ [22]

Table 3 shows descriptive statistics for the three specifications of job density. The most salient feature in Table 3 is the large discrepancy between job density at the 99th and 100th percentiles. The concentration of less-educated employment opportunities in more affluent regions partially explains these outliers. Nevertheless, they may also be a product of local boundaries calculations.[23] This is important to keep in mind when analyzing our econometric results as large outliers may drive our findings.

Table 3: Descriptive statistics for job density models in 2012 ODS.

[22] Unfortunately, the ODS identifies gender as a binary. Hence, we cannot explore non-binary identities.

[23] Even though the ODS considers a more extensive region than the greater Santiago area, some observations are located in peripheral localities of the dataset. This means that, for some localities, the observation of potential competitors may be censored, leading to high job density values. Six observations were dropped due to not having any observations for the denominator. For example, in some localities, there were no skilled female residents.

IV.f Residential segregation and job density clusters in Santiago

The spatial mismatch theory asserts that residential segregation is paired with the clustering of employment opportunities in more-educated neighborhoods. Santiago's segregation is primarily economic. Figure 1 shows that the less-educated population concentrates in the southern and western banks of the city (in purple) while more-educated households populate the northeastern quadrant (in green).

[INSERT FIGURE 1 HERE]

Job density follows a similar distribution. To see this, we must first analyze if high-density localities neighbor other high-density localities. In other words, if job density is spatially autocorrelated. As explained earlier, Moran's I measures spatial autocorrelation. The top-left corner of each panel in Figure 2 shows the index for Moran's I for less- and more-educated jobs, respectively. They show that the distribution of job density is significantly autocorrelated in space.

To contrast the distribution of jobs and segregation, I decompose Moran's I into local indicators of spatial association (LISA). Localities with a statistically significant high job density[24] neighboring other statistically high-density localities are part of a *high-High* cluster.[25] In Figure 2, these localities' centroids are marked with a red dot. Conversely, observations with statistically low job density in proximity to other low-density localities are assigned into a *low-Low* group (Anselin 1995). [26] These localities' centroids are marked with a blue dot. Localities that do not meet any of these criteria are not clustered into any group, and thus are not depicted in the LISA maps.

[INSERT FIGURE 2 HERE]

[24] p-values < 0.01%.

[25] Neighboring localities are weighted according to how close they are to the observed locality using an inverted-distance weight matrix.

[26] The mathematical expression for LISA can be found in annex 4. We could also find high-Low and low-High clusters.

Job density for both less- and more-educated workers is significantly higher in Santiago's downtown and northeast regions. Contrasting Figure 2 with Figure 1, we notice that there is a geographical match between job-dense regions and more-educated neighborhoods. As the spatial mismatch hypothesis predicts, less-educated workers are more likely to suffer the economic consequences of a spatial mismatch.[27]

V. Identification and self-selection issues

Self-selection can be a serious problem in calculating spatial mismatch effects. Individuals with a higher predisposition to participate in the labor force may choose to live in high-density areas. If this is the case, labor market participation could be driving job density rather than the other way around.

To assess potential self-selection problems, I analyze if less-educated caregivers can actually choose to reside in job-dense localities. The first step is to account for the history of Santiago's segregation. As outlined below, political and economic factors exogenous to household decision-making have been the main drivers of the city's residential pattern.

Secondly, using census data, I inspect housing relocation patterns among caregivers. I show that less-educated caregivers are unlikely to self-select in high-density regions. Moreover, there is no statistically significant difference in relocation patterns between labor market participants and non-participants. Finally, using the ODS, I show that labor force participation determinants do not predict job density among less-educated female caregivers.

V.a The political and economic history of Santiago's segregation

Santiago's segregation emerged from market-oriented reforms and forced resettlement processes under the authoritarian rule of Augusto Pinochet (1973-1990). The return of free and fair elections in 1989 did not alter Santiago's urban trajectory. In fact, segregation would peak more than a decade into democratic rule (Agostini et al. 2017).

