It is all about social norms: Gender differences in commuting times in Brazilian cities

Deborah M. S. Seabra[1] | Carlos Roberto Azzoni[2] (iD)

[1] NEREUS - The University of Sao Paulo Regional and Urban Economics Lab, Department of Economics, University of Sao Paulo, Brazil. E-mail: seabradms@gmail.com
[2] NEREUS - The University of Sao Paulo Regional and Urban Economics Lab, Department of Economics, University of Sao Paulo, Brazil. E-mail: cazzoni@usp.br

ABSTRACT
Based on a sample of 34,834 heterosexual couples living in Brazilian metropolitan regions, we verify econometrically the existence of a gender differential in the time spent commuting to work and the role of the division of domestic tasks. We use PNAD data for the period 2011-2015 and estimate Multivariate Ordered Probit models to calculate the probability of an individual choosing a determined commuting time interval. The results indicate that women exhibit shorter commuting times than men. This does not change when we add variables representing socioeconomic characteristics, relative income (typically lower for women), different types of work, age, and the property of the residence. We include the amount of time dedicated to household chores, the division of household responsibilities, and the contribution to the couple's income (bargaining power). The results indicate that the difference in commuting times between men and women has little to do with gender per se but is strongly related to the social roles represented in the family. The shares of chores and income are always important in defining the commuting time of individuals. Simultaneous equation estimates for the two members of the couples indicate that the effect of the share of household chores on commuting time is more intense for men than for women, which is probably the result of the normative asymmetric division of gender in the responsibility for the home.

KEYWORDS
Commuting time, Household Responsibility Hypothesis, Gender discrimination, Social norms

É tudo sobre normas sociais: Diferenças de gênero nos tempos de deslocamento nas cidades brasileiras

RESUMO
Com base em uma amostra de 34.834 casais heterossexuais residentes em regiões metropolitanas brasileiras, verificamos econometricamente a existência de um diferencial de gênero no tempo despendido no deslocamento para o trabalho e no papel da divisão das tarefas domésticas. Utilizamos dados da PNAD para o período 2011-2015 e estimamos modelos Multivariados de Probit Ordenado para calcular a probabilidade de um indivíduo escolher um determinado intervalo de tempo de deslocamento. Os resultados indicam que as mulheres apresentam menor tempo de deslocamento do que os homens. Isso não se altera quando acrescentamos variáveis que representam características socioeconômicas, renda relativa (tipicamente menor para as mulheres), diferentes tipos de trabalho, idade e propriedade da residência. Incluímos a quantidade de tempo dedicado às tarefas domésticas, a divisão das responsabilidades domésticas e a contribuição para a renda do casal (poder de barganha). Os resultados indicam que a diferença nos tempos de deslocamento entre homens e mulheres pouco tem a ver com o gênero em si, mas está fortemente relacionada aos papéis sociais representados na família. As parcelas de tarefas e renda são sempre importantes na definição do tempo de deslocamento dos indivíduos. Estimativas de equações simultâneas para os dois membros dos casais indicam que o efeito da participação dos afazeres domésticos sobre o tempo de deslocamento é mais intenso para os homens do que para as mulheres, o que provavelmente é resultado da divisão normativa assimétrica de gênero na responsabilidade pelo lar.

PALAVRAS-CHAVE
Tempo de deslocamento, Hipótese da Responsabilidade Doméstica, Discriminação de gênero, Normas sociais

1. Introduction

This research studies the relevance of the division of household chores as a determinant of gender differentials in commuting to work. The explanation for women traveling less than men regularly observed empirically is related to a bias in the type of activity performed, which conditions them to take more widely spread jobs in space, and to the gender pay gap, which reduces their returns on long commutes. Another line of reasoning credits the shorter female commuting times to the task allocation process between the partners, with women being responsible for the primary care of the home and children, thus restricting their schedule and distance options. The literature calls this line of reasoning the Household Responsibility Hypothesis (HRH).

Based on a sample of dual-earner families collected by the 2011-2015 PNAD – Pesquisa Nacional por Amostra de Domicílios, this research verifies the existence of gender differentials in the time spent commuting to work in Brazilian metropolitan areas. We estimate Multivariate Ordered Probit models relating the commuting times to individual and household characteristics. We seek to understand the role of the division of household tasks in addition to measuring the heterogeneity of the relationship between domestic responsibilities and commuting time.

In contrast to previously developed studies, this research contributes to the literature by focusing on the factors behind the HRH. By bringing the discussion to the Brazilian reality, this work expands the frontier of knowledge beyond developed countries, on which the vast majority of studies on the subject concentrate. We also contribute by explicitly including variables representing the division of household chores and the bargaining power between couple members. Some studies deal with specific aspects of the problem, such as the responsibility for children (Treas and Rai, 2012), occupational segregation in the work environment (Fagnani, 1983), or domestic responsibilities (Hanson and Pratt, 1995; Rouwendal and Nijkamp, 2004; Mok, 2007). However, none explores jointly the various dimensions of the problem, as we do in this study. In the methodological realm, we advance by estimating the equations simultaneously for both couple members, preserving the relationship between the partners. This approach is new to the literature and considers the important interactions between couple members in deciding which job to take. The results provide a clear idea of the HRH's validity, the relationship that commuting holds with the gender of individuals and the importance of the roles played by each partner within a marriage.

The work is organized into seven sections, including this introduction. Section 2 presents a brief review of the literature on the HRH, followed by the methodology and data in Section 3. The following section presents general results on the differences in commuting times between men and women, including checks for robustness. Section 5 focuses on the analysis of the HRH, and the subsequent section evaluates the heterogeneity of the effects between men and women belonging to couples. In the last section, we summarize the results.

2.   Literature review

The travel pattern of an individual reflects his/her demand for activities performed outside the home, subject to the pertinent restrictions and limitations (Kitamura et al., 1997). Displacements are highly correlated with the distribution of activities in space, the transport system, and the socioeconomic characteristics of individuals. Men and women present different travel patterns, with women making more trips unrelated to work, such as visiting markets, laundromats, and pharmacies. They are also likelier to engage in trip chaining (school – laundromat – pharmacy) and choose more flexible transport modes.

The increase in female participation in the labor market has generated the need to analyze the differential in commuting to work. In the urban setting, the study of commuting is fundamental because it acts as a key link in analyzing spatial inter-actions between employment and housing. As commuting involves costs, people are only willing to face longer journeys in exchange for some compensation, whether in the labor market—higher wages—or in the housing market—lower land prices. Empirical studies show that men spend, on average, more time on home-to-work commuting than women, even when considering only the group of married individuals—that is, those who are subject to the same residential choice decision. Although women have consistently reached a higher educational level, which gives them better opportunities in the labor market, there is no convergence in the time spent on transit. In some localities, it has even expanded (Crane and Takahashi, 2009).

In addition to the pecuniary cost, commuting takes time, causes stress, and is the daily activity that causes the most disutility for individuals (Kahneman and et al., 2004). A natural question in this scenario is: "If displacement is bad, why can women's shorter commuting times put them at a disadvantage?" To answer this question, we must understand the reasons behind this phenomenon, the explanations for which essentially revolve around the idiosyncrasies of the labor market and the decisions that occur in the family sphere (MacDonald, 1999). As for the labor market, the bias in the type of activity performed, which conditions women to take more widely spread jobs in space and the gender wage gap are relevant. Another explanation is the HRH, according to which the reduced female commuting is related to the task allocation within the couple. As women are responsible for the primary care of the home and children, their schedules and distance options are necessarily more restricted (Johnston-Anomunwo, 1992).

The HRH takes on concepts borrowed from the geography of space–time, such as personal indivisibility and temporal finitude (Hägerstrand, 1970). It assumes, albeit implicitly, that the time spent performing domestic chores translates into reducing the time available for commuting to work. The HRH establishes a well-defined causal re-lationship between commuting and household chores: the reduced commuting times of women are a response to the task allocation process in the family sphere, in which

women assume most of the domestic responsibilities. Since there are considerable impediments to free residential relocation for double-earner families (Cervero, 1998), each individual's commuting time can also be seen, in equilibrium, as the result of the choice of workplace. It follows from the HRH that the shorter commuting times arising from the asymmetric division of tasks are a limiting factor for the full mobility of individuals in the urban space, thus generating an inability to freely arbitrate jobs that are in different locations. The key issue in the investigation of the spatial mismatch in the job search is the separation of how much of this conflict can be attributed to individual choices and how much is due to the restrictions faced by economic agents.

