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Commuting Time and Household Responsibilities: Evidence Using Propensity Score Matching

J. Ignacio Gimenez-Nadal
Jose Alberto Molina

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J. Ignacio Gimenez-Nadal
University of Zaragoza
and CTUR

Jose Alberto Molina
University of Zaragoza
and IZA

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IZA

P.O. Box 7240
53072 Bonn
Germany

Phone: +49-228-3894-0
Fax: +49-228-3894-180
E-mail: iza@iza.org

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ABSTRACT

Commuting Time and Household Responsibilities: Evidence Using Propensity Score Matching*

The growth in women's participation in the labor force has attracted attention to the gender differences in commuting behavior, and to their implications. This study analyses the relationship between individual commuting behavior and household responsibilities, with a focus on gender differences in that relationship. Using the Dutch Time Use Surveys for the years 2000 and 2005, we analyze the relationship between commuting time, and the time devoted to home production and childcare. To deal with reverse causality, we use Propenstity Score Matching techniques to obtain imputed data for individuals. After reverse causality is taken into account, we find that the effect of home production on commuting time for women is more than double the effect for men, while childcare time has an effect on women's commuting time behavior only. Our results explain why prior studies have found that women have shorter commutes than men, shedding light on the Household Responsibility Hypothesis (HRH).

JEL Classification: D13, J16, J22

Keywords: commuting, home production, childcare, propensity score matching, Multinational Time Use Study

Corresponding author:

Jose Alberto Molina
Department of Economic Analysis
Faculty of Economics
University of Zaragoza
Gran Vía 2
50005 Zaragoza
Spain
E-mail: jamolina@unizar.es

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1. Introduction

In this paper, we analyze the relationship between commuting time and the time devoted to both home production and childcare, with a focus on gender differences. We use the Dutch Time Use Surveys for the years 2000 and 2005, which allow us to analyze the time devoted to commuting, home production, and childcare during the day, and with information for seven days of the week for each individual. Furthermore, to deal with reverse causality, we use Propensity Score Matching techniques to obtain imputed data for individuals. The fact that individuals report their daily activities, in their own words, makes these surveys extremely helpful, as has been shown in Gimenez-Nadal and Molina (2014), given that individual perceptions determine whether the activity is considered as commuting, or not.

Recent studies have shown that most household responsibilities (e.g., time devoted to home production and childcare) continue to be carried out by women (Aguiar and Hurst, 2007; Gimenez-Nadal and Sevilla, 2012), and evidence from time use surveys in developed countries shows that there is still a gender gap in commuting time favouring men, and that this difference has remained relatively constant over time. More specifically, Figure 1 shows the average time devoted to commuting by men and women in the Netherlands, the United Kingdom, and the United States in recent decades, obtained from an analysis of the Multinational Time Use Study. We observe that the average commuting time of women is well below that of men, and that such gender differences in commuting time have remained relatively constant in the 3 countries, and have even increased in the UK.

Prior literature on the effect of gender on commute duration is not conclusive. Some studies have shown that commuting differences by gender changed little, historically, with women's trip lengths remaining substantially below those of men (see, among others, Kain, 1962; Rosenbloom, 1978; Giuliano, 1979; Wachs, 1987, 1991). Crane (2007) shows that, in the US, after controlling for other sources of difference, such as demographics and community features, the average woman's trip to work differs markedly from the average man's.[1] Iwata and Tamada (2008) show that time spent by Japanese married women in commuting follows a backward-bending pattern. Sandow and Westin (2010) find that Swedish women have a shorter commute than men

[1] Other recent studies about gender differences in commute time are Blumen (1994), Lee and McDonald (2003), and Mok (2007).

regardless of employment sector, education level, and family situation, indicating that the gender role and the daily time constraints of women impose stricter limitations on women's geographical labor mobility. But other studies have challenged the idea that transportation needs of women are different with respect to those of men. Doyle and Taylor (2000) argue that commute times converged for gender, among other variables, as early as the mid-1990s. Gossen and Purvis (2005) report that San Francisco journey-to-work times in 2000 were the same for women and men in all age groups, except for those in their 50s, and Vandersminssen, Thériault and Villenueve (2006) show that commute distances in the Quebec Metropolitan Area also converged when controlling for type of household or for the presence of children.

The debate about gender differences in commuting behaviour is reflected in theories about women's commuting trips. Rational utility theorists argue that women's lesser attachment to the labour force is behind women's shorter commute times, with these gender differences tending to diminish in the near future. Others contend that women's shorter commutes are an outcome of the constraints society puts on women at home and at work, with these being divided into those who attribute the source of the difference to the problem of gender discrimination in the labour market, and those who attribute it to women's household responsibilities, thus hypothesizing that the disproportionate burden of household responsibility on women requires short commute times and makes it difficult for them to work away from home (this has come to be known as the Household Responsibility Hypothesis, HRH).

Considering the HRH issue, Turner and Neimeier (1997) review prior evidence regarding the relationship between commuting and household responsibility, and find that the research evaluating the degree to which this gender differential in commuting can be explained by the division of labour in the household has produced mixed results, despite that the authors find evidence in favour of the HRH. Against this background, this paper focuses on testing the HRH, and offers new empirical findings. To that end, we use the sample of working individuals from the Dutch Time Use Surveys (DTUS) of 2000 and 2005 to empirically address the relationship between commuting time and the time devoted to both home production and childcare activities. One substantial advantage of the DTUS over other time use surveys, such as the American, the Australian, and the British, is that there is time use information for 7 consecutive days for each individual, allowing us to take into account potential variations of commuting

times across days. In our empirical analysis, we take into account that the time devoted to commuting, home production, and childcare are choices workers make, and we thus propose the use of a matching strategy (Propensity Score Matching) to deal with potential reverse causality between commuting time and household responsibilities.

Our results show that, after reverse causality is taken into account, the effect of home production on commuting time for women is more than double the effect for men, while childcare time affects only women's commuting time. As the negative relationship between commuting time and time devoted to home production is greater for women, we interpret this result as evidence that such responsibilities impose more restrictions on commuting time for women, compared to men, which explains why women have shorter commutes. Moreover, the fact that childcare is negatively associated with women's commuting time also helps to explain why women have shorter commutes than men.

Our contribution to the literature is threefold. First, as argued by Crane (2007), understanding the effect of women's roles on their commute lengths may help predict future housing and work-place location preferences, depending on their household responsibilities and lifestyles, and it can also help predict future location decisions of employers who want to employ women, who may or may not be spatially restricted. Our study proves relevant for this issue. Second, it may be relevant for future transportation planning, regarding the varied demands of transportation modes for women and men. For instance, it could be that, due to their household responsibilities, women may be more likely than men to use public transport (Schulz and Gilbert, 1996; Doyle and Taylor, 2000; Hamilton and Jenkins, 2000; Hoedemaeker et al., 2012; Sánchez de Madariaga, 2013). Third, we introduce time use surveys as an alternative data source to analyze individual commuting behaviour. As has been shown in Gimenez-Nadal and Molina (2014), the use of this type of survey together, with the Propensity Score Matching method, are helpful in analyzing the relationships between labour market hours, commuting time, and other uses of time.

The rest of the paper is organized as follows. Section 2 reviews the factors that have been identified as being related to the commuting behaviour of individuals. Section 3 describes the data. Section 4 describes the empirical strategy, Section 5 describes our results, and Section 6 sets out our main conclusions.

2. Factors related to commuting behavior

Prior research has identified numerous potential influences on commuting habits, and they can basically be grouped in 3 categories: microeconomic, land use/geographical, and macroeconomic factors. The microeconomic and land use/geographical variables are the most common analyzed characteristics, while the analysis of macro variables, such as the use of Gross Domestic Product (GDP) or (lagged) changes in GDP to make predictions, or as a control variable, is quite limited in the literature (Dargay and Gately, 1999; Johansson et al., 2002; Östh and Lindgren, 2012).

Regarding the microeconomic variables, characteristics such as gender, age, level of education, personal income, presence and number of children, home ownership, or car availability/ownership, have all been considered as influencing the commuting behavior of individuals. The factors that may have a positive relationship with commuting are personal income (Benito and Oswald, 2000; Pucher and Renne, 2003; Rouwendal and Nijkamp, 2004; Schwanen et al., 2004; Dargay and Van Ommeren, 2005; Simonsohn, 2006; Susilo and Maat, 2007; Sandow, 2008; Sandow and Westin, 2010; Dargay and Clark, 2012; Gutiérrez-i-Puigarnau and Van Ommeren, 2012; Östh and Lindgren, 2012), education (Benito and Oswald, 2000; Susilo and Maat, 2007; Sandow, 2008; Östh and Lindgren, 2012), and home ownership (Deding et al., 2008; Groot et al., 2012) and car ownership (Pucher and Renne, 2003; Schwanen et al., 2004; Dargay and Clark, 2012). Microeconomic factors that have been found to have a negative relationship with commuting are gender (Hanson and Hanson, 1993; Turner and Niemeier; 1997; Kwan; 1999; Hjorthol; 2000; Simonsohn, 2006; Sandow, 2008; Sandow and Westin, 2010; Dargay and Clark, 2012; Groot et al., 2012; Gutiérrez-i-Puigarnau and Van Ommeren, 2012), age (Susilo and Maat, 2007; Sandow and Westin, 2010; Van Acker and Witlox, 2011; Dargay and Clark, 2012; Östh and Lindgren, 2012) and children (Simonsohn, 2006; Sandow, 2008; Gutiérrez-i-Puigarnau and Van Ommeren, 2012). Other factors that have been included in the analysis of commuting behavior are the full-/part-time status of workers (Benito and Oswald, 2000; Van Acker and Wiltox, 2011; Groot et al., 2012), partner's commute (Sandow and Westin, 2008), and country of origin (Östh and Lindgren, 2012).

