BANCA D'ITALIA
EUROSISTEMA

Temi di Discussione

(Working Papers)

You've come a long way, baby. Effects of commuting times on couples' labour supply

by Francesca Carta and Marta De Philippis

Number 1003

March 2015

BANCA D'ITALIA
EUROSISTEMA

Temi di discussione

(Working papers)

You've come a long way, baby. Effects of commuting times on couples' labour supply

by Francesca Carta and Marta De Philippis

Number 1003 - March 2015

ISSN 1594-7939 (print)
ISSN 2281-3950 (online)

Printed by the Printing and Publishing Division of the Bank of Italy

YOU'VE COME A LONG WAY, BABY.
EFFECTS OF COMMUTING TIMES ON COUPLES' LABOUR SUPPLY

by Francesca Carta* and Marta De Philippis*

Abstract

This paper explores the effects of husbands' commuting time on their wives' labour market participation and on family time allocation. We develop a unitary family model of labour supply, which includes commuting times and household production. In a pure leisure model longer commuting time for husbands increases their wives' labour market participation and reduces their own working hours. However, a model that includes household production might determine the exact opposite result. We then examine the sign of these effects by using data from the German Socio-Economic Panel from 1997 to 2010. Employer-induced changes in home to work distances allow us to deal with endogeneity of commuting times. We find that a 1% increase in a husband's commuting distance reduces his wife's probability of participating in the labour force by 1.7 percentage points, 2% over the mean. Moreover, it increases his working hours by 0.2 hours per week. The average effect masks substantial heterogeneity: lower participation rates are concentrated in couples with children and where the husband has higher levels of education.

JEL Classification: D13, J16, J21, J22.
Keywords: household production, gender economics, time allocation and labour supply, commuting time.

Contents

* Bank of Italy, Structural Economic Analysis Directorate.

1 Introduction

Establishing the determinants of labour supply behaviour has always been a key issue for economists. Starting from Cogan (1981)'s seminal work, much of the literature has focused on fixed costs of participation and, in particular, on commuting time. Most scholars have analyzed the relationship between commuting time and labour supply in models where the decision unit is the single agent (Gronau, 1977; Wales, 1978; Van den Berg and Gorter, 1997). Within this framework, an increase in commuting time has an unambiguous negative effect on both labour market participation and working hours.[1]

However, the data show[2] the existence of interdependencies between commuting time and partners' time use.[3] First, there is substantial heterogeneity in commuting times depending on gender and marital status. Indeed, married women commute to work much less than singles, while the contrary holds for men (Figure 1, panel a). Second, Figure (2) shows that longer commuting time for husbands is associated with a higher specialization within the couple: the wife is more involved in housework and the husband in market work.

Moreover, at odds with the theoretical predictions arising from single agent models, empirical analyses (Solberg and Wong, 1992; Gutiérrez-i Puigarnau and Van Ommeren, 2010; Gimenez Nadal and Molina, 2011) estimate a positive relationship between own commuting time and working hours.[4]

Clearly, the single agent framework is not satisfactory in explaining the above empirical evidence. In this paper we study how husbands' commuting time affects their wives' labour market participation and partners' time allocation using a family framework. Our focus is on variations in commuting time for husbands, rather than wives, because we believe that they are more widespread and relevant to families' time allocation. Indeed, married men show stronger labour force attachment (Barron et al., 1993), lower labour supply elasticity to income shocks (Blundell et al., 2011), and longer commuting times (OECD, 2010) than women.

The analysis of the effect of husbands' commuting time on their wives' labour market participation and family time allocation is interesting on three grounds. First, it could help to explain and address low employment rates and short commutes of married women with respect to married men observed all around the world (OECD, 2010). Among the determinants of female labour supply, partners' participation costs have been rather neglected, since the extensive literature on the topic has focused mainly on the role of wages, and the price and availability of childcare in shaping female labour supply (Blau and Kahn, 2007; Lundin et al., 2008; Goux and Maurin, 2010). Second, if a reduction

[1] Provided that consumption is a normal good.