The neoclassical theoretical framework argues that the division of domestic responsibilities results from the optimal allocation of time and resources to maximize family utility. Becker (1965) states that partners share tasks according to the comparative advantages, with men specializing in paid work and women in home tasks. From this perspective, the spatial restriction women find in the search for jobs is efficient from an economic point of view. This view of the intrafamily decision-making process fails to take into account several cultural aspects that shape how individuals act. Social norms play an important role in deciding the activities performed by each gender in family and professional life. They result in substantial occupational segregation between genders at home (Geist and Cohen, 2011). Work at home, such as cooking, cleaning, and managing the house, is generally perceived as a non-male activity (Treas and Rai, 2012). Even when men recognize their importance at home, women still take major responsibility for children (Doucet, 2001). By reinforcing the social perception of how men and women should act, marriage and the presence of young children in the house intensify the gender bias in the division of household chores. Reducing women's available time to commute limits the spatial extension of their job search process. In such a patriarchal culture, the decisions made by women about their search for jobs do not necessarily represent their first best choices.

The time devoted to commuting to work is a consequence of a set of rational choices taken by individuals, determined by the balance between the housing market and the labor market. Urban economics considers an individual's commuting time as the result of his/her choice of residence, taking the location of the place of work as given. The trade-off individuals face concerns only the size of housing and the degree of accessibility to work, with the level of utility being constant in all parts of the city. In contrast, labor economics takes commuting as a response to the choice of the workplace. The spatial versions of job search models analyze how workers assess the urban space when looking for jobs, taking the location of their homes as given. Thus, commuting to work is a source of mobility, allowing workers to access jobs scattered throughout the city (Cameron and Muellbauer, 1998).

Moving from one point to another in space is costly. The hypothesis of non-spatial arbitrage, which determines that the level of individuals' utility should be the same at any point in the urban space, implies that longer commuting times should be compen-

sated for in some way. From the urban economics perspective, the bid–rent function establishes that the compensation comes from the negative relationship between the distance to the business center and the land prices. The spatial balance in the labor economics framework is established through the relationship between commuting costs and wages. Ultimately, the individual resistance to incurring commuting costs shapes the urban landscape and justifies the existence of cities. Its study is, therefore, fundamental to understanding issues related to the urban configuration, the labor market, and the residential choices of families.

Despite the numerous transformations in the labor market and cities, gender differences in commuting times persist and are an important topic in the literature. The shorter commuting time of women finds several justifications, the first of which is the wage gender differential. While men can increase their income by prospecting for jobs far from their place of residence, the same does not happen for women, who have a "narrower wage window" at any point in space (Madden, 1981). Therefore, the rational behavior of women is not to make long journeys to work since the effort of spending more time in traffic would not bring them the corresponding financial benefit. Results found in the literature support this idea, showing a positive relationship between commuting time and wage gains for women (Hanson and Pratt 1995), although they are still lower than men's.

The second reason for the gender differentiation in commuting times is the occupational segregation of the workforce. Despite continued convergence, occupations still carry a large share of gender bias. Pink-collar and blue-collar jobs were coined to designate the female- and male-dominant occupations. Men are usually prevalent in the primary and secondary sectors, while women work mainly in the tertiary sector. Because they have specialized occupations, the jobs available to men are located in more specific places in the city, which leads them to have longer travel times.

On the other hand, pink-collar jobs are relatively better distributed in space, making it easier to match women's needs with jobs near their homes. Fagnani (1983) shows that blue-collar occupations are associated with longer displacement times, regardless of the worker's gender. Hanson and Pratt (1995) present evidence that women in "masculine" sectors have commuting times that are similar to men's, while those employed in "feminine" sectors have shorter commuting times. Still, on this line, there is a view that the location decision of firms is endogenous to that of families; that is, urban labor markets are spatially heterogeneous due to the characteristics of the workers residing in each residential area. Thus, the types of occupations developed in different parts of the city depend on the locational choices of firms, and these take into account the skills of the workers who live in each area.

Madden (1981) addresses a third reason in his study on the duration of work trips in the US. Taking into account aspects of the labor market and the urban economy, the author concludes that women tend to work closer to home not only because of their lower wage rates or the type of occupation that they have but also because their

responsibilities at home restrict their ability to participate in longer journeys. Women circumvent the temporal pressure from double duty (away from home/at home) by reducing their displacements as much as possible.

This result is known in the literature as the Household Responsibility Hypothesis. It establishes a negative relationship between the degree of accountability for household chores and the time spent commuting to work (Johnston-Anomunwo, 1992). Thus, the gender differentials in commuting times found in the literature are justified by the gender differentials in the division of household chores between partners, which gives women the double role of provider and housewife, affecting their marginal value of time. Traditionally, the valuation of time takes place via opportunity costs, which hold an intimate relation to wage rates (Lucas Jr and Rossi-Hansberg, 2002). For women, however, commuting costs are not restricted to reducing the number of hours offered in the labor market. The lower availability of time and the greater rigidity in their schedules, resulting from the fact that they are responsible primarily for caring for the house and children, increase their marginal valuation of time beyond the marginal return of labor.

It is worth mentioning at this point that, even when men fulfill responsibilities for the house, the domestic work they undertake is different from that performed by women. While women perform most routine and discretionary chores, such as washing, ironing, cooking, cleaning, and caring for their children, men are responsible for performing activities that can be carried out less frequently, probably at weekends, such as gardening, maintenance, etc. Thus, the temporal pressure suffered by women with domestic responsibilities differs from that experienced by men.

Suppose the effort made by women before and after the out-of-home working hours to perform unpaid activities in their homes is considered. In that case, their opportunity cost of working far from home, measured in terms of time and disposition, is higher than that of men. Nevertheless, women are significantly more likely to choose their workplace after the housing decision has been made and are even more likely to change jobs after a residential change (Hanson and Pratt, 1995; Rouwendal and Nijkamp, 2004; Mok, 2007)). The displacement costs are thus positively related to the volume of domestic responsibilities. The evidence shows that the amount of time spent on unpaid domestic work diverges after parenthood, with men performing fewer and fewer activities and women increasing the time spent on this sort of activity (Baxter et al., 2008). Thus, from the HRH perspective, women have shorter commuting times than their male counterparts because, *ceteris paribus*, their commuting costs to work are higher.

One way to validate the HRH is to use the marital status as a proxy for accountability for household chores. Although clearly important, the presence of children is not essential for women to assume the role of housewife. Marriage is a source of disparity in the division of domestic responsibilities between the genders and, consequently, commuting. Sermons and Koppelman (2001) show that family composition explains

only partially the differences in the sensitiveness of men and women to commuting time in residential choice. Rapino and Cooke (2011) study the white and non-Hispanic American communities and find evidence that married women have the shortest commuting times, partly because they are more responsible for activities associated with home maintenance and the care of children. Fan (2017) provides evidence that differences in the travel patterns of men and women continue to be motivated by the unequal division of responsibilities at home. Focusing on analyzing the different family structures, the author shows that gender differences in the time spent on trips to work are only statistically significant in couples with children. When it comes to trips related to household chores, the duration of travel is very sensitive to the presence of children at home but not to the presence of a spouse. Jun and Kwon (2015) point out that the roles played by women in Seoul, Korea, are the main determinant of women's choice of work near the home. Ghasri and Rashidi (2019) find that the structure of the family and the type of work of Australian wives affect the displacement time of partners. Sánchez and González (2016) obtained similar results for Andalusia, Spain. Silveira Neto et al. (2015) find that marital status is important in determining the commuting time for Brazilian women, who present a 7% larger chance of spending less than 30 minutes traveling to work than their male counterparts.

Another way to validate the HRH is to show that the presence of older adults in the house positively affects women's commuting time since they can take on part of the responsibilities of caring for the house and children. Lee and McDonald (2003) investigate how the presence of the elderly and the number of children affect the distance to work of married women in South Korea, a traditional society in which the participation of women in the labor market is seen as secondary, given their responsibility as a wife and mother. The results show that having in-laws living in the same house positively affects the women's commuting-to-work times, a result attributed to the possibility of sharing the responsibilities. Compton and Pollak (2014) and Silveira Neto et al. (2015) obtain similar results for the US and Brazil, respectively.

A third way to validate the HRH is to include household chores explicitly in the quantitative analysis. Gimenez-Nadal and Molina (2016) show that the time devoted to domestic activities affects women's commuting time twice as much as men's. Moreover, the time spent on childcare negatively affects the commute time of women but does not influence the commute time of men. In the last section of this paper, we explicitly consider the time devoted by the partners to household chores, which allows for a better estimation of the other factors influencing the gender gap in commuting times.

In short, women make decisions regarding commuting under a different set of alternatives from that faced by men, which includes different employment opportunities, lower wages, and, mainly, greater responsibilities (Hughes, 1996). Gender convergence in travel behavior still encounters substantial barriers at home. The next section will address how many of these come from the choices made or from social

restrictions.