For the land use/geographical variables, other studies have found a negative relationship between commuting and population/residential density (Rouwendal and Nijkamp, 2004; Schwanen et al., 2004; Susilo and Maat, 2007; Sandow, 2008; Dargay

and Clark, 2012) and job density (Johansson et al., 2002; Rouwendal and Nijkamp, 2004). Factors that may condition the commuting behavior of individuals are the urban/rural residence (Schwanen et al. 2004; Susilo and Maat, 2007; Östh and Lindgren, 2012), residential region (Pucher and Renne; 2003; Sandow and Westin, 2010), housing price (Rouwendal and Nijkamp, 2004), and intensity of land use (Rouwendal and Nijkamp, 2004; Van Acker and Wiltox, 2011), among others.[2]

Several explanations can be used to address the gender differences in commuting behavior. First, it could be that differences in the socio-demographic characteristics of men and women explain the gender gap in commuting distance and time, as higher income and education are positively related with commuting distance. However, and despite that the gender difference in commuting decreases when one controls for income and occupation (Singell and Lillydahl, 1986; Gordon et al., 1989; Hanson and Johnston, 1995; Sandow and Westin, 2010), the difference does not disappear. A second factor is geographical, as there are gender-segregated labour markets in which women are concentrated in female-dominated occupations. To the extent that these female-dominated occupations are more evenly distributed, compared to male-dominated occupations, women have greater possibilities to find a job closer to home, with a shorter commute (Hanson and Johnston, 1985; Hanson and Pratt, 1995). The third and main hypothesis of this paper is related to social roles: social roles for men and women are different, and women must adapt their commuting patterns to their chores at home, accepting jobs closer to home (Turner and Niemeir, 1997; Sandow and Westin, 2010). In an analysis using German data, Gutiérrez-i-Puigarnau and Van Ommeren (2010) find that the effect of commuting distance on labour supply patterns is (much) stronger for female workers, which may indicate that female workers are more restricted in their commuting behaviour, consistent with differential social roles. Similarly, Compton and Pollak (2014) find that the predicted probability of employment and labour force participation is higher for married women with young children, living in close proximity to their mothers or their mothers-in-law, compared with those living further away. This is consistent with the Household Responsibility Hypothesis, which posits that women must adapt their employment patterns to their chores at home.

[2] Despite the fact that household location choice models with commuting distance have been developed (e.g., DeSalvo (1985); DeSalvo and Huq, 2005; Ng, 2005; Deding, Filges and Van Ommeren, 2009), we consider the location choice as fixed.

3. Data: The Dutch Time Use Surveys, 2000 and 2005

The data used for the empirical analysis is drawn from the versions of the Dutch Time Use Survey 2000 and 2005 included in the Multinational Time Use Study (MTUS). The DTUS contains information on daily activities, gathered by means of the completion of a personal diary, and household and individual questionnaires. Both surveys were conducted in October of the reference year, and one member of the household, aged 12 or older, was selected to report information on daily activities during 7 consecutive days. The diary time frame is twenty-four consecutive hours (from 12:00 a.m. until 12:00 a.m. the following day) and is divided into fifteen-minute intervals.

The MTUS is an ex-post harmonized cross-time, cross-national, comparative time use database, coordinated by the Centre for Time Use Research at the University of Oxford. It is constructed from national randomly-sampled time-diary studies, with common series of background variables, and total time spent in 41 activities (Gershuny, 2009). The MTUS provides us with information on individual time use, based on diary questionnaires in which individuals report their activities throughout the 24 hours of the day. The advantage of time-use surveys over stylized-questions, such as those included in the data bases ECHP, the BHPS, and the SOEP (where respondents are asked how much time they have spent, for example, in the previous week, or normally spend each week, on market work or home production) is that diary-based estimates of time use are more reliable and accurate than estimates derived from direct questions (Juster and Stafford, 1985; Robinson, 1985; Bianchi et al., 2000; Bonke, 2005; Yee-Kan, 2008).

In the labour supply literature, Klevmarken (2005) argues that information on actual hours of work from time-use surveys is more relevant than the normal hours or contracted hours generally reported in stylized questions. This author shows that time-use data yields much smaller estimates of wage-rate effects compared to measures of normal hours of work, which may have important implications for tax policy design, among other things. Thus, in the same way that money-expenditure diaries have become the gold standard in the consumption literature, so have time-use diaries become the preferred method of gathering information on time spent on market work, non-market work, and leisure. Most studies documenting how individuals use their time are now based on these data sets, including recent studies of the analysis of trends in time use

(Aguiar and Hurst, 2007; Guryan, Hurst and Kearney, 2008; Gimenez-Nadal and Sevilla, 2012; Sevilla et al., 2012).[3]

For the sake of comparison with prior studies (Aguiar and Hurst, 2007; Gimenez-Nadal and Sevilla, 2012), we restrict our sample to full-/part-time workers between the ages of 21 and 65 (inclusive). Our results can thus be interpreted as being "per working adult", who are likely to commute in their working days. Additionally, given that households have typically been defined as those formed by a couple and their children (Connelly and Kimmel, 2009; Gimenez-Nadal and Molina, 2013), we also restrict the sample to individuals who are the head of the household or the spouse/partner of the couple (e.g. we only analyze individuals living in couples). Finally, for the analysis of the relationship between childcare responsibilities and commuting, we additionally restrict the sample to individuals living in couple with at least one child under 18 in the household. The existing literature (Kalenkoski, Ribar and Stratton, 2005; Guryan, Hurst and Kearney, 2008) shows that the time devoted to childcare activities by men and women depends on their family status, with single parents devoting less time to their children.

Our variables of interest refer to the daily time devoted to commuting, home production, and childcare. For the time devoted to *Commuting*, we use the information collected in the variable *main63* "travel to or from work" of the MTUS, measuring the time devoted to *Commuting* during the reference day. For the time devoted to *Home Production*, we use the information collected in the variables main18 "food preparation, cooking", main19 "set table, wash/put away dishes", main20 "cleaning", main21 "laundry, ironing, clothing repair", main22 "home/vehicle maintenance/improvement", main23 "other domestic work", main24 "purchase goods", main26 "consume other services", main27 "pet care (other than walk dog)", main32 "adult care", main66 "child/adult care-related travel", and main67 "travel for shopping, personal or household care", and we sum the time devoted to all these activities. For the time devoted to *Childcare*, we use the information collected in the variables main28 "physical, medical childcare", main29 "teach, help with homework", main30 "read to, talk or play with child", and main31 "supervise, accompany, other childcare", and we

[3] The MTUS has been widely used across the social sciences (Gershuny, 2000; Gershuny and Sullivan, 2003; Gauthier et al., 2004; Guryan, Hurst and Kearney, 2008; Gershuny, 2009, Gimenez-Nadal and Sevilla, 2011;2012; Gimenez-Nadal and Molina, 2013).

sum the time devoted to all these activities. Thus, we have information for *Commuting*, *Home Production* and *Childcare* at the individual level for the seven days of the week.

Empirical evidence

Table 1 shows the overall time devoted to *Commuting*, *Home Production*, and *Childcare* for all the working individuals in our sample, by gender. We observe that men devote 0.90, 1.18 and 0.53 hours per day to *Commuting*, *Home Production* and *Childcare*, while women devote 0.62, 2.65 and 1.06 hours per day to those activities, respectively.[4] We find a gender difference in the time devoted to *Commuting* that is statistically significant at standard levels, with male workers devoting more time to this activity (0.28 more hours per day) compared to their female counterparts, consistent with the existing literature showing that men have longer commutes than women (Pazy et al., 1996; Turner and Neimeier, 1997; Plaut, 2006).[5] We also find a gender gap favouring females in *Home Production* and *Childcare*, with women devoting 1.47 and 0.53 more hours per day, respectively, to these activities compared to their male counterparts, with such differences being statistically significant at standard levels. Thus, we find that working females, compared to their male counterparts, devote less time to *Commuting* and more time to *Home Production* and *Childcare*, which is consistent with the HRH framework, within which women have shorter commutes because they have more household responsibilities. Additionally, these differences in the time devoted to the three activities are also reflected in terms of participation in the activity, as the percentage of males doing *Commuting* on any day is larger compared to females, while the opposite holds for *Home Production* and *Childcare*. In this sense, males are 5.67 percentage points more likely to do *Commuting* during the day of the diary, while they are also 17.34 and 16.29 percentage points less likely to do *Home Production* and *Childcare*, respectively. These differences indicate that men not only devote more time to *Commuting*, but are also more likely to commute, and the opposite holds for *Home Production* and *Childcare*.