[2] We refer to the German Socio-Economic Panel (GSOEP; Section 4) and the American Time Use Survey (ATUS). Similar patterns are observed in almost all OECD countries.

[3] These facts are exacerbated by the presence of children.

[4] One of the explanations for this positive effect is that agents not only choose working hours, but also the number of workdays: since commuting time is a daily fixed cost, an increase in commuting time reduces workdays and increases working hours (once agents incur the daily fixed cost they smooth it by working more hours). However, the empirical literature has found workdays to be invariant with respect to commuting time.

in commuting time generates an indirect effect on spouses' labour force participation, it will have to be considered in the evaluation of policies that reduce commuting time with the specific purpose of boosting individual labour supply. Third, a reallocation of time at the family level might provide a possible explanation for the positive relationship between own commuting time and own working hours, through the increasing household specialization associated with the husband's longer commute.

We build a unitary family model in which the wife decides whether to participate in the labour force or not, and, depending on her decision, the couple allocates their time between leisure, housework and market work. When the family's Hicksian consumption good can be bought only on the market, the model would unambiguously[5] predict a reduction of household specialization in response to an increase in the husband's commuting time: the husband works less, the wife more. The husband's longer commuting time represents a negative income shock for the household. This pushes the woman to work more hours or to start participating in the labour market, even for involving a longer commute, and the husband, if anything, to work less. When the consumption good is produced by using both market and time inputs, a different mechanism could be at work. The wife now has another margin of adjustment to the negative income shock: she can stay out of the labour force, save her commuting time and increase housework. The husband, instead, may work more hours to compensate for his wife's labour supply responses. Specialization within the couple could, therefore, increase and women would be less willing to work and commute. This mechanism is at work when women earn low wages and market and time inputs are substitutes in consumption. Thus, by abandoning the *work vs. leisure* model the sign of the relationship between specialization within the couple and husband's commuting time is ambiguous. Moreover, we predict substantial heterogeneity in the effect of longer commuting time for husbands on his wives participation and propensity to commute. First, it is expected to be more negative for couples where the wife receives low wage offers and the husband earns high wages. The gain from the wife staying at home is greater for these couples because the marginal contribution in terms of consumption from entering the labour force is lower than the one associated with staying at home. Second, the effect is more likely to be negative for couples with children. The model with household production is particularly suited to situations in which consumption cannot be entirely bought on the market but consists, instead, in a combination of time and market inputs, which is typically the case for households with children. For singles or couples without children it is more feasible to buy all goods on the market.

We empirically investigate which mechanism is at work using data from the GSOEP, between 1997 and 2010. We use commuting distance as a proxy for commuting time. We take care of possible endogeneity in commuting distance by using a reduced form approach.[6] In particular, we exploit the panel structure of our data and we use household fixed effects. Moreover, in the spirit of Gutiérrez-i Puigarnau and Van Ommeren (2010), we only consider those couples where the husband experienced plausibly employer-induced

[5]The implicit assumptions are: 1) the utility function is separable in its arguments, 2) marginal utility from consumption is higher when the woman is unemployed than in the two earner-couple case.

[6]We therefore avoid assuming any structure for the correlation of the error terms, differently from what structural models do (Bloemen and Stancanelli, 2008).

changes in commuting distance, by looking at variations in work to home distance not due to changes of employer or of household's residential location.

Our empirical section shows that the inclusion of household production in the model is actually key to explaining our findings. We find evidence that longer commuting distances for husbands increase labour specialization within the couple, by reducing female labour supply on the extensive margin and increasing male labour supply on the intensive margin. A 1% increase in men's commuting distance decreases women's labour supply on the extensive margin by 1.7 percentage points, 2% over the average. In line with the theory, reductions in participation are driven by the presence of children and mainly observed in couples where the husband has post-secondary education. Finally, the husband supplies 0.2 more hours per week.