3. Methodology

3.1 Data

We work with data from the Pesquisa Nacional por Amostras de Domicílios (PNAD), a yearly survey produced by the IBGE, the Brazilian official statistics office, covering the metropolitan areas and the largest cities in the country. Travel times are recorded only for house-to-work commutes, and there is no information on trip chaining. They are measured in four categories: at home, less than 30 minutes, 30 minutes to 1 hour, and more than 1 hour. The database covers the nine official Brazilian metro regions, representing almost one-third of the national population. Information on the use of time for unpaid domestic work does not allow the identification of the type of task performed by individuals, only the total time spent on all household chores, including the care of children. We use stacked information from 5 surveys (2011–2015)[1]. The database consists only of heterosexual couples in which both members are 18–65 years old and employed. The use of this age range intends to restrict the analysis to the working-age population. We drop all couples in which at least one of the members is engaged in agriculture, military, or public sector activities since the job search process for these occupations follows a logic distinct from the private urban labor markets. Couples with zero income are also excluded. To avoid distortions arising from particular cases, we exclude couples whose hours spent on weekly paid work was 4 or more times larger than the hours spent on household chores in the week of reference for at least one of the partners. Similarly, to avoid including individuals with exhaustive journeys, only couples in which both members worked for less than 75 hours per week are considered. Finally, to avoid disregarding couples who did not perform domestic activities in the reference week, an infinitesimal value of time devoted to household chores is imputed to the members of such couples. The final database contains 34,834 couples or 69,668 individuals. Table A7 in the Appendix shows the descriptive statistics.

3.2 Empirical strategy

We estimate different models addressing the issue from a particular perspective, incorporating different questions and using different sample clippings. The dependent variable is the time spent on the home-to-work displacement. In one case, however, the response variable takes the form of a dummy that indicates whether the partners have the same commuting time. We use individual data to estimate regressions such as:

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[1]Unfortunately, 2015 is the last year PNAD collected the necessary information, limiting the period of analysis. However, five consecutive years provide a reasonable collection of data to estimate the models of interest.

$$y_i = x_i\beta + z_i\gamma + d_i + t_i + \epsilon_i \tag{1}$$

In which y is the commuting time of individual i, expressed as an ordinal categorical variable; x_i is a vector of the characteristics of individual i, including a dummy variable for gender; z_i is a vector of the characteristics of the household of individual i; β and γ are the respective parameters; d_i and t_i are region and year fixed effects; ε is the normally distributed error term. Once the gender difference is established, we introduce the role played by the time devoted to domestic activities. For that, we use the model:

$$y_i = x_i\beta + w_i\alpha + z_i\gamma + d_i + t_i + \epsilon_i \tag{2}$$

The vector w_i indicates the division of labor between individual i and his/her partner. We use ordered probit to estimate the models. Positive signs for the parameters indicate a higher probability of having larger commuting times.

The third model aims to measure the heterogeneity of the effect of home responsibility on each gender. We use a simultaneous estimation of two equations, one for each couple member, which allows for different coefficients for men and women. It also captures the correlation between the members' commuting times. The system of equations is given by

$$y_{c,1} = x_{c,1}\beta_1 + w_{c,1}\alpha_1 + z_c\gamma_1 + d_c + t_c + \varepsilon_{c,1} \tag{3}$$

$$y_{c,2} = x_{c,2}\beta_2 + w_{c,2}\alpha_2 + z_c\gamma_2 + d_c + t_c + \varepsilon_{c,2} \tag{4}$$

The difference from the previous models is that the two members (subscripts 1 and 2) belong to a couple c. Therefore, the error term ϵ is related to the couple and follows a normal distribution given by

$$N\left[\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 0 & \rho \\ \rho & 0 \end{pmatrix}\right]$$

The parameter ρ captures characteristics intrinsic to the couple that affect the partners' commuting times but are not observed by the researcher. Given the ordinal and discrete nature of variable y, the system of equations is estimated with Bivariate Ordered Probit. In all the estimations, we assume that the wages in each location are given and that the matching of couples is exogenous.

4. General results

As the commuting times are measured in time intervals, we estimate Ordered Probit models[2]. We start by estimating the following equation:

$$y_i = \beta_1 W_i + \beta_2 SocioEcon_i + \beta_3 WorkCond_i + \beta_4 MeansTransp_i + \beta_5 HouseQual_i + d_i + t_i + \epsilon_i \quad (5)$$

in which y_i is a four-level categorical variable indicating the commuting time interval of individual i. W is a dummy variable for females, taking males as the reference group. A negative and significant coefficient β_1 indicates, ceteris paribus, lower chances of women presenting long displacements when compared with men. $SocioEcon_i$ is a vector of socioeconomic characteristics. It includes: age, measured in years – women's dedication to household chores is closely related to their age, due to maternity and care of children, as the literature reviewed above indicates; whether individual i is the head of the household – although we control also for income, it is important to consider the role of the individual in the household; race – given the established race wage discrimination in the labor market, it is important to control for this aspect; whether the individual was born in the same municipality – migrants might have more flexibility to accommodate the location of the residence in relation to the job location; education, measured in five cycles; the couple's income – commuting time differences between men and women might change with the income level, including different transportation modes; the household per capita income, measured in three brackets – income levels influence the transportation mode choice and access to children' care alternatives (nanny, kindergarten, full-time schools); the number of children, in three age brackets – as an indicator for the intensity of the need of household care by the parents; and the presence of persons other than children living in the household – the presence of older relatives (grand parents, for example) change the working options of the couple members. The type of work performed is relevant, and we include some variables to represent it: $WorkCond_i$ indicates the weekly number of hours dedicated to paid work; the type of labor contract (three possibilities); the sector of activity (four sectors); and whether the work is performed between 5 a.m. and 10 p.m. To capture living conditions other than income, we include: $HouseQual_i$ indicates whether the building occupied is a house; the number of bedrooms; the number of bathrooms; and the quality of the building. $MeansTransp$ are dummies indicating the ownership of cars and motorbikes. Table A6 in the Appendix displays the description of the variables. Unobserved heterogeneities resulting from institutional, historical, and cultural factors, as well as the urban configuration and the transport system of each locality, are captured by the regional fixed effect term d. Year dummies

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[2]Although data constraints impose the choice of this model, it is important to recognize its limitations. It assumes a linear relationship between the explanatory variables and commuting times, and that the odds of moving from commuting time categories are constant. It also assumes that the presence or absence of other categories does not influence the odds of choosing one category over another. The model lacks flexibility in capturing complex relationships in the data, especially when the true underlying structure is nonlinear.

t capture the unobservable effects that affect the commuting time of all individuals in each period. Variables squared for age and time of paid work are included to add the possibility of nonlinearity to these components.

Table A1, in the Appendix presents the results. In all cases, the regional and year fixed effects are included. The commuting time is first regressed on the dummy variable for women (column 1), producing a negative and significant coefficient. Thus, compared with men, women in this setting have lower chances of presenting longer commuting times. The result remains unchanged when we add socioeconomic controls, but the size of the coefficient is reduced, evidencing that the gender differential in commuting time is partially associated with the characteristics of individuals (column 2). Column 3 contains the possession of cars and motorbikes, the time of the day when the job is performed to control for work outside traditional hours, and the quality of the house. The estimated coefficient for women remains almost identical to that obtained in column 2, suggesting that the gender effect on commuting time is unrelated to these variables. The estimated marginal effects for each of the four commuting time intervals computed from column 3 in Table A1 are presented in column 1 of Table 1. The probability of a married woman working at home is 1.76 percentage points (p.p.) higher than that of a married man; the probability of her traveling for less than 30 minutes to work is 2.1 p.p. higher, but the probability of her spending more than 1 hour traveling to work is 2.6 p.p. lower.

We now explore the factors the literature presents as possible causes of such results. We start with the relative income earned by men and women. Since women generally make less money than men, they have fewer incentives to commute long distances. To include that factor, we calculate the income the individual would receive if she/he belonged to the other gender group. These relative incomes are given by

$$RltvInc_{i,g}^m = Inc_{i,g}^m / AvgInc_g^f \tag{6}$$

and

$$RltvInc_{i,g}^f = Inc_{i,g}^f / AvgInc_g^m \tag{7}$$

This expression shows how much the labor income of individual i of gender j=w,m, belonging to group g, represents concerning the mean of that group for the opposite gender. We define the groups according to the year, region of residence, age cohort, sector of activity, type of employment contract, and educational level. It indicates how much income a woman in the same region, with the same age, sector, labor contract, and educational level, would make if she were a man in the same situation. The results are presented in column 4 of Table A1. Even discounting this factor, the commuting differential persists, although the size (in modulus) of the coefficient for W is substantially reduced.