[27] Moreover, the rest of the city presents low job density clusters for more-educated workers. This does not imply a spatial mismatch for them, since they mostly reside in the northeast. However, it does mean than more-educated individuals lack economic incentives to move away from more affluent regions.

The early years of Pinochet's dictatorship were a social and economic catastrophe. In addition to gruesome human rights violations, high inflation and high unemployment plagued the Chilean economy (Ffrench-Davis 2003). The inability of Pinochet's initial economic advisors to deal with the crisis led him to replace them with a group of young economists trained at the University of Chicago (Silva 1996). Under their advice, the government rapidly deregulated market activity and privatized public enterprises (Klein 2007). The set of policies known as 'shock therapy' also included the deregulation of land and housing markets.

In 1979, the Chilean government eliminated landholding and property-transaction taxes and auctioned a significant share of state-owned land property. That same year, a well-known geographer—Neil Smith—published an article arguing that unregulated housing markets induce speculative behavior among real estate entrepreneurs (Smith 1979). Smith argued that if land rents are expected to rise in the future, it is likely that housing prices will increase today. In line with Smith's predictions, the deregulation of the housing market led residential prices to spike in regions with greater accessibility to Santiago's economic center (Sabatini 2000; Garreton 2017).

A significant number of informal settlements had spawned in these areas in the preceding decades. Salvador Allende's government (1970-1973) had promised not to evict settlers, leading many working-class families to occupy undeveloped lands in otherwise wealthy neighborhoods (Hidalgo et al. 2016). The deregulation of residential markets turned these lands into profit opportunities for developers and landowners (Sabatini 2000).

Additionally, organized slum-dwellers played a central role in the popular resistance to Pinochet's dictatorship. Hence, with the support of developers and landowners, the government proceeded to violently disperse slum-dwellers to different peripheries of the city (Morales 1990). Nearly 165,000 people were displaced and resettled between 1979 and 1985 (Garreton 2017).[28]

The resettlement program displaced families to the southern and western peripheries of the city (Morales 1990; Garreton 2017). If you recall from Figure 1, these regions are now populated mainly by less-educated residents. At the time, these neighborhoods were scarcely

[28] According to the 1982 census, nearly 5% of people in Chile were relocated during this period.

populated, had poor access to clean water, poor access to electricity, and almost no public transportation connectivity (Hidalgo 2007). The resettlement programs reshaped and segregated the city. However, they were not the only form in which the state segregated Santiago.

The 1980 constitutional reform transformed the role of the state in the provision of affordable housing. Before the reform, the state was a direct supplier of social housing. Thereafter, the state would assume a subsidiary role. Instead of publicly providing affordable housing, the state begun subsidizing individual families to participate in the private housing market. In this context, private developers became the *de facto* providers of affordable housing (Hidalgo et al. 2016).

Additionally, the government loosened restrictions on the construction of affordable housing. It became permissible to build these projects on inadequately urbanized land (Ibid.). The loosening of restrictions made the cheap and poorly urbanized territories to the south and west of Santiago's center the most suitable for affordable housing to turn a profit for private developers. This way, the new institutional framework for affordable housing further deepened Santiago's segregation (Sabatini and Brain 2008).

One important note regarding the role of affordable housing in deepening segregation: Even though subsidies became available, the provision of affordable housing was insufficient to meet the demand for housing. By 1989, Santiago's housing deficit reached 40% (Garreton 2017). Nearly half of Santiago's households had two or more families living together. Reducing the housing deficit would become a central banner in the political campaign that eventually ousted the dictatorship.

1990 marked the end of Pinochet's dictatorship. The newly elected government (Patricio Aylwin, 1990-1994) kept its promise and reduced the housing deficit. They did so by loosening the requirements on housing subsidies and, thus, increasing the provision of subsidies. These policies were very effective. By the year 2000, the deficit had reduced to less than 10%. However, under the institutional framework inherited from the dictatorship, the market continued to allocate the urban poor to the southern and western banks of the city.

Consequently, by 2002, even though the deficit had reduced, the city was significantly more segregated than it was in 1990 (Agostini et al. 2017).