Two approaches have been taken in the economic literature to the relationship between commuting time and labour supply. The first is the urban economic approach, where commuting times are chosen contextually with the residence location and the labour supply decision is discrete (if agents participate, they will work a fixed number of hours) (Madden and White, 1980; Rouwendal, 1999; Abe, 2011; Buchinsky et al., 2014). The other is the labour economic approach, where commuting times are exogenous, the residence decision is given and labour supply is the relevant margin of choice. This paper belongs to the second strand of literature and, to our knowledge, there are only two papers dealing with commuting time and labour supply within a family context. The first, by Solberg and Wong (1992),[7] analyzes how commuting times affect time allocation in a unitary model where consumption can be bought on the market or produced at home. The market and the home produced goods are assumed to be perfect substitutes, which immediately implies that they are weakly separable from pure leisure activities. Because of this assumption, hours of housework do not depend on commuting times but only on relative wages. Their model predicts that longer commuting time for husbands unambiguously increases female working hours and reduces those supplied by men. However, their empirical results, obtained by estimating a simultaneous equation model with cross sectional data, do not validate these predictions. They recognize in the way in which home production is incorporated in the model one of the reasons why the theory does not fit the data.[8] The second contribution, by Black et al. (2013), shows that when commuting time for both partners (i.e. the average commuting time in the city of residence) increases, then one partner, typically the wife, may withdraw from the labour force to avoid bearing both spouses' participation costs. They validate this theoretical prediction by exploiting cross-sectional variation in average commuting times across fifty American metropolitan cities.

Finally, our paper relates also to the literature supporting the Household Responsibility Hypothesis, according to which the disproportionate burden of household responsibility

[7] They build the two-earner version of Gronau (1977)'s model, in which partners' participation decisions are exogenous.

[8] Indeed, the first version of Gronau (1977)'s two-earner model was built and analyzed by Graham and Green (1984), who tried to overcome the weak separability hypothesis of Gronau (1977) by assuming that spouses enjoy housework as part of leisure, but market and domestic goods are still perfect substitute. However, Kooreman and Kapteyn (1987) showed that this model is observationally equivalent to Gronau (1977)'s the two-earner version as presented by Solberg and Wong (1992). For this reason, we preferred to use the simplest version possible as our reference.

on women determines their shorter commuting (Turner and Niemeier, 1997; MacDonald, 1999; Giménez and Molina, 2015).

We contribute to the theoretical literature by extending Solberg and Wong (1992)'s model to include the response on the extensive margin and to generalize the technology of consumption, removing the weak separability assumption of market and domestic goods from partners' leisure time, rejected by the empirical literature (Browning and Meghir, 1991). With respect to Black et al. (2013),[9] we include household production and analyze time allocation in general, not only participation responses; moreover, we allow for commuting time to vary across partners, thus studying intra-family responses to spouse specific variations in commuting time. Finally, to our knowledge, our paper is the first to estimate empirically the effect of husbands' commuting distance on their wives participation. Our identification strategy is similar to Gutiérrez-i Puigarnau and Van Ommeren (2010), but we consider explicitly the family dimension of the labour supply decisions.

The paper is organized as follows. Section 2 presents our model and Section 3 illustrates our main theoretical predictions. Section 4 describes the data used and in Section 5 we outline the identification strategy. Section 6 presents our empirical results, the analysis of heterogeneous effects and some robustness checks. Section 7 concludes.

2 Model - basic setup

We consider a population of couples, whose size is normalized to 1. In each couple there is a primary earner (the husband) who always participates in the labour market and a secondary earner (the wife) who chooses whether or not to participate in the labour market. Depending on the wife's participation decision, spouses decide their time and consumption allocations. The problem is solved in two steps: first, partners determine their consumption possibilities for the two cases in which the wife does or does not work; second, the family determines the wife's employment status according to which scenario provides the highest utility.