The second justification is occupational segregation. Men and women occupy jobs in different sectors, distributed differently in the urban space. Therefore, because

women's jobs are less spatially concentrated, they are more likely to find jobs closer to home. To check that, we compose a sample in which both partners had jobs in the same sector of activity and another sample in which both partners were employed in the service sector (columns 5 and 6 of Table A1). Once again, the gender differentials persist, although, for the service sector, the coefficient is strongly reduced (in modulus).

Another issue is the configuration of cities and the spatial segregation of income. Since poverty concentrates in the urban fringes of Brazilian cities, long commutes are strongly related to low-income families. Following Silveira Neto et al. (2019), we organize two unique samples: one that excludes the poorest 25% and another with only households with full access to electricity, piped water, garbage collection, and the sewage network and buildings with masonry walls. As columns 7 and 8 of Table A1 indicate, the gender differential remains. The behavior concerning the labor market might be different for individuals in different positions in their life cycle. To verify that, we assembled a sample that contained only couples in which both members were between 30 and 45 years of age and near the top of their productivity and professional seniority. The results in column 9 of Table A1 indicate the permanence of the gender differential in commuting time.

Since commuting connects the real estate and labor markets, the determination of commuting times can be attributed to two inherently antagonistic choice processes. Married women likely have shorter commuting times because the family, when choosing the place of residence, gives priority to them. If the site of residence is given, the shorter commuting time means that women prefer to work closer to home. As discussed earlier, this study deals with a scenario in which the decision regarding the place of residence precedes that regarding jobs. In this context, the gender differential in commuting brings a loss of utility to women. If the low commuting times for women are caused by a spatial restriction in the employment search, women may not reach the overall maximum utility level. The database contains information on the time of employment of the individuals in their current work but has no information on the length of residence. Therefore, we cannot determine which decision was made first. However, it is well known that married individuals are less likely to change their homes than singles since the decision involves coordinating the wishes of two or more members. Similarly, residents who own their homes are more fixed in space than those who rent due to the time horizon inherent in the decision to purchase a property, and the costs associated with the transaction of the property end up creating friction in the real estate market (Deding et al. (2009), Coulter et al. (2010), Rabe (2011)).

Individuals employed in the private sector, which is the case in the sample, are subject to high turnover, which increases the chances that the medium- and long-term decision-making on the place of residence of this group is not conditioned on the current place of work. More than half of the individuals in the database had been in their current jobs for less than 4 years, and about 75% of families owned

their homes. As such, the results found so far are influenced by families in which the members chose their jobs after establishing their place of residence. In any case, to bring greater robustness to the results, we made some sample cuts to allow the separation of families according to the degree of rigidity of the real estate market vis-à-vis the labor market.

The results for couples living in their own homes, shown in columns 10 and 11 of Table A1, indicate that the gender effect on commuting time remains. In column 11, only individuals who had been in their current job for less than 3 years are included. Given that all couples owned their homes in this sample, this increases the chances that the residential location decision preceded the choice of the job. The significant and negative coefficients for women indicate that gender continues to appear as a determining factor of the time spent commuting to work, although the value of the coefficient (in modulus) is lower than that for all homeowners. Women are more likely to have reduced times than men because they find jobs closer to home. The marginal effects presented in columns 2 and 3 of Table 1 reveal that women have a probability of working within 30 minutes of home which is 2.2 p.p. higher than men. The probability of working more than 1 hour from home is 2.8 p.p. less for women than for men. The results change only marginally for the sample of individuals who had been in their current job for less than 3 years. In such a sample, the probability of working at home is 1.1 p.p. larger for women (in contrast to 1.9 p.p. in column 1), and their probability of spending between 30 minutes and 1 hour on daily commuting is 0.8 p.p. lower.

Table 1. Marginal effects for *Woman*

	(1)	(2)	(3)
		Home owners only	
	All couples	*Baseline*	Less than 3 years in the job
At home	0.0176**	0.0195**	0.0115**
	−0.0019	−0.0022	−0.003
Up to 30 min	0.0210**	0.0220**	0.0180**
	−0.0022	−0.0025	−0.0046
30 min to 1h	−0.0126**	−0.0134**	−0.0088**
	−0.0014	−0.0015	−0.0023
>1h	−0.0259**	−0.0281**	−0.0207**
	−0.0027	−0.0031	−0.0053

Source: Prepared by the authors. Significance level: ** $p < 0.01$, * $p < 0.05$. The marginal effects are the average of the marginal effects of the observations.

5. Investigating the Household Responsibility Hypothesis

The previously presented results show the existence of a gender difference in commuting to work among the couples analyzed. The evidence is robust to several scenarios tested, including those mentioned in the literature as possible causes of the problem, such as bargaining power and occupational segregation. In this section, we seek to understand the extent to which the responsibilities for the home justify the divergent behavior between men and women regarding commuting times.

As opposed to the vast majority of the literature on the subject, the validation of the HRH is performed explicitly by including the time dedicated to domestic chores, the division of responsibilities in the house, and the bargaining power. The importance of including the latter variable is due to its possible relationship with the portion of household chores performed by each member (Becker (1965), Manser and Brown (1980), Lundberg and Pollak (1994). Ignoring it could bias the results. However, the possible reverse causality between this variable and the time spent commuting to work is recognized. We estimate the following equation:

$$y_i = \beta_1 W_i + \beta_2 ShChor_i + \beta_3 TimeChor_i + \beta_4 ShInc_i + \gamma Controls_i + d_i + t_i + \epsilon_i \qquad (8)$$

$ShChor_i$ is the share of member i in the total hours spent by the couple on household chores, being a measure of accountability for the care of the home. $TimeChor_i$ is the number of weekly hours that an individual i dedicates to the performance of these tasks. It reveals the level effect of this variable. $ShInc_i$ is the portion of the total income earned by member i and represents his/her bargaining power. The vector $Controls_i$ includes all the variables defined in the previous section. If the HRH is important in the gender differential in commuting to work, it is expected that the magnitude of the β coefficient will be reduced or even cease to be significant when this variable is inserted as a regressor.

The results presented in Table A2 provide evidence that corroborates the HRH. Adding the share of household chores (column 1) already eliminates the significance of the coefficient associated with the variable *Woman*. This shows that the commuting time differential is related more to the roles played by each gender in the family unit than to gender per se. The negative sign of the coefficient shows that the more an individual is responsible for home care, the lower his or her chance of presenting long commuting times. Adding the number of hours dedicated to household chores (column 2) and bargaining power (column 3) does not affect the overall conclusion: gender per se has little to do with commuting time in the case studied. As expected, the estimated coefficient for bargaining power has a positive signal, meaning that the responsibility for providing for the family is positively related to the time devoted to commuting to work. This result could be a consequence of the high correlation between the care for household chores and the dummy for women. As reported in Table A8 in the Appendix, the Pearson's correlation coefficient between these two variables

is around 0.7, and that between the gender dummy and the income share is -0.5. These moderate correlations are not high enough to cause discomfort with the results found.

To reinforce the conclusion that the degree of accountability with the activities of care for the house and children eliminates the gender effect, we estimate some other specifications. In columns 4 to 6, we exclude the ShChor variable. If the HRH is the reason for men and women having different commuting times to work, suppressing this variable would imply the significance of the gender dummy coefficient. Besides offering robustness to the HRH, the results provide important insights into the role of the other variables. Column 4 shows that, alone, bargaining power cannot explain the inequality in commuting time between men and women, as the coefficient for *Woman* becomes negative and significant. Column 5 shows that the effect on the amount of time spent on activities in the home, although important, also does not justify the differential in travel behavior. Even the addition of both regressors in column 6 cannot annihilate the gender effect, which remains negative and highly significant. However, the value of the coefficient (in modulus) is reduced.

The second robustness test aims to verify the strength of the regressors of interest in the absence of the gender variable. This test is pertinent because it is possible that the effect of the share of household chores only exists in the presence of the gender variable, and, therefore, it would not be able to explain by itself the differences in the time commuting to work between men and women. Columns 7–9 in Table A2 show that the significance of the domestic responsibilities persists in all three scenarios analyzed: when only the basic controls are considered (column 7); when the time dedicated to household chores is included (column 8); and when bargaining power (column 9) is also considered.

Thus, it can be concluded that the effect of domestic responsibilities overlaps with gender in determining commuting time, even when considering the bargaining power (or, otherwise, the degree of responsibilities for the support of the house) of the individual. The marginal effects corresponding to column 3 of Table A2 are shown in the upper-left corner of Table 2 (all couples). The magnitude of the influence of bargaining power is always larger than that of domestic responsibilities. Increasing the share of household chores by 1 p.p. reduces the probability of traveling for more than 1 hour to work by 2.67 p.p. Increasing the share in the income by 1% increases the same probability by 6.3 p.p. A 1% increase in the time dedicated to household chores is related to an increase in the probability of working at home of 0.5 p.p.