[4] We have used all the individuals in our sample to compute the average time in *Commuting* and *Home Production*. In the case of *Childcare* time, we use individuals with at least one child under 18 in the household.

[5] *Diff. Men-Women* measures the difference in the overall value of the variable for men and women, *p-value diff* shows the p-value of a t-type test of equality of *means*. A *p-value* lower than 0.05 indicates that the difference between the mean values is statistically significant at standard levels.

Figure 2 shows kernel-density distributions for the time devoted to *Commuting*, *Home Production*, and *Childcare* for both men and women.[6] We observe that the time devoted to *Commuting* is concentrated between 0 and 2 hours per day for both men and women, and that the variation of *Commuting* for women is smaller than the variation for men, as the variance coefficient yield values of 0.70 and 0.32 for men and women, respectively. Considering the time devoted to *Home Production* by men and women, we observe that it is concentrated in less than 4 hours per day for males, and 6 hours per day for females, yielding variance coefficients of 4.42 and 5.87 for men and women, respectively, showing that there is more daily variation in *Home Production* time for females than for males. For the time devoted to *Childcare* by men and women who have at least one child under 18, we observe that it is concentrated in less than 2 hours per day, and there is more daily variation in the time devoted to this activity for women, as variance coefficients for men and women are 0.75 and 2.04, respectively. We also note that the time devoted to these three activities does not follow a normal distribution, as the values of skewness and kurtosis are different for reference values of 0 and 3, respectively.

Figure 3 plots the mean time devoted to *Commuting*, on the one hand, and the time devoted to *Home Production* and *Childcare*, on the other, at the individual level, for both men and women, on working days. Specifically, for a given individual and for the days that the individual reported positive time in market work (days when individuals devote at least 1 hour to market work, excluding commuting), we compute the average time devoted to these activities, obtaining one value for *Commuting*, *Home Production*, and *Childcare* for the reference individual. We then plot (scatterplot) the mean time devoted to *Commuting* (y-axis) on the time devoted to *Home Production* or *Childcare* (x-axis) for all individuals. In the case of men, we observe that, in the range between 0 and 2 hours of *Commuting*, where most observations are concentrated, the variation is rather small. In the case of women, we observe a larger variation in the distribution, as the points are more evenly distributed over the different times devoted to *Home Production* and *Childcare*. Thus, it seems that there is a larger variation for women in the relationship between *Commuting*, and *Home Production* and *Childcare*.

[6] The analysis is restricted to working days, defined as days where respondents devote 60 or more minutes to market work activities, excluding commuting, where market work is defined as the sum of the time devoted to the categories main7 "paid work, main job (not at home)", main8 "paid work at home", main9 "second or other job not at home", main11 "travel as a part of work" and main12 "other time at workplace".

Figure 4 plots the average time devoted to *Commuting* for each time devoted to *Home Production* and *Childcare*; that is, for all the diaries with the same amount of time devoted to *Home Production*, we average the time devoted to *Commuting* by gender. The same applies to *Childcare* time. We plot mean *Commuting* time (y-axis) on the time devoted to *Home Production* or *Childcare* (x-axis). We have also added a linear prediction of *Commuting* time on *Home Production* or *Childcare*, including confidence intervals at the 95 per cent level. As can be seen, the linear predictions are a good fit for both men and women, as many values of *Commuting* are in the confidence intervals of the linear prediction. Additionally, the linear prediction yields a negative slope for the relationship between *Commuting*, and *Home Production* and *Childcare*, indicating that there is a negative raw correlation between *Commuting* and the other two non-market work activities. Raw partial correlations show that the correlation between *Commuting* and *Home Production* is -0.30 and -0.32 for men and women, while the correlation between *Commuting* and *Childcare* is -0.10 and -0.13 for men and women, respectively.

4. Empirical Strategy

We estimate Tobit (Tobin, 1958) models on the time devoted to *Commuting*, by gender. Foster and Kalenkoski (2013) compare the use of Tobit and OLS models in the analysis of the time devoted to childcare activities, finding that the qualitative conclusions are similar for the two estimation methods. We have also estimated OLS models, and results (available upon request) are qualitatively the same.

The statistical model is as follows. For a given individual 'i', let C_{ij} represent the daily hours individual "i" on day "j" devotes to commuting, let $Home\_Production_{ij}/Childcare_{ij}$ be the time devoted to home production/childcare by individual "i" in day "j", let X_i be a vector of socio-demographic and regional characteristics, and let ε_{ij} be random variables that represent unmeasured factors. We suppose that there is a latent variable (C^*_{ij}) that linearly depends on X_i via the parameters β and (vector) γ that determines the relationship between $Home\_Production_{ij}/Childcare_{ij}$ and the independent vector X_i, on the one hand, and C^*_{ij}, on the other. The observable variable (C_{ij}) is defined as being equal to the latent variable whenever the latent variable is above zero, and '0' otherwise. We estimate the following equations:

$$C_{ij} = \begin{cases} C^*_{ij} \text{ if } C^*_{ij} > 0 \\ 0 \text{ if } C^*_{ij} \leq 0 \end{cases} \text{ where } C^*_{ij} = \alpha + \beta_1 \text{Home\_Production}_{ij} + \gamma X_i + \varepsilon_{ij} \quad (1)$$

$$C_{ij} = \begin{cases} C^*_{ij} \text{ if } C^*_{ij} > 0 \\ 0 \text{ if } C^*_{ij} \leq 0 \end{cases} \text{ where } C^*_{ij} = \alpha + \beta_2 \text{Child\_Care}_{ij} + \gamma X_i + \varepsilon_{ij} \quad (2)$$

where $Commuting_{ij}$ represents the time devoted to *Commuting* by individual "i" on day "j" (j=1,3...7), and $Home\_Production_{ij}$ and $Child\_care_{ij}$ is the time devoted to *Home Production and Childcare* by individual "i" on day "j". Where the raw data shows a negative relationship between *Commuting*, and *Home Production* and *Childcare* (see Figure 4), we would expect to find that $\beta_1 < 0$ and $\beta_2 < 0$. Given prior research showing that the factors affecting time-allocation decisions of men and women are different (Gimenez-Nadal and Sevilla, 2011;2012; Gimenez-Nadal and Molina, 2013), we run each model separately by gender. As the distributions of *Commuting*, *Home Production* and *Childcare* do not follow a normal distribution, we have corrected the standard errors, and we have additionally clustered the observations at the individual level in order to account for the unobserved heterogeneity of individuals.

The vector X_i includes socio-demographic and regional characteristics, according to the factors reviewed in Section 2.[7] We include age and its square, university education, secondary education, working full-time (as opposed to part-time), whether the partner is employed (a proxy for the commuting probability of the partner), the number of children under 18 in the household, whether the youngest child in the household is under 5, between 5-12, or between 13-17, if there is at least one motorized vehicle at home (as an indicator of car availability), and whether there is at least one computer at home, to control for the possibility that the respondent may be doing tele-work. We also include a vector of dummy variables to scale the day of the week (Ref.: Saturday), and we cluster observations by individuals to take into account potential variations of commuting times across days.

Existing research has shown a relationship between wages and individual commuting behaviour (Van Ommeren et al, 2000; Rupert et al., 2009), but unfortunately the DTUS does not include wages or earnings of individuals. However, to the extent that income and education have been found to have a positive relationship with commuting time, we use education and household income as proxies for earnings. This household income

[7] Table 1 shows summary statistics for all the socio-demographic and land use/geographical variables.

refers to monthly household income in €. Moreover, prior research has shown a relationship between occupation and commuting (Hanson and Johnston, 1985; Gordon et al., 1989; Hanson and Pratt, 1995), as female-dominated occupations are more evenly distributed compared to men, and thus women may choose jobs closer to home. One of the limitations of the DTUS is that it does not contain information on occupations, despite that we can control for whether the individual works in the public sector or not, since the category of female-dominated occupations includes jobs in the public sector (Sandow and Westin, 2010). Thus, we cannot identify the relationship between commuting time and non-market work (home production and childcare) net of individual heterogeneity in occupations. We expect that this heterogeneity in occupations may induce an upward bias in the relationship between gender, commuting, and non-market work, as one channel that may explain gender differentials in commuting behaviour is a gender-segregated labor market - despite the fact that Sandow and Westin (2010) find that women consistently have shorter commutes than men employed in the same sector.

Finally, we include a set of variables that may be considered relevant from the point of view of land use/geographical factors, and considering the aggregation level that we are able to obtain with the two datasets. The first refers to the urban/rural residence of individuals, as we do have information on whether individuals live in an urban or rural area. This variable is originally coded by the MTUS team and thus we cannot vary the definition of urban/rural residence. Additionally, there is information on the region of residence of the respondent, coded according to the 12 major regions in the Netherlands (Drenthe, Flevoland, Friesland, Gelderland en Zop, Groningen, Limburg, Noord Brabant, Noord Holland, Overijssel en Nop, Utrecht, Zeeland and South Holland) plus an additional variable including respondents in Amsterdam, Rotterdam and The Hague. With this information, we include dummy variables to control for the regional residence of respondents, with South Holland being the reference category. We have included the population density and housing prices defined for these regions. To compute the population density, we obtained figures from Eurostat for each of the 12 regions in both 2000 and 2005, and for the category with the 3 cities we have considered the population density for Amsterdam. In the case of housing prices, for each region, we have used the House Price Index of all dwellings with base 2005, obtained from the Statistics

Netherlands, and where for the category with the 3 cities we have considered the House Price Index in Amsterdam.