The structural determinants of Santiago's segregation have not changed much in the 21st century. Residential markets continue to have insufficient government oversight. Additionally, affordable housing subsidies have persisted as the main instrument for low-income families to become homeowners.[29]

Forced resettlement programs, market deregulation, and the privatization of affordable housing provision have significantly reduced the urban poor's capability to locate in or near high job-density regions. Additionally, by 2014, Santiago's segregation was paired with enormous differences in mobility capabilities. While the wealthier areas connect to the city's economic center through high-speed highways, 40% of affordable housing residents—and 70% of slum-dwellers—had little to no access to public transportation (Shirahige & Correa 2015).

V.b Residential mobility patterns

The 2012 census asks every citizen's mother's birth location (unfortunately, not their fathers'). With this information we can test whether female caregivers currently residing with their children have moved between municipal jurisdictions since birth. If labor market participation was driving job density, we should observe a flow of participant caregivers from low-density jurisdictions to high-density ones.

However, this is not the case. I calculate municipal job density and band each of Santiago's thirty-six municipalities in six density-based groups (from least-dense to most-dense). The results are staggering. Over 83% of less-educated working mothers born in the least-dense regions (Group 1) still live there. They are the least mobile among all caregivers.

Furthermore, those born in the most-dense regions were the most mobile. Nearly 45% of less-educated working mothers born in high-dense regions moved away from their region of birth. This is precisely the opposite flow one would expect if labor preferences were guiding residential location.

[29] Some initiatives at the municipal level have attempted to integrate some sectors of the city by building affordable housing in affluent neighborhoods, but they have not made a significant dent on Santiago's segregation.

Figure 3 depicts female caregivers' residential mobility. The vertical axis represents the fraction of caregivers born in each density group that now reside in a different one. Only a small percentage of less-educated women born in low-density regions moved into high-density ones. In fact, those born in denser areas moved into less dense regions at a significantly higher rate. This suggests that, on average, less-educated women hardly self-select into high-density regions.

[INSERT FIGURE 3 HERE]

Additionally**,** I test if mobility patterns between less-educated participant caregivers participating in the labor force is significantly different from that of non-participant caregivers. If there is self-selection, participant caregivers should have moved at a higher rate to high-density jurisdictions. Table 4 shows that they do not.

The table summarizes the percentage point differences between these two groups for all possible mobility combinations. A positive value indicates that the percentage of labor market participants moving between density groups is higher than that of non-participants. For instance, the rate of labor force participants born in the least-dense group (Group 1) currently residing in Group 2 exceeds that of non-participants in the same condition by 0.8 percentage points. The diagonal bolded numbers represent percentage point differences between participant and non-participant mothers who did not move.

Out of thirty-six possible combinations, thirty-four show no significant differences in residential mobility patterns. The two significantly different combinations in statistical terms (G1 to G4, and G1 to G6) are not economically significant. Only a very small fraction of the population born in the least-dense areas moved to Group 6 or Group 4 jurisdictions (1% and 2%, respectively). This is evidence that less-educated caregivers with high participation preferences are unlikely to locate their homes in high-density areas.

[INSERT TABLE 4 HERE]

More-educated caregivers' mobility patterns do exhibit household relocation towards higher job density (See Annex 5). Hence, self-selection may occur among more-educated workers.

V.c Individual and household characteristics do not predict job density

If individuals with a higher predisposition to participate could freely choose their residential location, labor force participation determinants would predict job density. Table 5 shows that this is not the case for less-educated female caregivers. Using the ODS, and conditional on municipal fixed effects, OLS regressions show that individual and household level labor market participation determinants are not significant predictors of job density.

[INSERT TABLE 5 HERE]

Table 5 shows the calculations for two subpopulations: All less-educated women and less-educated female caregivers. Even though the degree of significance is low for both groups, there is one outstanding difference. When considering the entire population of less-educated women, residing with children between seven and fourteen years old is negatively associated with job density. One interpretation for this is that pre-adolescent and teenage children need more space. Larger homes cost more, especially in areas that are close to employment opportunities. On the other hand, non-caregivers may afford to live in smaller places in job-dense regions. Hence, non-caregivers are more likely to self-select into high-density neighborhoods.