We performed robustness checks to verify whether the above results resulted from causes other than the HRH alone. The results presented in Table A3 show that the *Woman* coefficient is not significant in all the tested specifications, which reinforces the argument that the commuting differential between men and women has little relationship with gender itself but a considerable relationship with the social roles that they represent in the family. The share of chores and income is always important in

defining the commuting time of individuals.

As in the previous section, we explore the interaction between job and residence choice. Column 10 of Table A3 presents the estimation of the model for the subsample of couples that own their residence, and column 11 restricts the sample even more, considering only individuals in owned homes who have been in their current jobs for less than 3 years. When the time spent on activities in the home, the share of household chores, and the bargaining power are included, there is no gender difference in the commuting time for homeowning couples. The last two variables are strongly significant, leading to the conclusion that greater responsibilities for household chores are associated with a search for employment in locations closer to home, even when controlling for the responsibility for house support. This result is quite relevant because it reveals that if social norms dictate that a particular gender should perform most domestic activities, they also implicitly prescribe that this group will be spatially restricted in the employment search, as the share of household chores imposes a limitation on the time available for commuting to work.

The upper center and right parts of Table 2 present the marginal effects. The first point to highlight is the consistency of the magnitude of the effect of domestic responsibilities in all four classes of commuting time between the sample containing all the households (upper left corner of the table) and the one containing homeowners only. For example, an increase of 1 p.p. in the probability of spending up to 30 minutes commuting to work is 2.16 p.p. for all households and 2.07 p.p. for homeowners. The probability of commuting for more than 1 hour is 2.6 p.p. for both samples. The same occurs with the share of income: the marginal effect for commuting for up to 30 minutes is -5.1 p.p. in the complete sample and -5.2 p.p. for homeowners. This robustness is also valid for the time spent on household chores, the effect of which is virtually identical for the two samples in all the commuting time brackets. For homeowning couples who have been working in their current job for less than 3 years, there is an increase (in modulus) in the average marginal effects, especially for the more-than-1-hour bracket (e.g., for bargaining power, the effect rises from 6.7 p.p. in general to 9.7 p.p. for these homeowners). For the latter group, a 1 p.p. increase in the share of household chores implies a reduction of 3.3 p.p. in the probability of spending more than 1 hour commuting to work.

The presence of children in the household is an interesting aspect to explore. Although all the results presented so far already consider the number of children in three age groups, they do not allow for the analysis of the heterogeneity of the effect of the presence of children. A regression with just the dummy variable *Woman*, without any controls, produces a coefficient of -0.067 for couples without children and -0.131 for couples with children (not shown in the tables, but both significant). This shows that the presence of children is an important factor in the gender differences in commuting. As controls are included (columns 7 and 8 of Table A4), the gender effect disappears. It is worth mentioning that the time dedicated to domestic chores

is only significant for couples with children. This may be due to an aggravation of the temporal restriction introduced by additional time devoted to the care of children.

The middle part of Table 2 presents the marginal effects. In the reduced model (No controls), the mean marginal effects for couples with children are always higher (in modulus) than those without children, corroborating the HRH. Women with children exhibit 3 p.p. less chance than men of commuting to work for more than 1 hour, twice as much as women without children. In the complete model, the marginal effects of the share of domestic chores are similar between couples with and without children, oscillating between 1.3 p.p. and 2.7 p.p. across the four commuting time brackets. This result supports the idea that having children is a key factor in determining the gender differential in commuting times. When we discount this factor, the effect is similar between couples with and couples without children. As for bargaining power, its effect on the probability of working at home is 0.5 p.p. larger (in modulus) for couples without children and 1.5 p.p. larger for the probability of spending more than 1 hour commuting.

Another relevant point is the heterogeneity of the effects of the division of house-hold chores and bargaining power on the tails of the income distribution. Given that rich and poor people make different choices regarding the location of their jobs and homes, as well as tending to incorporate cultural norms and standards with more or less tenacity, some differences in the importance of these variables in determining commuting times are expected. To study these differences, the reduced and complete models are estimated separately for the poorest 25% and the wealthiest 25% of the sample, with results shown in columns 9 and 10 of Table A4.

As in the previous cases, the gender difference only appears if no controls for bargaining power and responsibility for household chores are included. The most in-teresting point is that gender inequality ceases to exist for different reasons in both groups. While the division of household chores is significant in determining com-muting time differences for the poorest, bargaining power is the determining factor for those in the upper-income quartile. This result indeed derives from the fact that, for this last group, there is a more egalitarian distribution of chores among partners, which gives a more important role to bargaining power. Additionally, the income dis-tribution tends to be more asymmetric for rich couples than for poor ones.

The bottom part of Table 2 presents the marginal effects. In the reduced model (No controls), the gender effect is similar across groups. The poorest and wealthiest women have about 2.4 p.p. more chance of spending up to 30 minutes commuting to work than their husbands. However, poor married women present a probability of 1.3 p.p. and 3.2 p.p. less than their husbands of having a commuting time between 30 minutes and 1 hour and more than 1 hour, respectively, against 2 p.p. and 2.6 p.p. of the richest. The analysis of the complete model reveals that the size of the effect of bargaining power for the rich is, on average, twice as large as that for the poor. For the poorest, an increase of 1 p.p. in the share of domestic chores increases the chances

Table 2. Estimated marginal effects - HRH

All couples / **Homeowners only—All couples** / **Homeowners only—Up to 3 years in job**

	All couples				Homeowners only—All couples				Homeowners only—Up to 3 years in job			
	At home	Up to 30 min	30 min–1 h	>1 h	At home	Up to 30 min	30 min–1 h	>1 h	At home	Up to 30 min	30 min–1 h	>1 h
Woman	-0.0002 / -0.0024	-0.0002 / -0.0029	0.0001 / -0.0017	0.0003 / -0.0035	0.001 / -0.0028	0.0012 / -0.0032	-0.0007 / -0.0019	-0.0015 / -0.0041	-0.0049 / -0.0041	-0.0075 / -0.0061	0.0037 / -0.0031	0.0087 / -0.0071
ShChor	0.0181** / 0.0000	0.0216** / 0.0000	-0.0130** / 0.0000	-0.0267** / -0.0001	0.0184** / -0.0044	0.0207** / -0.0049	-0.0126** / -0.0030	-0.0265** / -0.0063	0.0185** / -0.0059	0.0283** / -0.009	-0.0140** / -0.0045	-0.0328** / -0.0104
TimeChor	0.0053** / -0.0013	0.0050** / -0.0012	-0.0039** / -0.001	-0.0064** / -0.0016	0.0053** / -0.0016	0.0047** / -0.0013	-0.0037** / -0.0011	-0.0063** / -0.0018	0.0027 / -0.0021	0.0033 / -0.0025	-0.0021 / -0.0017	-0.0039 / -0.003
ShareInc	-0.0430** / -0.0001	-0.0511** / -0.0001	0.0308** / -0.0001	0.0633** / -0.0001	-0.0465** / -0.0089	-0.0523** / -0.0100	0.0318** / -0.0061	0.0670** / -0.0129	-0.0545** / -0.0124	-0.0837** / -0.019	0.0414** / -0.0094	0.0968** / -0.022

No children / **With children**

	No children				With children			
	At home	Up to 30 min	30 min–1 h	>1 h	At home	Up to 30 min	30 min–1 h	>1 h
Woman (No controls)	0.0100** / 0.0034	0.0130** / 0.0044	-0.0081** / 0.0028	-0.0149** / 0.0051	0.0205** / 0.0022	0.0238** / 0.0026	-0.0142** / 0.0016	-0.0301** / 0.0032
Woman	-0.0008 / 0.0042	-0.0011 / 0.0054	0.0007 / 0.0034	0.0012 / 0.0062	0.0006 / 0.0029	0.0007 / 0.0033	-0.0004 / 0.0020	-0.0008 / 0.0042
ShChor	0.0166* / 0.0070	0.0216* / 0.0092	-0.0135* / 0.0057	-0.0247* / 0.0105	0.0185** / 0.0043	0.0213** / 0.0049	-0.0127** / 0.0029	-0.0271** / 0.0063
TimeChor	0.0009 / 0.0025	0.0010 / 0.0028	-0.0007 / 0.0020	-0.0012 / 0.0032	0.0064** / 0.0016	0.0058** / 0.0014	-0.0045** / 0.0011	-0.0076** / 0.0018
ShareInc	-0.0341* / 0.0151	-0.0446* / 0.0198	0.0278* / 0.0123	0.0509* / 0.0226	-0.0454** / 0.0094	-0.0525** / 0.0108	0.0312** / 0.0064	0.0667** / 0.0138