Propensity Score Matching

We must beware of endogeneity in our analysis, since commuting distance, commuting time, and non-market work activities could all be related to unobserved factors that influence the individual choices of where to live, where to work, and how to get from one to the other. Thus, to estimate the empirical relationship between commuting and non-market work hours, we must deal with potential endogeneity between commuting and the time devoted to home production or childcare. As a method to overcome this problem, we propose the use of Propensity Score Matching to impute the time devoted to *Home Production* and *Childcare*. Our strategy is based on Borra, Sevilla and Gershunny (2013), and applied in Gimenez-Nadal and Molina (2014) where the authors use a statistical matching method to combine data from two different datasets to obtain imputed values of a range of uses of time.

The PSM method was originally proposed by Rosenbaum and Rubin (1983) to evaluate employment and education programs (Lalonde, 1986; Fraker and Maynard, 1987; Dehejia and Wahba, 2002), and it is suitable when an experimental design is not feasible, or when the evaluation questions are broader than assessing the effect of an intervention on participants, and it allows us to match individuals in a treatment group to others who did not participate, but have comparable characteristics.

The innovation of PSM compared to other matching methods is that it develops a single (propensity) score that encapsulates multiple characteristics, rather than requiring a one-to-one match of each characteristic, simplifying matching by reducing dimensionality. The interest in PSM accelerated after Heckman et al. (1998a,b) assessed the validity of using propensity matching to characterize selection bias using experimental data. PSM employs a predicted probability of group membership (treatment vs. control group), based on observed predictors usually obtained from a logistic regression to create a counterfactual group.

One of the advantages of these matching methods over regression is that the variation in the imputed variable that occurs in the donor dataset is simulated as closely as possible, given that a unique donor value can be found for each recipient record

(Connelly and Kimmel, 2009). Another benefit is that it restricts inferences to samples for which there is overlap in covariate distributions across data sets (the common support region), thereby avoiding unwarranted model extrapolations (Dehejia and Wahba, 2002). A further advantage of matching over regression analysis is that it is non-parametric: matching does not impose functional form restrictions, such as linearity and homogeneous effects on the distribution of covariates, both assumptions being usually unjustified, either by the economic theory or by the data (Zhao, 2008). Moreover, matching does not require exclusion restrictions for the identification of the imputed variable when used in the combined dataset.

To implement propensity score matching, both datasets are combined and a dummy variable is constructed taking value 1 if the observation belongs to the recipient file DTUS 2005, and value 0 if the observation belongs to the donor file DTUS 2000. The propensity score is defined as the probability of belonging to the recipient database, conditional on the common observed covariates ($p(X_i)=Pr(i \in DTUS\ 2005 | X=x)$). Hence, we consider individuals included in the 2005 survey as if they are the treated group, and individuals included in the 2000 survey as if they are the untreated group. Thus, individuals from 2000 are used to impute the time devoted to non-market work (home production and childcare) by individuals in 2005, and individuals from 2005 are used to impute the time devoted to non-market work by individuals in 2000. This imputed non-market work time can still be used to examine the relationship between commuting time and non-market work hours, since the imputed variable preserves the variation of the original data. Additionally, given that the same factors may differentially affect the time devoted to both home-production and child-care, depending on the gender of the respondents, we apply this matching strategy by gender.

We first specify and estimate a binomial probit model of the probability of belonging to the 2005 sample; that is, we obtain the propensity score. Second, we impose the common support condition; that is, we restrict the 2000 sample to observations whose estimated propensity scores lie within the ranges of estimated propensity scores of the 2005 sample (we lose one male observation from the 2000 sample). Third, we pair each recipient unit with that donor for which the difference between the propensity score is lower in absolute values, and impute the time devoted to *Home Production* and *Childcare* for that individual. In this last step, we consider 2005 as recipients and 2000 as donors, and also 2000 as recipients and 2005 as donors, so that individuals in both

2000 and 2005 have imputed values of individuals from the other survey. During this matching process, each diary is considered as an independent observation, since for each individual we treat each of the 7 diary days as if they were independent observations.

Table 2 shows the results from the probit model of the likelihood of belonging to the 2005 sample, for men and women separately. We run a probit regression of the binary indicator, taking value "1" for observations in the 2005 sample and "0" for observations in the 2000 sample, over the set of common variables. We consider the demographic and personal characteristics of the respondents (education), household characteristics (living in urban area, computer at home), and time-use behaviour (time devoted to personal care and market work, diary was collected during a working day). In the estimation of the propensity score, the balancing property is fulfilled (the mean propensity score is not different for treated and untreated individuals in each block).[8] Figures 5A and 5B show the propensity score histograms for both datasets, and for men and women, respectively, showing a high degree of overlap between the two distributions, indicating that the common support assumption is satisfied.

5. Results

Columns (1) and (2) in Table 3 show the results of estimating Equation (1) on the time devoted to *Commuting*, and Columns (3) and (4) show the results of estimating Equation (2) on the time devoted to *Commuting*. According to results using the original time use variables, we find that both *Home Production* and *Childcare* are negatively related to the time devoted to *Commuting*, consistent with results obtained from Figure 3. Thus, we find that one hour of *Home Production* per day is associated with 0.26 and 0.27 fewer hours of *Commuting* per day for both men and women, respectively, while one hour of *Childcare* per day is associated with 0.35 and 0.37 fewer hours of *Commuting* per day. These results imply that as the time devoted to non-market work activities increases, the time devoted to commuting decreases, consistent with the

[8] In the literature of evaluation of public policies/programs, researchers must face the dimensionality problem, which consists of the lack of common support between the treated and untreated groups with cells containing treated observations and/or untreated observations only, and it is present when the number of covariates is large, or many of the covariates have many values, or are continuous. In this framework, the "Balancing Property" establishes that the mean propensity score must not be different for treated and untreated individuals in each cell, and if this property is not fulfilled, a less parsimonious specification of the propensity score is needed. The fulfilment of this property prevents us from choosing all the covariates used as controls in our main regressions, and only a limited set of such covariates can be included as covariates in the PSM.

Household Responsibilities Hypothesis that considers that household responsibilities decrease the time devoted to commuting. To the extent that females devote 1.47 and 0.53 more hours per day to these activities, we obtain that women devote 0.59 (1.47*0.266 + 0.371*0.53) fewer hours per day to commuting time.

However, results for Equations (1) and (2) may be biased, as the time devoted to *Commuting*, *Home Production*, and *Childcare* are jointly determined, and thus our results may suffer from potential endogeneity between commuting time and non-market work activities. Columns (5) to (8) in Table 3 show the results of estimating Equations (1) and (2) on the time devoted to *Commuting*, where the time devoted to *Home Production* and *Childcare* have been imputed using Propensity Score Matching to take into account reverse causality issues. These results can be interpreted as being free of the problem of reverse causality, despite that we cannot identify the relationship between commuting time and labour market hours net of individual unobserved heterogeneity.

Columns (5) and (6) show a negative relationship between *Commuting* and *Home Production* for both men and women, with both coefficients being statistically significant at standard levels. In this sense, we find that one hour of *Home Production* is associated with a decrease of 0.06 hours per day of *Commuting* for men, while for women it is associated with a decrease of 0.16 hours of *Commuting* per day. Thus, we find that the negative relationship between commuting time and time devoted to home production is more significant for women, by a factor close to three. A t-type test of equality of the coefficients indicates that the coefficients differ from each other ($p<.01$), indicating that the effect of *Home Production* on *Commuting* is greater for women than for men. Considering the Household Responsibilities Hypothesis, we interpret this result as that these responsibilities impose more restrictions on commuting time for women than for men, which would explain why women have shorter commutes.

Furthermore, if we look at the relationship between *Commuting* and *Childcare*, we find that only the *Childcare* of women has a negative and statistically significant relationship with the time devoted to *Commuting*, as one hour of *Childcare* for women is related to a decrease of 0.148 hours in the commuting time of women. In the case of men, we find no statistically significant relationship between *Commuting* and *Childcare*. When we control for reverse causality of commuting on childcare, we find that only childcare by women reduces their commuting time, while we find no effect for

men. This result is consistent with the Household Responsibility Hypothesis, which posits that childcare responsibilities are negatively associated with the time devoted to commuting for women, and also helps to explain why women have shorter commutes.

It is a truism that there are social roles in society, and those roles vary by gender, with our results in this work providing a specific example: women adapt their commuting patterns to their chores (home production and childcare), leading them to take jobs closer to home and thus reducing their commuting time and distance (Turner and Niemeir, 1997; Sandow and Westin, 2010).