These regressions also consider the presence of a metro station in the observation's locality. As one would expect, this neighborhood-level characteristic is a significant predictor of job density. Hence, to avoid a confounding variable problem, we must include it in our primary analysis.

Considering the history of Santiago's residential segregation, less-educated caregivers' residential mobility patterns, and the predicting capability of labor force participation

determinants on job density, self-selection issues are unlikely among less-educated female caregivers.

VI. Methodology and Results

Since self-selection is not likely to be an issue, I use a fixed effects OLS model to estimate spatial mismatch effects on less-educated caregivers' participation. I model labor market participation as a function of individual and household determinants (Larrañaga 2006, Contreras et al. 2011*).*

Individual controls include schooling (in years), age, the total number of non-dependent women and men in the household (discounted by the observation), household income (in log, and discounted by the observation's income), and a dummy variable indicating pregnancy. Household-level controls include the total number of children (between zero and 14 years old), the total number of dependent adults, and if the home hires domestic help.

Additionally, I include two mobility variables: (i) the presence of a metro station within the observation's locality radius and (ii) a dummy variable indicating if the individual owns a driver's license and a vehicle.

As discussed earlier, coupling constraints are crucial in explaining spatial mismatch effects on caregivers. Since municipalities play a central role in providing public child and health care services that reduce coupling constraints the model includes municipal fixed effects. Finally, job density captures spatial mismatch effects. In line with Hellerstein et al. (2008), we include an interaction term between job density and schooling (in years) to capture differences in spatial mismatch effects across the education spectrum. [30]

$$LMP_{ihm} = \alpha + \beta X_i + \gamma Y_h + MunicFE_m + \theta JobDensity_{ih} + \delta(JobDensity_{ih} * Schooling_i) + \varepsilon_{ihm}$$

[30] The primary subset for analysis considers less-educated caregivers. However, within the less-educated group there is significant variation in schooling. Around 40% of less-educated caregivers do not have a high school diploma.

LMP_{ih} is a dummy variable equal to one if individual i in household h participates in the labor market and zero otherwise. X_i is a vector of individual variables, Y_h is a vector of household-level variables, and $MunicFE_m$ represents the municipal level fixed effects.

I estimate spatial mismatch effects on different sub-populations to contrast the effects of job density on less-educated female caregivers' labor force participation. These subpopulations are less-educated male caregivers, less-educated non-caregivers, and more-educated caregivers.

VI.a *Descriptive statistics*

Dividing the sample into these subpopulations, Table 6 describes the mean value for each regressor. Additionally, I test if these averages are statistically different from those associated to less-educated female caregivers.

[INSERT TABLE 6 HERE]

Table 6 shows that less-educated female caregivers have poor access to mobility. Less-educated female caregivers are the least likely to hold a driver's license or own a car (as is the case for all less-educated women). More-educated caregivers, on the other hand, are six times more likely to have a drivers' license. On average, they also have about three times the number of cars at their disposal than less-educated caregivers. This means that more-educated caregivers have a higher ability to overcome the distance between home and employment.

Albeit slightly, less-educated non-caregivers are also better positioned than caregivers. They are more likely to live closer to subway stations. Families with dependents are usually larger and therefore require bigger households. Larger homes near subway stations may just be unaffordable for these families. Affordability could also explain why more-educated caregivers, who have a higher income, are able to reside in areas with better urban connectivity.

For less-educated caregivers, low mobility is paired with the lowest local job density among all subpopulations. Job density differs significantly across genders. Interestingly, job density measured through the economic activity model and the education stratification model

show that less-educated female caregivers live in denser places than their male counterparts. This relation is inversed when stratifying job density according to education and gender. Less-educated men are more likely to live closer to places that hire men, than women to places that hire women.

VI.b Results for less-educated caregivers

The estimations (Table 7) confirm the presence spatial mismatch effects on labor force participation among less-educated female caregivers. For this group, all specifications of local job density are positive and statistically significant. Furthermore, the interaction term between job density and schooling level is negative and statistically significant. Since schooling levels are usually higher than job density levels, this negative parameter indicates that in places where job density is very low, net job density effects may be negative.