25% poorest / **25% richest**

	25% poorest				25% richest			
	At home	Up to 30 min	30 min–1 h	>1 h	At home	Up to 30 min	30 min–1 h	>1 h
Woman (No controls)	0.0209** / 0.0035	0.0244** / 0.0040	-0.0129** / 0.0022	-0.0325** / 0.0053	0.0227** / 0.0039	0.0242** / 0.0041	-0.0205** / 0.0035	-0.0264** / 0.0045
Woman	-0.0002 / 0.0047	-0.0003 / 0.0055	0.0001 / 0.0029	0.0004 / 0.0074	0.0080 / 0.0047	0.0086 / 0.0051	-0.0073 / 0.0043	-0.0094 / 0.0055
ShChor	0.0209** / 0.0069	0.0243** / 0.0080	-0.0127** / 0.0042	-0.0325** / 0.0107	0.0134 / 0.0079	0.0143 / 0.0084	-0.0121 / 0.0072	-0.0156 / 0.0092
TimeChor	0.0073** / 0.0027	0.0058** / 0.0021	-0.0047** / 0.0017	-0.0085** / 0.0030	0.0060* / 0.0026	0.0052* / 0.0021	-0.0053* / 0.0022	-0.0059* / 0.0024
ShareInc	-0.0256 / 0.0002	-0.0297 / 0.0002	0.0156 / 0.0001	0.0398 / 0.0003	-0.0468** / 0.0138	-0.0497** / 0.0147	0.0422** / 0.0125	0.0544** / 0.0161

Source: Calculations by the authors.
Notes: Averages of the marginal effects of the observations. All controls included. Marginal effects calculated from Table A2. The average of the semi-elasticity $(dx/dy)*(1/x)$ is calculated for TimeChor. ShChor - time dedicated to domestic chores; TimeChor – division of responsibilities in the house; ShInc -bargaining power. Significance levels: ** $p<0.01$, * $p<0.05$.

of having a commuting time of less than 30 minutes by 2.4 p.p., while an increase of 1 p.p. in the share of aggregate income for the richest decreases the probability of working at home by 4.7 p.p.

6.   Gender heterogeneity and commuting time differences

The results of the previous sections have shown that gender explains the commuting time for married individuals only if each partner's responsibilities in the home are not taken into account. That is, the differential in commuting time between men and women is not the result of gender per se but of factors such as the division of household chores between partners. The results are robust to all the sample cuts, which provides confidence in the conclusions. The comparison of couples with and without children indicates that the division of tasks has a similar effect for both groups. On the other hand, bargaining power has different impacts for poor and rich couples: the division of domestic activities is more important for the first group, and bargaining power is more important for richer couples. This section studies the relationship between domestic responsibilities, bargaining, and commuting for each gender. The equations are reestimated separately for each gender, preserving the relationship between the partners. We apply the seemingly unrelated regression (SUR) or probit ordered bivariate method, in which the equations are estimated simultaneously for each couple member. Thus, all the non-observable characteristics common to the couple are taken into account, as the correlation between partners in the determination of commuting time is considered explicitly.

It is important to recognize the limitations of the exercise. Given the time restriction, there is less time to perform any tasks for those individuals who devote more time to traveling to work, and vice versa, meaning that it is impossible to establish a causal relationship between the variables. Another point is the participation in income. The bargaining power of each individual is included in the regression for its effect on the division of domestic responsibilities. The causality here is not clear either. Members with greater bargaining power could have greater power in the location of the residence and end up presenting shorter commuting times. The positive relationship between commuting and income observed in the previous results could indicate otherwise. The dubious relationship between income and commuting time prevents the results on bargaining power from being interpreted as causality.

The results in Table A5 show that the three variables of interest are relevant to determining women's commuting time. Men's time spent on household chores does not matter. This result is in line with the type of domestic activity performed by each gender, in which it is up to women to perform everyday tasks, such as washing, cooking, and caring for children, Men are left with those that can be performed at weekends and therefore have little impact on their temporal restriction. Table 3 reports the marginal effects of these estimates. The results show that the effect of the share of domestic chores on commuting time is more intense for men than for women, as a result of the

normative asymmetric division of gender in family responsibilities. A 1 p.p. increase in household responsibilities for women—which necessarily implies a decrease of the same magnitude in their partners' responsibility—is reflected in a drop of 1.8 p.p. in the probability of spending more than 1 hour commuting; for men, that value is 2.9 p.p. Even more impressive is the effect of the contribution to income, which, for specific time brackets, is 7 times larger than previously discussed. For women, a 1 p.p. increase in their contribution to the couple's income is related to a reduction of 7.3 p.p. in the probability of working at home, in contrast to the effect of 2.7 p.p. for men. Finally, a 1% increase in women's time spent on household chores is related to a drop of 1.2 p.p. in the chances of commuting for more than 1 hour to work. The evidence shows that the share of domestic responsibilities has a greater effect on men than on women in determining commuting time, indicating that any increase in the share of responsibilities for the house means a change in their type of activity, which is no longer sporadic and becomes discretionary.

Finally, to understand whether domestic responsibilities impose a spatial restriction on the job search for women, the regressions are re-estimated for the subsample of homeowning couples. The results in Table A5 show that the HRH is valid and dictates how far women can travel in their search for jobs; hence, the more responsibilities they take on at home, the lower their chances of spending a long time commuting, as the negative and significant coefficient of the share of household chores in column 3 indicates. On the other hand, the share of income is only relevant for men, with the expected positive sign. Table 3 reports the marginal effects. A 1 p.p. effect of the share of domestic responsibilities is around 2 p.p. for women, being stronger in the first and fourth time brackets. The contribution to income, in turn, presents a much more intense relationship and surpasses that of men by 4 p.p. in the probability of commuting for more than 1 hour to work.

7. Conclusions

This work evaluated the relevance of the division of household chores as a determinant of the gender differentials in the time devoted to commuting to work. Based on a sample of 34,834 heterosexual couples living in the Brazilian metropolitan regions, we performed econometric estimates to verify the existence of a gender differential in the time spent commuting and to understand the role of the division of household tasks in determining the gender differential. We also measured the heterogeneity of the relationship between domestic responsibilities and commuting time. This research contributes to the literature by exploring the factors determining the prevalence of HRH and providing results for a developing country, unlike most studies, which deal with developed countries. The time dedicated to household chores and the bargaining power of individuals within couples are explicitly included in the analysis. We also used a simultaneous equation estimation incorporating the couple's unobservable characteristics, and the correlation between partners in determining their commut-

Table 3. Marginal effects from the simultaneous equations

	Woman				**Man**			
	At home	Up to 30 min	30 min to 1 h	More than 1 h	At home	Up to 30 min	30 min to 1 h	More than 1 h
All couples								
ShChor	0.0133*	0.0135*	−0.0085*	−0.0183*	0.0168**	0.0274**	−0.0145**	−0.0297**
	-0.0058	-0.0058	-0.0037	-0.0079	-0.0061	-0.0099	-0.0052	-0.0108
TimeChor	0.0098**	0.0085**	−0.0062**	−0.0120**	-0.0002	-0.0003	0.0002	0.0003
	-0.0022	-0.0018	-0.0014	-0.0026	-0.001	-0.0016	-0.0009	-0.0017
ShInc	−0.0727**	−0.0737**	0.0463**	0.1001**	−0.0276**	−0.0449**	0.0238**	0.0488**
	-0.0128	-0.013	-0.0082	-0.0176	-0.0091	-0.0148	-0.0078	-0.0161
Homeowning couples only								
ShChor	0.0151*	0.0140*	−0.0091*	−0.0199*	0.0131	0.0207	-0.0109	-0.023
	-0.0069	-0.0064	-0.0042	-0.0092	-0.007	-0.0111	-0.0058	-0.0124
TimeChor	0.0108**	0.0084**	−0.0066**	−0.0127**	-0.0001	-0.0002	0.0001	0.0002
	-0.0026	-0.002	-0.0016	-0.003	-0.0011	-0.0017	-0.001	-0.0018
ShInc	−0.0733**	−0.0679**	0.0444**	0.0969**	−0.0338**	−0.0534**	0.0279**	0.0593**
	-0.0152	-0.0141	-0.0092	-0.0201	-0.0103	-0.0163	-0.0085	-0.0181

Source: Calculations by the authors.
ShChor time dedicated to domestic chores; TimeChor – division of responsibilities in the house; ShInc - bargaining power. Significance levels: ** $p<0.01$, * $p<0.05$.

ing times.