Regarding the rest of the socio-demographic and geographic/land use factors, we find that age has an inverted u-shaped relationship with daily commuting for women, with the maximum reached around the age of 40, and that working full-time, and housing prices, are both positively related to the duration of women's daily commuting.

6. Conclusions

The existing literature has shown that commuting entails monetary and mental/physical health costs, and many urban and job search models have included commuting as one of their variables of interest, although the evidence of gender differentials in commuting behaviour has been inconclusive. In this paper, we analyze time use data from three developed countries to determine whether there are gender-variant differences in commuting durations, and whether any such differences have held relatively constant over time. One theory proposed to explain shorter commutes by women is the Household Responsibilities Hypothesis, which posits that the disproportionate burden of household responsibility on women necessitates shorter commuting times and makes it more difficult for them to work away from home.

In this paper, we analyze the relationship between commuting time and the time devoted to both home production and childcare, with a focus on gender differentials. In doing so, we use a sample of working individuals from the Dutch Time Use Surveys (DTUS) of 2000 and 2005 to empirically address the relationship between commuting time and the time devoted to both home production and childcare activities. In our empirical analysis, we take into account that the time devoted to commuting, home production, and childcare are choices workers make, and we thus propose the use of a matching strategy (Propensity Score Matching) to deal with potential reverse causality

between commuting time and household responsibilities. Our results show that the effect of home production on commuting time for women is more than double the effect for men, while childcare time affects women's commuting time behaviour only; this is consistent with the Household Responsibility Hypothesis.

We hope that our results will stimulate further research on the topic of commuting behaviour and its connection to household responsibilities. Theoretical - as well as further empirical - research is needed to shed light on the question of how gender affects the commuting behaviour of individuals. Furthermore, employment policies should consider the relationship between commuting and household responsibilities, as more family-friendly policies would increase the desire of women to work further away from home, which could ultimately increase their labour force participation.

The data used in this paper impose two limitations. First, it is a cross-section of individuals, which does not allow us to identify the relationship between commuting and household production hours net of (permanent) individual heterogeneity in preferences. Second, our data does not include information on wages or occupations, and so we cannot ascertain the relationship between commuting and household production hours, net of individual heterogeneity, in wages and occupations (factors that have been shown to affect individual commuting behaviour and the gender gap). Alternative datasets with a panel data structure, such as the British Household Panel Survey and the Panel Study of Income Dynamics, both of which provide information on market-work hours, and which lend themselves to a similar matching strategy, could be used to investigate this topic. We leave this issue for future research.

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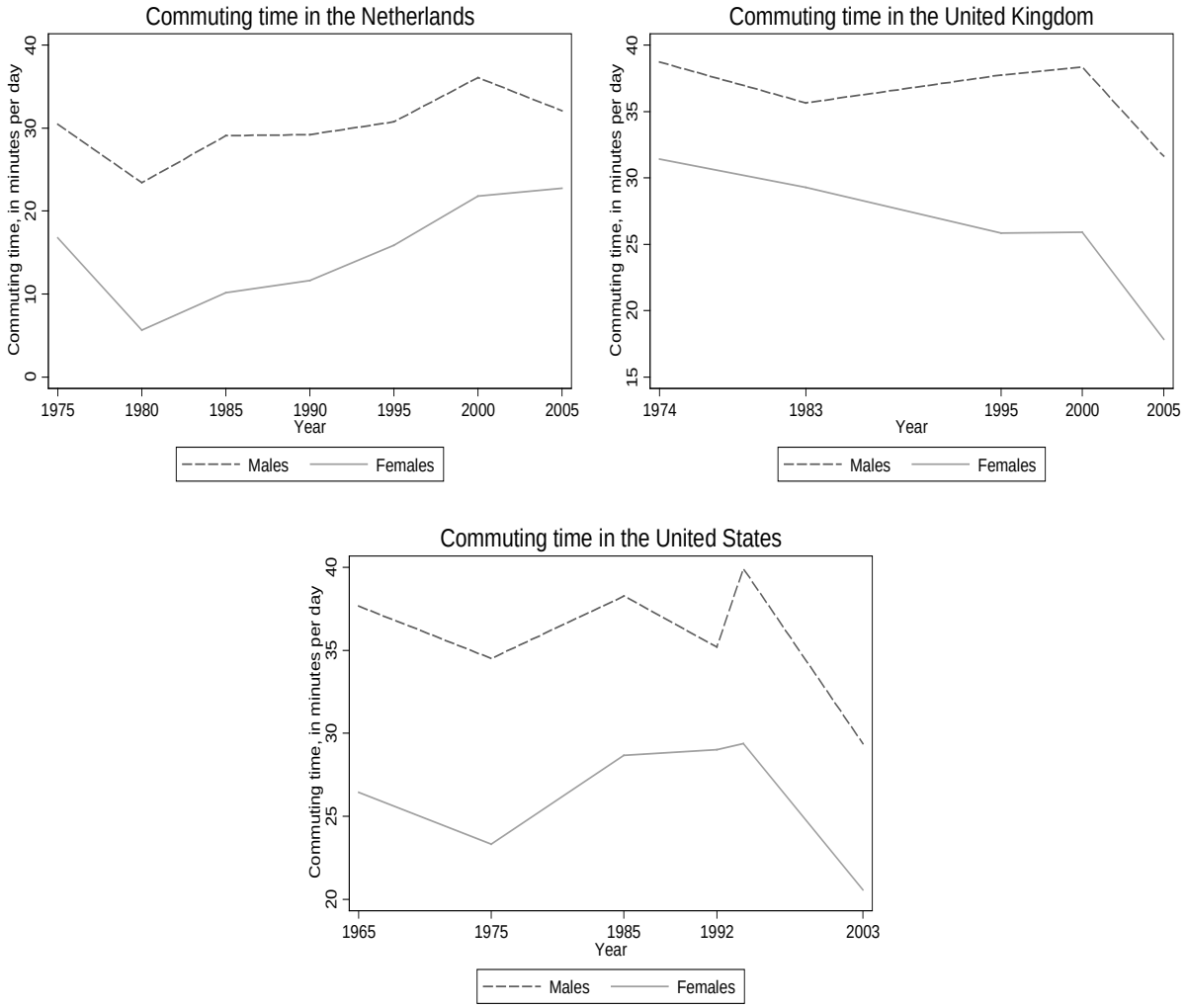
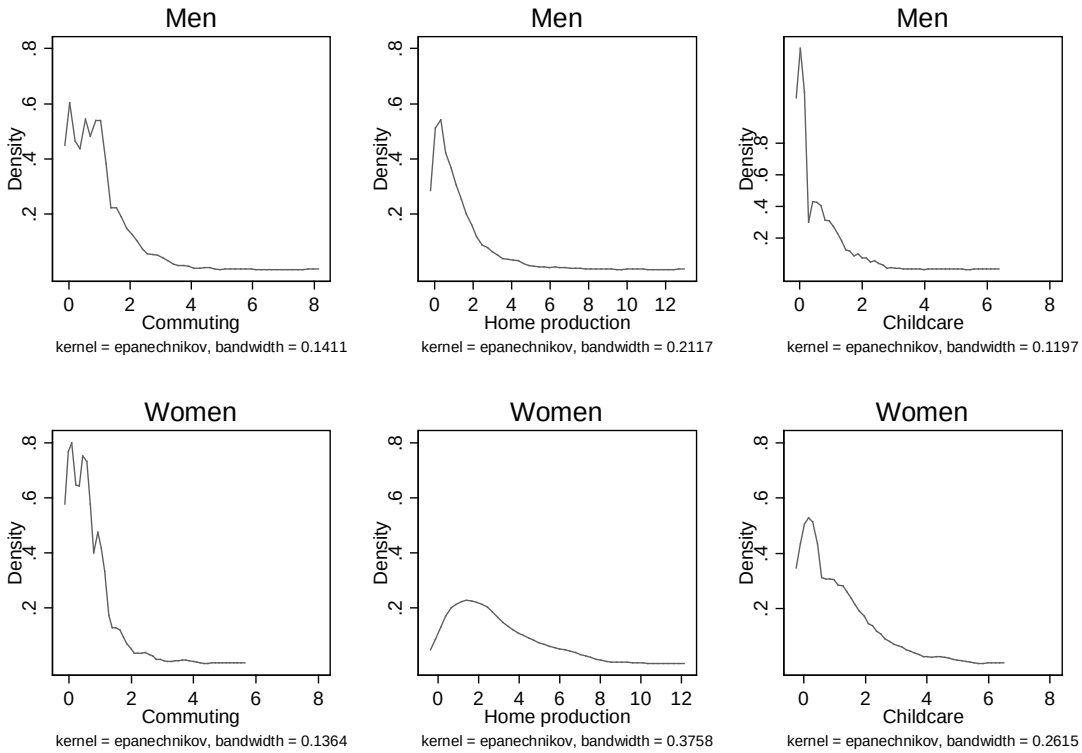
Figure 1. Time devoted to commuting time in the Netherlands, the United Kingdom and the United States, by gender