[INSERT TABLE 7 HERE]

These results illustrate the emergence of geographical inequalities due to spatial mismatch effects. Female caregivers residing in high-density regions are significantly more likely to participate than those in low-density localities. Hence, spatial mismatch effects partially explain the spatial autocorrelation of labor force participation.[31]

Spatial mismatch effects also intensify gender inequalities within marginalized neighborhoods. Men's participation is unaffected by job density. The gendered difference in spatial mismatch effects is summarized in Table 8. Female caregivers in heterosexual relationships residing in marginalized regions are then more likely to depend on male wages. In other words, the process of residential segregation may have intensified economic dependence among this group.

[INSERT TABLE 8 HERE]

[31] The model accounts for spatial autocorrelation in labor market participation. We know this because residuals are not spatially autocorrelated (See section 6 in the Annex).

VI.b.1. Analyzing the magnitude of job density effects across Santiago's municipal jurisdictions. A gendered geography of jobs?

What is the net effect of job density affect caregivers' participation? Interaction effects complicate the analysis as they discount job density effects. To address this issue, I analyze net job density effects for a less-educated female caregiver of average schooling (10.3 years). Figure 5 shows the average job density effects (by municipal jurisdiction) on labor force participation. The shade of the municipal jurisdiction indicates the size of spatial mismatch effects on participation. Darker colors indicate higher net effects. Additionally, I have highlighted the jurisdictions with lowest (in red) and highest (in blue) job density effects.

[INSERT FIGURE 4 HERE]

These maps are a reflection of Santiago's residential segregation. The lower-income southern and western regions (especially La Pintana, Cerro Navia, Renca, and Pudahuel) have the lowest net effects. On the other hand, the city's northeast (Santiago, Providencia, Vitacura, and Las Condes) is more likely to spark participation among its female residents.

The *economic activity* model predicts that a less-educated female caregiver of average schooling is 24% more likely to participate in the labor market if she resides in high-density jurisdictions (top-five jurisdictions) vis-a-vis low-density regions (lowest-five). The *education stratification* model predicts a 28% difference.

The predicted differences in magnitude associated to the *gender and education stratification* model are substantively higher. Caregivers residing in the top-five densest regions are 39% more likely to participate in the labor force than those in least-dense jurisdiction. What explains this difference? Unlike the other job density models, the gender and education stratification model assigns a high value to Lo Barnechea (top-right corner of Santiago). A mostly residential high-income municipal jurisdiction where domestic service is one of the main sources of employment for less-educated people in this region.

These results support the gendered geography of jobs hypothesis presented above. In addition to mobility constraints limiting participation, occupational segregation in the labor market is imprinted in the city's geographical landscape. Less-educated female caregivers in marginalized regions need to travel longer distances than their male counterparts to find employment. Gendered spatial mismatch effects are thus a product of both mobility constraints as well as gendered geographical differences.

VI.c*Robustness and sensitivity analysis*

For robustness purposes, we *winsorize* job density measures by 1% and 5%. Additionally, local job density is recalculated at double the walking-distance rate (2-kilometer radius for drivers and 2.8-kilometer for non-drivers) to test if results hold up when easing locality assumptions.

VI.c.1. *Winsorization of job density measures.*

To ensure that outliers do not drive our findings, we *winsorize* the data and recalculate the model. This process assigns less-extreme values to observations with exceptionally high and low values. Here, we winsorize the top and bottom 1% of the distribution, as well as the top and bottom 5%. Table 9 summarizes OLS results after winsorization, indicating that the parameters' statistical significance holds after the transformation process.

[INSERT TABLE 9 HERE]

VI.c.2. Re-defining locality

Table 10 shows the coefficients for the different models after doubling the locality radius. I consider a 2,800-meter locality radius for individuals who do not own a car and a 2,000-meter one for those who do. The results show that the education stratification model and the gender and education stratification model are robust to the widening of local job markets.