The first exercise indicated that, when compared with men, women have a lower chance of presenting long commuting-to-work times. This result remained the same when including socioeconomic controls and information on the possession of means of transportation and the period of the day in which the paid work is performed. Quantitatively, the probability of a married woman working from home is 1.7 percentage points (p.p.) higher than that of a married man; the probability of commuting for less than 30 minutes is 2.1 p.p. higher; and the probability of spending more than 1 hour commuting is 2.6 p.p. lower. The conclusion remained even after considering the relative income, typically lower for women, the different types of work performed by the genders, and different income levels and age groups. The effect of gender on travel time persisted even when regressions were estimated only for families living in their own homes, both in general and, among those, for only individuals who had been in their current employment for a maximum of 3 years.

We explicitly analyzed the HRH by including variables capturing the amount of time dedicated to household chores, the division of responsibilities in the house, and the contribution to the aggregate income of each individual (bargaining power). The simple addition of the share of household chores showed that the differential in commuting time is related more to the roles played by each gender in the family unit than to the gender per se. The more one individual is responsible for home care, the lower his/her chance of presenting long commuting times. Adding information on the time dedicated to household chores and bargaining power did not affect the overall conclusion: gender per se has little connection to commuting time. As expected, the responsibility for providing for the family is positively related to commuting time. Robustness analyses indicated that the lack of a gender differential is a constant in all the tested specifications, which reinforces the argument that the commuting differential between men and women has little relationship with gender itself but a considerable relationship with the social roles that they represent in a family. On the other hand, the share of chores and income are always important in defining the commuting time of individuals.

Finally, to understand how the division of responsibilities for the home, the time spent on household chores, and the bargaining power affect the determination of the commuting time of men and women, simultaneous equations were estimated, separating each gender. The results indicated that the effect of the share of household chores on commuting time is more intense for men than for women, probably because of the asymmetric gender division of family responsibilities. An increase of 1 p.p. in household responsibilities reflects in a drop in the likelihood of spending more than 1 hour commuting to work of 1.8 p.p. for women and 2.9 p.p. for men. An increase of 1 p.p. in the contribution of women to the couple's income is related to a reduction of 7.3 p.p. in the probability of working at home, and 2.7 p.p. for men. A 1% increase in the time spent by women on household chores is related to a drop of 1.2 p.p. in their

chances of commuting for more than 1 hour to work.

The results of this research are solid in concluding that social norms promote the gender differential in the time devoted to commuting to work in Brazilian metropolitan areas by dictating that certain activities are carried out by women, restricting their participation in the labor market. In light of the evidence presented, how government actions could mitigate the adverse effects of HRH? More support for paid parental leave, childcare subsidies, and greater flexibility in working hours would facilitate the work of both spouses. Urban sprawl is a negative factor for women, as commuting becomes more intense with the area occupied by the cities, adding another negative aspect to having cities excessively spread in the territory. Controlling urban sprawl and or providing efficient public transportation systems is another area for public policy to reduce the negative aspects women face in the labor market.

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Appendix:

A.1. Estimated gender commuting time differentials

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | Home-owners only | |
| | | | | | | | | | | (10) | (11) |
	No controls	Socio-economic controls	All controls	Relative income	Same sector	Service sector only	Non-poor	Complete infrastructure	30-45 years old	Baseline	<3 years in job
Woman	-0.1654**	-0.1149**	-0.1137**	-0.0680**	-0.0958**	-0.0544*	-0.1118**	-0.1121**	-0.1142**	-0.1238**	-0.0871**
	-0.0086	-0.0118	-0.012	-0.0152	-0.0165	-0.0215	-0.014	-0.0137	-0.0184	-0.0138	-0.0222
$\mu 1$	-1.1622**	0.2734*	0.3140*	0.126	0.0806	-0.5678*	0.0122	0.2101	-0.3953	0.2297	0.1647
	-0.0439	-0.1272	-0.1291	-0.1868	-0.209	-0.2535	-0.1532	-0.2256	-0.6463	-0.1527	-0.2375
$\mu 2$	0.1487**	1.8245**	1.8675**	1.6667**	1.6486**	0.9680**	1.5731**	1.7145**	11.554	1.7745**	1.7864**
	-0.0436	-0.1278	-0.1296	-0.1872	-0.2094	-0.2536	-0.154	-0.226	-0.6468	-0.1533	-0.2379
$\mu 3$	1.0494**	2.8065**	2.8521**	2.6687**	2.6338**	1.9694**	2.5655**	2.6944**	2.1619**	2.7694**	2.7903**
	-0.044	-0.128	-0.1298	-0.187	-0.2097	-0.2539	-0.1541	-0.2261	-0.6467	-0.1533	-0.2381
# Obs.	69,668	69,668	69,668	42,861	29,272	17	50,198	49,444	27,872	51	22,386
Controls	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Source: Prepared by the authors. Significance level: ** $p<0.01$, * $p<0.05$.
Note: The marginal effects represent the average of the marginal effects of the observations.

A.2. Domestic chores and commuting time

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10) home-owners only	(11)
										All couples	<3 years in job
Woman	-0.0196	-0.0154	0.0013	-0.0884**	-0.0685**	-0.0454**	-0.0884**	-0.0685**	-0.0454**	-0.0067	0.0369
	-0.0155	-0.0155	-0.0155	-0.012	-0.0134	-0.0134	-0.012	-0.0134	-0.0134	-0.0181	-0.0302
ShChores	-0.1779**	-0.1295**	-0.1174**							-0.1170**	-0.1384**
	-0.0021	-0.0237	-0.0239							-0.0279	-0.0441
TimeChores		-0.0023**	-0.0023**		-0.0035**	-0.0034**		-0.0035**	-0.0034**	-0.0023**	-0.0012
		-0.0006	-0.0006		-0.0005	-0.0005		-0.0005	-0.0005	-0.0007	-0.0009
ShIncome			0.2779**	0.3081**		0.2967**	0.3081**		0.2967**	0.2963**	0.4089**
			-0.0509	-0.0508		-0.0507	-0.0508		-0.0507	-0.0568	-0.0926
μ1	0.2369	0.2137	0.0762	0.156	0.2473	0.0971	0.156	0.2473	0.0971	-0.0098	-0.0904
	-0.1291	-0.1292	-0.1343	-0.1342	-0.1293	-0.1343	-0.1342	-0.1293	-0.1343	-0.1572	-0.2401
μ2	1.7917**	1.7692**	1.6321**	1.7101**	1.8022**	1.6526**	1.7101**	1.8022**	1.6526**	1.5373**	1.5341**
	-0.1297	-0.1298	-0.1348	-0.1347	-0.1298	-0.1348	-0.1347	-0.1298	-0.1348	-0.1577	-0.2402
μ3	2.7767**	2.7541**	2.6176**	2.6953**	2.7869**	2.6378**	2.6953**	2.7869**	2.6378**	2.5333**	2.5396**
	-0.1299	-0.1299	-0.1349	-0.1349	-0.13	-0.1349	-0.1349	-0.13	-0.1349	-0.1577	-0.2402
# Obs	69,668	69,668	69,668	69,668	69,668	69,668	69,668	69,668	69,668	51	22,386
Controls	Yes	Yes	Yes	Yes	Yes	Yes	*	*	*	Yes	Yes
Regional FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Source: Prepared by the authors. Robust standard errors in parentheses. Significance levels: ** $p<0.01$, * $p<0.05$.

A.3. HRH and commuting time – Different controls and samples

	(1) Relative income	(2) Same sector	(3) Service sector only	(4) Non-poor	(5) Complete infrastructure	(6) 30 – 45 years of age
Woman	0.0286	-0.0117	0.0167	-0.0045	-0.0021	0.0047
	0.0192	0.0215	0.0279	0.0177	0.0177	0.0247
ShChor	-0.1162**	-0.0934**	-0.0946**	-0.1116**	-0.0935**	-0.1232**
	0.0296	0.0347	0.0449	0.0276	0.0271	0.0368
TimeChores	-0.0018*	-0.0015	-0.0006	-0.0019**	-0.0027**	-0.0022*
	0.0007	0.0009	0.0011	0.0007	0.0007	0.0009
ShareIncome	0.2071**	0.2441**	0.2567**	0.3459**	0.3149**	0.3448**
	0.0647	0.0786	0.0933	0.0575	0.0576	0.0849
$\mu 1$	-0.0585	-0.1153	-0.7754**	-0.3101	-0.0386	-0.6354
	0.1911	0.2195	0.2668	0.1609	0.2298	0.6480
$\mu 2$	1.4839**	1.4542**	0.7615**	1.2529*	1.4682*	0.9184
	0.1913	0.2197	0.2668	0.1615	0.2302	0.6483
$\mu 3$	2.4865**	2.4399**	1.7636**	2.2465*	2.4491*	1.9259**
	0.1911	0.2199	0.2670	0.1616	0.2302	0.6482
# Obs.	42,861	29,272	17	50,198	49,444	27,872
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Regional FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Source: Prepared by the authors. Robust standard errors in parentheses. Significance levels: ** p<0.01, * p<0.05.