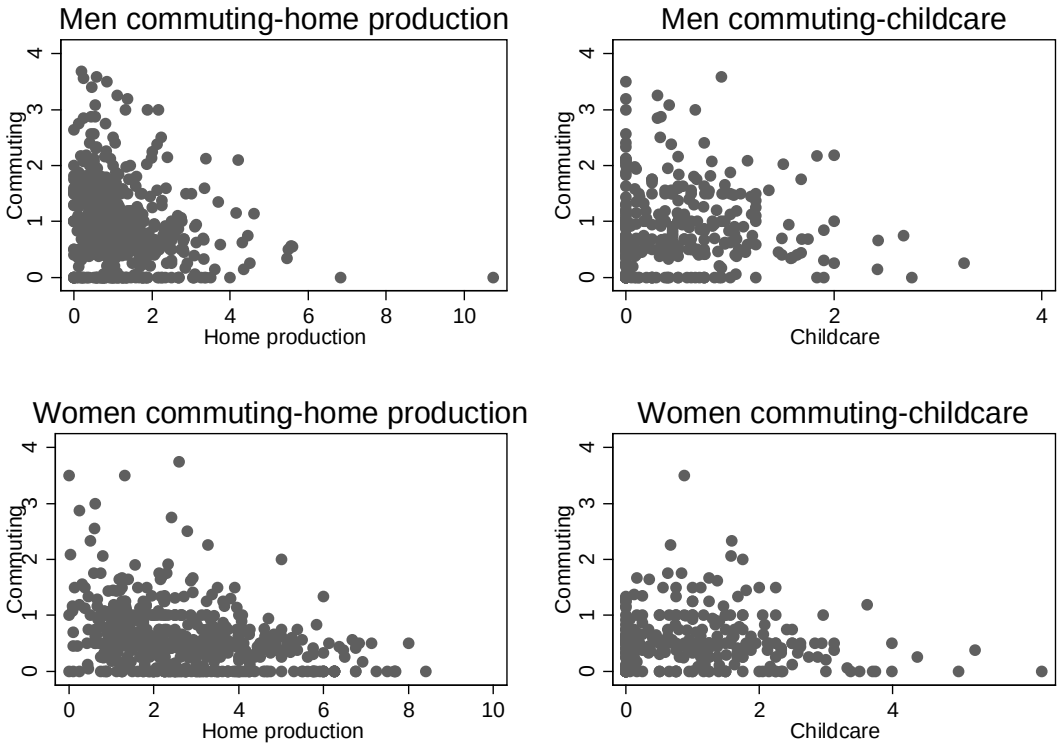
Notes: Source is the Multinational Time Use Study, version W58, accessed in November 2012. Sample consists of male and female respondents who participate in the labour market, from the Netherlands (1975, 1980, 1985, 1990, 1995, 2000, and 2005), the United Kingdom (1974, 1983, 1995, 2000 and 2005) and the United States (1965, 1975, 1985, 1992, 1994 and 2003). *Commuting* is the time devoted to "travel to or from work". We calculate the average time devoted to commuting by country, survey, and gender, and demographic weights included in the survey are used

Figure 2. K-density functions for commuting time, home production, and childcare



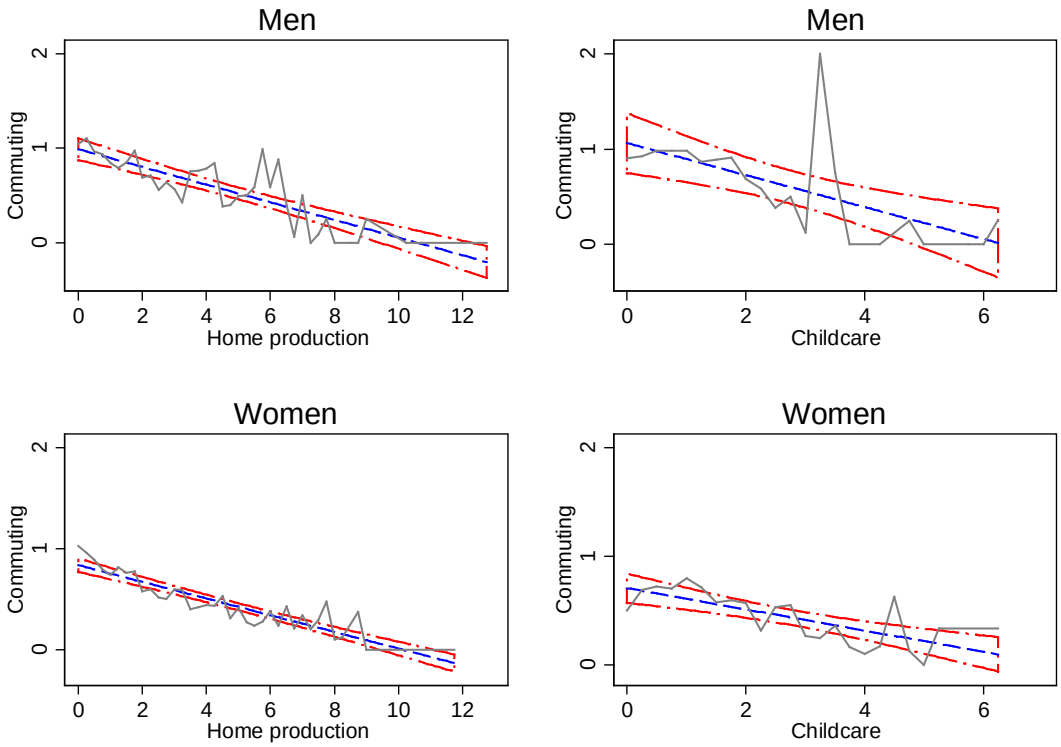
Notes: Sample consists of married male and female respondents aged 21-65, who are the head of the household or the spouse/partner of the household head, from the Dutch Time Use Survey, 2000 and 2005. *Commuting* is the time devoted to "travel to or from work". *Home production* includes the time devoted to "food preparation, cooking", "set table, wash/put away dishes", "cleaning", "laundry, ironing, clothing repair", "home/vehicle maintenance/improvement", "other domestic work", "purchase goods", "consume other services", "pet care (other than walk dog)", "adult care", "child/adult care-related travel" and ""travel for shopping, personal or household care". Childcare includes the time devoted to "physical, medical childcare", "teach, help with homework", "read to, talk or play with child" and "supervise, accompany, other childcare". Time use activities are measured in hours per day. The analysis is restricted to working days, defined as days where respondents devote 60+ minutes to market work activities excluding commuting, where market work is defined as the sum of the time devoted to the categories main7 "paid work, main job (not at home)", main8 "paid work at home", main9 "second or other job not at home", main11 "travel as a part of work" and main12 "other time at workplace".

Figure 3. Mean time devoted by individuals to commuting, home production, and childcare



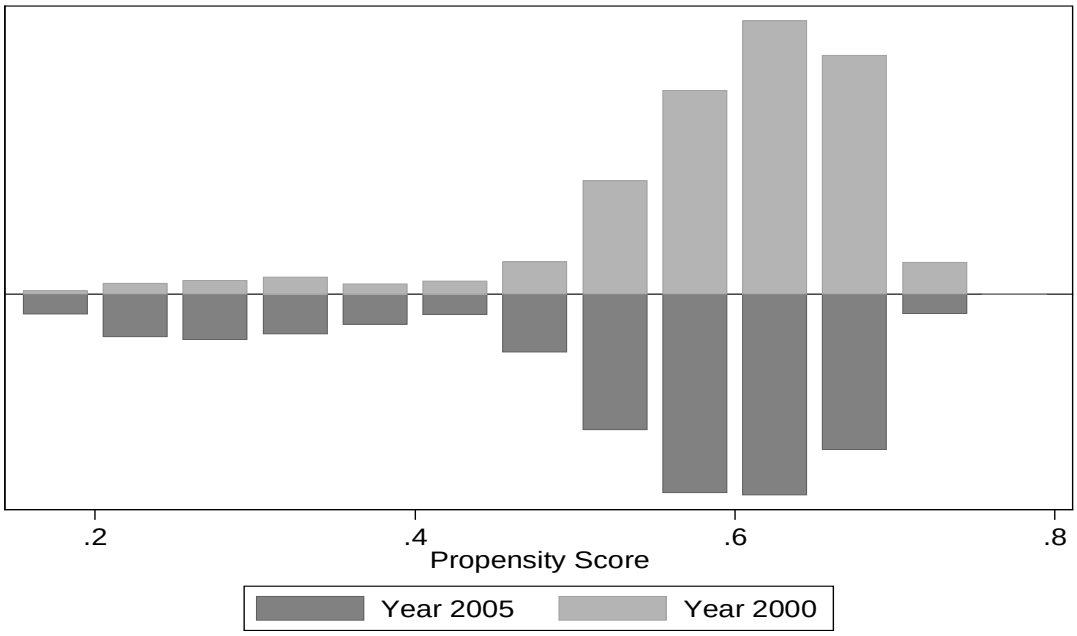
Notes: Sample consists of married male and female respondents aged 21-65, who are the head of the household or the spouse/partner of the household head, from the Dutch Time Use Survey, 2000 and 2005. *Commuting* is the time devoted to "travel to or from work". *Home production* includes the time devoted to "food preparation, cooking", "set table, wash/put away dishes", "cleaning", "laundry, ironing, clothing repair", "home/vehicle maintenance/improvement", "other domestic work", "purchase goods", "consume other services", "pet care (other than walk dog)", "adult care", "child/adult care-related travel" and ""travel for shopping, personal or household care". Childcare includes the time devoted to "physical, medical childcare", "teach, help with homework", "read to, talk or play with child" and "supervise, accompany, other childcare". Time use activities are measured in hours per day. The analysis is restricted to working days, defined as days where respondents devote 60+ minutes to market work activities excluding commuting, where market work is defined as the sum of the time devoted to the categories main7 "paid work, main job (not at home)", main8 "paid work at home", main9 "second or other job not at home", main11 "travel as a part of work" and main12 "other time at workplace".