[INSERT TABLE 10 HERE]

VII. Spatial mismatch effects for other subpopulations

We examine spatial mismatch effects on labor force participation for non-caregiving less-educated individuals and more-educated caregivers. **In the annex (Section 7), you can also find estimations for spatial mismatch effects on informality and full-time employment for less-educated caregivers.**[32]

VII.a.1. Less educated non-caregivers

Although our primary analysis focuses on less-educated caregivers, it is worthwhile to show if residential segregation affects the labor market participation of other subpopulations. As argued above, unpaid domestic work can also be a source of mobility constraints. Therefore, spatial mismatch effects may also affect non-caregivers.

Table 11 indicates that the participation of people without caregiving responsibilities is not affected by job density. These results underscore the relevance of caregiving's coupling constraints in limiting mobility.

[INSERT TABLE 11 HERE]

VII.a.2. *More-educated caregivers*

Table 12 shows that job density is not a significant determinant for more-educated caregivers' labor market participation. We must be careful in how we analyze these parameters. More-educated caregivers are more likely to relocate their homes to high-density regions. Hence, OLS regressions may not capture spatial mismatch effects due to self-selection problems.

Nevertheless, this is an unlikely explanation. If there were self-selection issues, job density would be positively and significantly correlated with labor market participation. It is not. A more likely explanation is that more-educated individuals are more mobile. As shown above, they are significantly more likely to hold a driver's license, own a car, and live nearby a subway station. Mobility mutes spatial mismatch effects.

[32] These results show that spatial mismatch effects on accessing formal and full-time employment are negligible for less-educated female caregivers. However, job density coefficients are positive and significative for male caregivers.

As shown in Table 6, more-educated caregivers are significantly more likely to live in high-density areas. The fact that more-educated caregivers are able to live in these neighborhoods means that they can afford it. Consequently, they are likely to afford other services that improve their mobility. For instance, paid care services. Higher access to care services reduces coupling constraints and, thus, inhibit spatial mismatch effects.

Spatial mismatch effects are asymmetrical across the educational spectrum. These asymmetries intensify the economic inequality between less-educated and more-educated households.

[INSERT TABLE 12]

VIII. Final remarks

Santiago's residential sorting adversely affects labor force participation among less-educated female caregivers. However, no other group is affected in this way, aggravating multiple forms of inequality.

First, male participation rates are unaffected by spatial mismatch effects. This is associated to a gendered allocation of care responsibilities and, consequently, a gendered allocation of coupling mobility constraints. Gendered mobility constraints in the context of a spatial mismatch result in the deepening of gender inequalities within marginalized households. Moreover, occupational segregation in the labor market may entail a gendered geography of jobs that intensify spatial mismatch effects on women.

Spatial mismatch effects also deepen geographical inequalities between marginalized households and those closer to job opportunities. This is in line with the original spatial mismatch hypothesis (Kain 1968). However, the mechanism connecting segregation to geographical inequality identified here differs from those in the original proposition. Gendered coupling constraints entail marginalized households being more likely to have a male breadwinner. On the other hand, homes in job-dense regions are more likely to be dual-earner households.

Finally, spatial mismatch effects may result in higher economic inequality between less- and more-educated households. The urban processes behind Santiago's residential distribution have ensued a skilled-sorted city. More-educated neighborhoods are also the most job-dense. Hence, the spatial mismatch disproportionately affects less-educated households. Although spatial mismatch analysis for more-educated caregivers may be subject to self-selection issues, our estimations show that job density is not a significant parameter in explaining their labor force participation.

These findings entail important implications for the role of urban policy in reducing economic and gender inequalities. The disabling of coupling constraints can be achieved by integrating the logistics of caregiving into public transportation design. Moreover, a wider availability of affordable care services in marginalized regions can significantly increase participation rates by reducing mobility constraints. The construction of affordable housing in job-dense regions is an additional venue for higher female labor force participation rates.

The case of Santiago illustrates how urban processes can deepen inequality. The deregulation of housing markets and slum clearances undoubtedly benefited landowners and developers. However, Gabriela and the families of many care providers in marginalized settlements bear the costs of segregation. New urban processes are necessary to mend this distributional injustice.

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