A.4. HRH and commuting time – Different controls and samples

	(1) Relative income	(2) Same sector	(3) Service sector only	(4) Non-poor	(5) Complete Infrast.	(6) Age 30–45	(7) No children	(8) With children	(9) 25% Poorest	(10) 25% Richest
Woman	0.0286	-0.0117	0.0167	-0.0045	-0.0021	0.0047	0.0054	-0.0037	0.0016	-0.0479
	0.0192	0.0215	0.0279	0.0177	0.0177	0.0247	0.0280	0.0185	0.0317	0.0283
ShChor	-0.1162**	-0.0934**	-0.0946**	-0.1116**	-0.0935**	-0.1232**	-0.1111*	-0.1186**	-0.1398**	-0.0801
	0.0296	0.0347	0.0449	0.0276	0.0271	0.0368	0.0471	0.0274	0.0462	0.0472
TimeChores	-0.0018*	-0.0015	-0.0006	-0.0019**	-0.0027**	-0.0022*	-0.0005	-0.0027**	-0.0028**	-0.0031*
	0.0007	0.0009	0.0011	0.0007	0.0007	0.0009	0.0013	0.0007	0.0010	0.0013
ShareIncome	0.2071**	0.2441**	0.2567**	0.3459**	0.3149**	0.3448**	0.2288*	0.2919**	0.1713	0.2788**
	0.0647	0.0786	0.0933	0.0575	0.0576	0.0849	0.1016	0.0601	0.1231	0.0823
$\mu 1$	-0.0585	-0.1153	-0.7754**	-0.3101	-0.0386	-0.6354	-0.2442	0.2292	0.8901**	-0.9719**
	0.1911	0.2195	0.2668	0.1609	0.2298	0.6480	0.2577	0.1637	0.3012	0.3129
$\mu 2$	1.4839**	1.4542**	0.7615**	1.2529*	1.4682*	0.9184	1.3429**	1.7812**	2.4566**	0.6322*
	0.1913	0.2197	0.2668	0.1615	0.2302	0.6483	0.2586	0.1643	0.3031	0.3128
$\mu 3$	2.4865**	2.4399**	1.7636**	2.2465*	2.4491*	1.9259**	2.3528**	2.7622**	3.4346**	1.6460**
	0.1911	0.2199	0.2670	0.1616	0.2302	0.6482	0.2592	0.1644	0.3033	0.3132
# Obs.	42,861	29,272	17	50,198	49,444	27,872	18,12	51,548	19,47	15,796
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Source: Prepared by the authors. Significance levels: ** $p<0.01$, * $p<0.05$.

A.5. Simultaneous equations estimation

	All couples		Home-owners only	
	Woman	Man	Woman	Man
ShChor	-0.0829*	-0.1251**	-0.0913*	-0.0976
	-0.036	-0.0453	-0.042	-0.0524
TimeChor	-0.0028**	0.0002	-0.0030**	0.0002
	-0.0006	-0.0012	-0.0007	-0.0013
ShInc	0.4538**	0.2055**	0.4436**	0.2513**
	-0.0798	-0.0679	-0.0918	-0.0766
$\mu 1$	0.3296	-0.6139**	0.2233	-0.6954**
	-0.1765	-0.1884	-0.2075	-0.2195
$\mu 2$	1.9279**	0.9561**	1.7960**	0.8814**
	-0.1768	-0.1885	-0.2078	-0.2195
$\mu 3$	2.8889**	1.9755**	2.7656**	1.9140**
	-0.1722	-0.1886	-0.2085	-0.2196
atanhrho	0.3037**		0.3065**	
	-0.0094		-0.0109	
# Obs.	34,834	34,834	25,5	25,5
Controls	Yes	Yes	Yes	Yes
Regional FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Source: Prepared by the authors. Significance levels: ** $p<0.01$, * $p<0.05$.

A.6. Decriptive statistics

	Full Sample		Men		Women	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Age (years)	39.52	9.97	40.84	10.07	38.20	9.70
Head (%)	0.50	0.50	0.76	0.43	0.24	0.43
White (%)	0.50	0.50	0.48	0.50	0.52	0.50
Migrant (%)	0.53	0.50	0.54	0.50	0.52	0.50
Hours worked	41.65	10.19	43.74	9.18	39.55	10.70
Schooling						
Up to 8 years (%)	0.17	0.38	0.18	0.38	0.17	0.37
8 – 14 years (%)	0.42	0.49	0.40	0.49	0.43	0.50
College and more (%)	0.18	0.38	0.16	0.37	0.19	0.40
Working condition						
Informal (%)	0.14	0.35	0.09	0.28	0.20	0.40
Self-employed (%)	0.24	0.43	0.27	0.45	0.22	0.41
Daily (%)	0.95	0.21	0.93	0.26	0.97	0.16
Sector						
Commerce (%)	0.27	0.45	0.27	0.45	0.27	0.45
Services (%)	0.47	0.50	0.36	0.48	0.58	0.49
Construction (%)	0.09	0.29	0.17	0.38	0.01	0.10
Labor Income						
Ln(Income)	7.37	0.83	7.58	0.78	7.16	0.82
PC HHold Income						
1 - 2 MW (%)	0.39	0.49				
2 - 3 MW (%)	0.13	0.33				
3 - 5 MW (%)	0.09	0.28				
5+ MW (%)	0.09	0.29				
HHold members						
Children age(0-4)	0.21	0.45				
Children age (5-13)	0.49	0.71				
Children age (14+)	0.57	0.84				
Siblings (%)	0.12	0.33				
Household						
# Bedrooms	1.90	0.74				
# Bathrooms	1.43	0.82				
House (%)	0.78	0.41				
Means of transportation						
Car (%)	0.59	0.49				
Motorbike (%)	0.13	0.33				

Source: Own elaboration, from PNAD 2011-2015, for 9 Metro Areas in Brazil.

A.7. Variables description

	Time spent in commuting to work
Comm	1 – Works a home 2 – Up to 30 minutes 3 – 30 minutes to 1 hour 4 – more than 1 hour
Woman	1 if woman; 0 otherwise
ShChor	Share in the couple´s number of weekly hours devoted to household chores
TimeChor	Number of weekly hours devoted to household chores by individual i
ShInc	Share of individual i on the couple´s income
Age	Age, in years
Head	1 if household head; 0 otherwise
White	1 if Caucasian; 0 0 otherwise
Migrant	1 if not born in the municipality; 0 otherwise
Education	Schooling cycle dummies: Illiterate=1; 0 otherwise (reference). Complete basic=1; 0 otherwise Incomplete high-school=1; 0 otherwise Complete high-school=1; 0 otherwise College and more=1; 0 otherwise
Paid work	Weekly number of hours in paid work
Type of work	Type of work dummies: Employee with labor card=1 (formal); 0 otherwise (reference) Employee in the informal sector=1; 0 otherwise Entrepreneur or self-employed=1; 0 otherwise
Sector	Sector dummies: Manufacturing=1; 0 otherwise (reference). Commerce=1; 0 otherwise Services=1; 0 otherwise Construction=1; 0 otherwise
Log Income	Natural logarithm of income on the main job, properly deflated
Per capita income	Household per capita income brackets (in minimum wages – MW) <1 MW; 0 otherwise (reference). 1 to 2; 0 otherwise 2 to 3; 0 otherwise 3 to 5; 0 otherwise 5 and more; 0 otherwise
# children 1	Number of children younger than 5 years old
# children 2	Number of children de 5 - 13
# children 3	Number of children 13 and
Siblings	1 if other siblings live in the household; 0 otherwise
Home	1 for a house; 0 otherwise
# Bedrooms	
# Bathrooms	
Car	1 if couple owns a car; 0 otherwise
Motor bike	1 couple owns a motor bike; 0 otherwise
Daily	1 if paid work occurs between 5 a.m. and 10 p.m.; 0 otherwise

Source: Prepared by the authors.

A.8. Pearson correlation matrix

	Woman	ShChor	ShInc	TimeChor
Woman	1			
ShChor	**0.7734**	1		
ShInc	-0.5467	-0.4918	1	
TimeChor	0.5408	0.6553	-0.3637	1

Source: Prepared by the authors.