Figure 4. Mean time devoted to commuting, by mean time devoted to home production and childcare



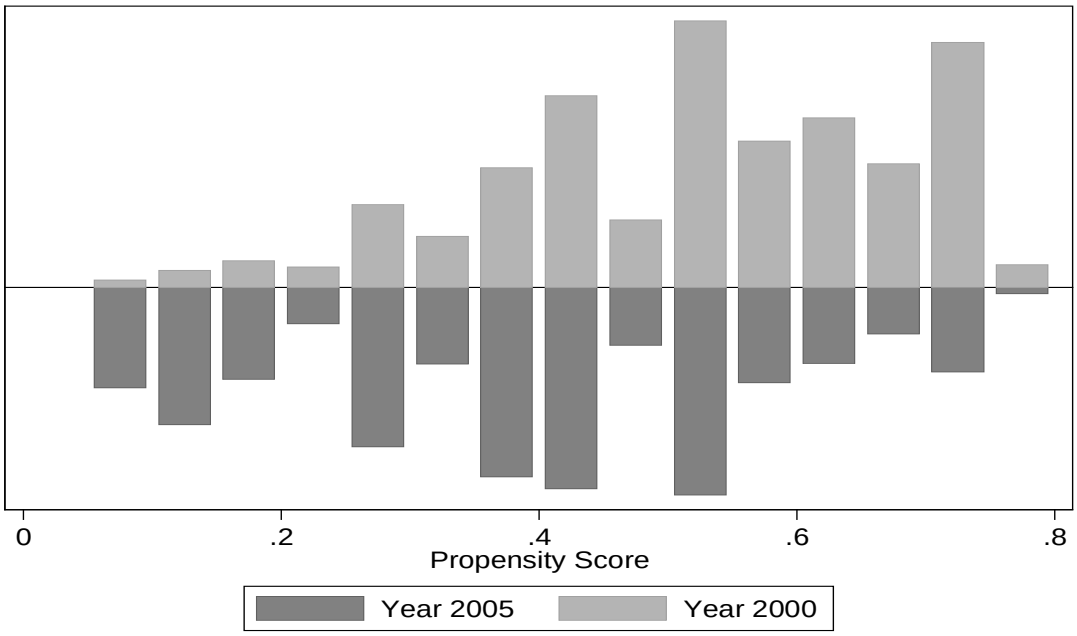
Notes: Sample consists of married male and female respondents aged 21-65, who are the head of the household or the spouse/partner of the household head, from the Dutch Time Use Survey, 2000 and 2005. *Commuting* is the time devoted to "travel to or from work". *Home production* includes the time devoted to "food preparation, cooking", "set table, wash/put away dishes", "cleaning", "laundry, ironing, clothing repair", "home/vehicle maintenance/improvement", "other domestic work", "purchase goods", "consume other services", "pet care (other than walk dog)", "adult care", "child/adult care-related travel" and ""travel for shopping, personal or household care". Childcare includes the time devoted to "physical, medical childcare", "teach, help with homework", "read to, talk or play with child" and "supervise, accompany, other childcare". Time use activities are measured in hours per day. The analysis is restricted to working days, defined as days where respondents devote 60+ minutes to market work activities excluding commuting, where market work is defined as the sum of the time devoted to the categories main7 "paid work, main job (not at home)", main8 "paid work at home", main9 "second or other job not at home", main11 "travel as a part of work" and main12 "other time at workplace".

Figure 5a. Distribution of the estimated propensity score for years 2000 and 2005, men



Notes: Sample consists of married male respondents aged 21-65, who are the head of the household or the spouse/partner of the household head, from the Dutch Time Use Survey, 2000 and 2005. Individuals in the year 2005 are considered the treated group, and individuals in the year 2000 are considered the untreated group.

Figure 5b. Distribution of the estimated propensity score for years 2000 and 2005, women



Notes: Sample consists of married female respondents aged 21-65, who are the head of the household or the spouse/partner of the household head, from the Dutch Time Use Survey, 2000 and 2005. Individuals in the year 2005 are considered the treated group, and individuals in the year 2000 are considered the untreated group.

Table 1. Sum stats

	Men		Women		Diff Men-Women	p-value diff
Commuting	**Mean**	**SD**	**Mean**	**SD**		
Time	0.90	(0.02)	0.62	(0.02)	0.28	(0.00)
Participation	76.29	(0.88)	70.62	(1.10)	5.67	(0.00)
Home production						
Time	1.18	(0.03)	2.65	(0.05)	-1.47	(0.00)
Participation	78.04	(0.85)	95.47	(0.50)	-17.43	(0.00)
Childcare						
Time	0.53	(0.02)	1.06	(0.04)	-0.53	(0.00)
Participation	51.30	(1.40)	67.59	(1.64)	-16.29	(0.00)
Demographics						
Age	42.84	(0.42)	40.87	(0.44)	1.98	(0.00)
Secondary education	0.35	(0.02)	0.51	(0.02)	-0.16	(0.00)
University education	0.46	(0.02)	0.33	(0.02)	0.14	(0.00)
Working full-time	0.90	(0.01)	0.24	(0.02)	0.66	(0.00)
Partner employed	0.67	(0.02)	0.91	(0.01)	-0.24	(0.00)
Number of children <18	1.05	(0.05)	0.96	(0.05)	0.10	(0.16)
Youngest child <5	0.23	(0.02)	0.24	(0.02)	-0.01	(0.77)
Youngest child 5-12	0.22	(0.02)	0.19	(0.02)	0.03	(0.16)
Youngest child 13-17	0.07	(0.01)	0.09	(0.01)	-0.02	(0.35)
At least one motorized vehicle at home	0.95	(0.01)	0.93	(0.01)	0.02	(0.11)
At least one computer at home	0.91	(0.01)	0.89	(0.01)	0.02	(0.20)
Household Income	30.43	(0.86)	29.65	(1.60)	0.78	(0.67)
Public sector	0.14	(0.02)	0.14	(0.02)	0.00	(0.96)
Living in urban area	0.81	(0.02)	0.80	(0.02)	0.01	(0.62)
Population density	830.06	(41.12)	750.22	(34.25)	79.84	(0.14)
Housing prices	1.97	(0.02)	1.87	(0.02)	0.10	(0.00)
Amsterdam, Rotterdam and the Hague	0.05	(0.01)	0.04	(0.01)	0.02	(0.19)
Drenthe	0.05	(0.01)	0.06	(0.01)	-0.01	(0.46)
Flevoland	0.03	(0.01)	0.03	(0.01)	0.00	(0.90)
Friesland	0.04	(0.01)	0.06	(0.01)	-0.02	(0.13)
Gelderland en Zop	0.07	(0.01)	0.10	(0.01)	-0.03	(0.09)
Groningen	0.05	(0.01)	0.05	(0.01)	0.00	(0.74)
Limburg	0.04	(0.01)	0.04	(0.01)	0.01	(0.57)
Noord Brabant	0.16	(0.02)	0.15	(0.02)	0.01	(0.76)
Noord Holland	0.11	(0.01)	0.10	(0.01)	0.01	(0.59)
Overijssel en Nop	0.10	(0.01)	0.10	(0.01)	0.00	(0.80)
Utrecht	0.08	(0.01)	0.06	(0.01)	0.02	(0.20)
Zeeland	0.03	(0.01)	0.02	(0.01)	0.01	(0.15)

Notes: Sample consists of married male and female respondents aged 21-65, who are the head of the household or the spouse/partner of the household head, from the Dutch Time Use Survey, 2000 and 2005. *Commuting* is the time devoted to "travel to or from work" and is measured in hours per day. The analysis is restricted to working days, defined as days where respondents devote 60+ minutes to market work activities excluding commuting, where market work is defined as the sum of the time devoted to the categories main7 "paid work, main job (not at home)", main8 "paid work at home", main9 "second or other job not at home", main11 "travel as a part of work" and main12 "other time at workplace". *Diff. Men-Women* measures the difference in the overall value of the variable for men and women, *p-value diff* shows the p-value of a t-type test of equality of *means.*

Table 2. Propensity score coefficients estimates

	(1)	(2)
Propensity score estimates	**Men**	**Women**
Living in urban area	0.269***	0.345***
	(0.045)	(0.044)
Education	0.082***	0.298***
	(0.024)	(0.025)
Personal care	0.036***	0.0234***
	(0.010)	(0.009)
Market work	0.034***	0.034***
	(0.009)	(0.009)
At least one computer at home	0.750***	0.976***
	(0.058)	(0.051)
Working day	-0.029	0.289***
	(0.079)	(0.065)
Constant	-1.443***	-2.429***
	(0.140)	(0.129)
Observations	5,513	6,516
Pseudo R-squared	0.044	0.117

Notes: Sample consists of married male and female respondents aged 21-65, who are the head of the household or the spouse/partner of the household head, from the Dutch Time Use Survey, 2000 and 2005. *Personal care* and *market work* are measured in hours per day. *Significant at the 90% level **Significant at the 95% level ***Significant at the 99% level.

Table 3. Results for market work and commuting

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Tobit models with original time				*Tobit models with imputed time*			
Commuting Time	**Men**	**Women**	**Men**	**Women**	**Men**	**Women**	**Men**	**Women**
Home Production	-0.264***	-0.266***	-	-	-0.061***	-0.162***	-	-
	(0.022)	(0.019)	-	-	(0.014)	(0.013)	-	-
Childcare	-	-	-0.352***	-0.371***	-	-	-0.005	-0.148***
	-	-	(0.067)	(0.048)	-	-	(0.041)	(0.032)
<u>*Demographic characteristics*</u>								
Age	0.001	0.080**	0.079	0.067	-0.020	0.082***	0.063	0.082
	(0.035)	(0.031)	(0.077)	(0.069)	(0.037)	(0.030)	(0.082)	(0.070)
Age Squared	-0.002	-0.109***	-0.103	-0.112	0.020	-0.118***	-0.082	-0.119
	(0.040)	(0.038)	(0.089)	(0.088)	(0.042)	(0.037)	(0.093)	(0.091)
Secondary education	-0.038	0.203*	-0.014	0.103	-0.016	0.174	-0.031	0.089
	(0.112)	(0.116)	(0.164)	(0.173)	(0.115)	(0.117)	(0.166)	(0.178)
University education	0.118	0.225*	0.183	0.249	0.123	0.156	0.111	0.221
	(0.116)	(0.126)	(0.173)	(0.177)	(0.120)	(0.126)	(0.172)	(0.186)
Working full-time	0.480***	0.367***	0.731***	0.531***	0.727***	0.596***	0.906***	0.566***
	(0.138)	(0.105)	(0.225)	(0.175)	(0.150)	(0.112)	(0.229)	(0.175)
Partner employed	0.129	-0.207	0.110	0.264	0.073	-0.300**	0.084	0.393
	(0.094)	(0.149)	(0.129)	(0.352)	(0.097)	(0.144)	(0.128)	(0.380)
Number of children <18	-0.155**	0.096	-0.200***	-0.089	-0.208***	-0.071	-0.238***	-0.106
	(0.063)	(0.067)	(0.074)	(0.080)	(0.069)	(0.070)	(0.075)	(0.082)
Youngest child <5	0.478***	-0.285*	0.634**	0.261	0.569***	-0.069	0.358	-0.338
	(0.167)	(0.158)	(0.258)	(0.210)	(0.178)	(0.169)	(0.243)	(0.217)
Youngest child 5-12	0.409**	0.110	0.345*	0.115	0.487***	0.171	0.287	-0.092
	(0.172)	(0.164)	(0.197)	(0.174)	(0.181)	(0.170)	(0.193)	(0.183)
Youngest child 13-17	0.084	0.053	-	-	0.160	0.186	-	-
	(0.180)	(0.164)	-	-	(0.185)	(0.162)	-	-
At least one motorized vehicle at home	-0.001	0.187	0.194	0.097	-0.004	0.232	0.223	0.224
	(0.173)	(0.145)	(0.333)	(0.228)	(0.190)	(0.158)	(0.358)	(0.232)
At least one computer at home	0.105	-0.001	0.066	0.066	0.063	-0.114	0.001	0.011
	(0.151)	(0.128)	(0.221)	(0.204)	(0.156)	(0.133)	(0.232)	(0.208)
Household Income	-0.001	0.002*	0.003	0.004***	0.002	0.002	0.003	0.003***
	(0.002)	(0.001)	(0.003)	(0.001)	(0.002)	(0.001)	(0.003)	(0.001)
Public sector	-0.012	0.004	-0.217	0.062	-0.036	0.096	-0.231	0.091
	(0.099)	(0.103)	(0.144)	(0.137)	(0.104)	(0.101)	(0.146)	(0.140)
Living in urban area	0.069	0.056	-0.042	0.102	0.011	-0.044	-0.055	0.070
	(0.099)	(0.089)	(0.129)	(0.134)	(0.103)	(0.095)	(0.129)	(0.136)
Population density	0.007	-0.002	0.013	0.000	0.010	-0.001	0.015*	-0.002
	(0.006)	(0.006)	(0.008)	(0.008)	(0.006)	(0.006)	(0.009)	(0.009)
Housing prices	-0.609*	0.702***	-0.501	0.798**	-0.591*	0.753***	-0.662	0.981**
	(0.325)	(0.250)	(0.460)	(0.381)	(0.335)	(0.260)	(0.471)	(0.395)
Amsterdam, Rotterdam and the Hague	-24.286	4.701	-41.118	-0.036	-31.845	2.546	-48.385*	4.726
	(19.545)	(18.181)	(27.387)	(27.261)	(20.209)	(18.052)	(28.103)	(28.562)
Drenthe	7.285	-1.362	12.412	0.300	9.645	-0.716	14.751*	-1.152
	(6.114)	(5.699)	(8.553)	(8.566)	(6.327)	(5.663)	(8.785)	(8.963)
Flevoland	6.834	-1.457	11.350	0.232	9.025	-0.776	13.472	-1.187
	(5.719)	(5.329)	(8.028)	(7.983)	(5.908)	(5.296)	(8.227)	(8.318)
Friesland	7.073	-1.150	12.247	0.197	9.593	-0.465	14.512*	-1.324
	(5.998)	(5.612)	(8.420)	(8.415)	(6.210)	(5.572)	(8.644)	(8.808)
Gelderland en Zop	6.172	-1.141	9.882	0.308	8.086	-0.622	11.776*	-1.002
	(4.964)	(4.599)	(6.966)	(6.917)	(5.135)	(4.566)	(7.149)	(7.235)
Groningen	6.860	-0.941	11.377	0.743	9.162	-0.301	13.384*	-0.761
	(5.651)	(5.277)	(7.924)	(7.949)	(5.854)	(5.246)	(8.129)	(8.308)
Limburg	4.842	-0.726	8.374	-0.287	6.453	-0.490	9.880*	-1.279
	(4.035)	(3.787)	(5.701)	(5.679)	(4.180)	(3.772)	(5.850)	(5.938)
Noord Brabant	5.486	-1.326	8.870	-0.194	7.183	-0.831	10.576*	-1.354
	(4.410)	(4.083)	(6.187)	(6.148)	(4.563)	(4.061)	(6.354)	(6.431)
Noord Holland	1.933	-0.352	2.793	0.122	2.473	-0.196	3.397	-0.350
	(1.553)	(1.430)	(2.182)	(2.145)	(1.607)	(1.422)	(2.236)	(2.235)
Overijssel en Nop	6.314	-1.152	10.940	0.234	8.343	-0.560	12.892*	-0.971
	(5.233)	(4.875)	(7.351)	(7.314)	(5.420)	(4.843)	(7.543)	(7.653)
Utrecht	3.236	-0.773	5.085	-0.027	4.101*	-0.544	6.040*	-0.754
	(2.374)	(2.193)	(3.322)	(3.313)	(2.446)	(2.173)	(3.405)	(3.471)
Zeeland	7.023	-1.386	11.522	-0.065	9.303	-0.976	13.755	-1.663

	(5.936)	(5.532)	(8.366)	(8.367)	(6.154)	(5.480)	(8.581)	(8.750)
Constant	-9.860	-2.407	-18.083*	-4.696	-12.718*	-3.153	-20.398**	-3.877
	(6.875)	(6.447)	(10.021)	(9.697)	(7.114)	(6.412)	(10.298)	(10.185)
Observations	3,571	4,020	1,889	2,045	3,571	4,020	1,889	2,045
Pseudo R-squared	0.190	0.228	0.163	0.155	0.153	0.184	0.149	0.126

Notes: Sample consists of married male and female respondents aged 21-65 in working days, who are the head of the household or the spouse/partner of the household head, from the Dutch Time Use Survey, 2000 and 2005. *Commuting* is the time devoted to "travel to or from work". *Home production* includes the time devoted to "food preparation, cooking", "set table, wash/put away dishes", "cleaning", "laundry, ironing, clothing repair", "home/vehicle maintenance/improvement", "other domestic work", "purchase goods", "consume other services", "pet care (other than walk dog)", "adult care", "child/adult care-related travel" and ""travel for shopping, personal or household care". *Childcare* includes the time devoted to "physical, medical childcare", "teach, help with homework", "read to, talk or play with child" and "supervise, accompany, other childcare". Time use activities are measured in hours per day. The analysis for the relationship between commuting and childcare is restricted to individuals with at least one child under 18 in the household. *Significant at the 90% level **Significant at the 95% level ***Significant at the 99% level.