2.1 Time and consumption allocation

We assume that the household has a single utility function:

$$U = U(X, l_1, l_2) \tag{1}$$

where l_s is the leisure time of spouse $s = 1, 2$ and X is a Hicksian consumption good. Person $s = 1$ is the husband, 2 is the wife. The good X is produced using market services X_m and partners' domestic time h_s, for $s = 1, 2$, according to the technology:

$$X = F(X_m, h_1, h_2). \tag{2}$$

[9]They adopt a collective family model with constant weights for individual utilities. It is the unitary version of a collective model, thus we are not too restrictive with respect to their framework. However, in Appendix C we check the robustness of our theoretical results with respect to alternative household-decision models.

The function F is assumed to be increasing and concave in its arguments.[10]

The household maximizes utility subject to technology, income and time constraints. We denote w_s the real after-tax wage rate of individual s and m_s the time spent at market work. We focus on commuting only as a time cost and we neglect the monetary one (we assume it is constant, independent of commuting time and, for simplicity, equal to zero).[11] Assuming that the husband always works (Kleven et al., 2009),[12] the income constraint is the following:

$$X_m = w_1 m_1 + w_2 m_2 \tag{3}$$

where $m_2 > 0$ if the woman works.

Each partner is endowed with one unit of time and subject to the respective time constraint:

$$l_1 + h_1 + m_1 + t_1 = 1 \tag{4}$$

$$l_2 + h_2 + m_2 + 1\{m_2 > 0\} t_2 = 1, \tag{5}$$

where the wife spends time in commuting only if she works. $1\{m_2 > 0\}$ is an indicator function equal to 1 if she works, zero otherwise. At this stage of the model we deal with travel times t_i as being exogenously determined.[13]

The household's decision problem consists in selecting $(l_1, l_2, h_1, h_2, X, m_1, m_2) \geq 0$. By concavity, the first set of inequalities always holds without equality. m_1 is, by assumption, always positive. Only the last inequality represents a corner solution in our setting.

We adopt the Kuhn-Tucker approach to solving the household problem, since corner solutions might be optimal. The associated Lagrangian function is:

$$\begin{aligned}\mathcal{L} =& U\left(F(X_m, h_1, h_2), l_1, l_2\right) + \lambda_1 \left(1 - l_1 - h_1 - m_1 - t_1\right) + \lambda_2 \left[1 - l_2 - h_2 - \rho\left(m_2 + t_2\right)\right] \\ &+ \lambda_3 \left(w_1 m_1 + w_2 m_2 - X_m\right) + \mu_2 m_2\end{aligned}$$

where λ_1, λ_2 and λ_3 are the multipliers associated, respectively, with the individual time constraints and the household budget constraint, μ_2 is the Kuhn-Tucker multiplier for the constraint on m_2. The Kuhn-Tucker conditions are reported in Appendix A and

[10] The non-perfect substitutability between market purchases and domestic production in good X technology is our departure from Solberg and Wong (1992). The perfect substitutability assumption is highly discussed in their paper, since it mainly drives predictions on home production rejected by the data.

[11] Introducing monetary cost does not change our results but goes in the same direction, because it is a pure income component.

[12] Even if recent papers (Heim, 2007; Blau and Kahn, 2007) tend to agree that labour supply elasticity of married women has decreased substantially in recent years, it is still much higher than men's and single women's elasticity.

[13] As we show in Subsection 2.2, the wife's travel time is determined by the participation decision. The household's residence is assumed to be fixed (in the data we can control for changes in residential location) and the wife decides whether or not to accept a job, which pays a given wage and involves some commuting time.

can be rearranged as follows:

$$U_{l_s} = U_X F_{h_s} \geq w_s U_X F_{X_m} \tag{6}$$

for $s = 1, 2$, with equality for $m_s^* > 0$. Marginal utilities are computed at the optimal solutions. Moreover, income and time constraints have to be satisfied.

2.2 Participation decision

The wife will participate in the labour market[14] if the family's utility when she works is higher than when she does not, respectively $\hat{U}$ and U^*.

Given (w_1, w_2, t_1), we define $\bar{t}_2$ as the maximum amount of time agent 2 is willing to commute in order to accept a job, such that:

$$\hat{U}(w_1, w_2, t_1, \bar{t}_2(w_1, w_2, t_1)) = U^*(w_1, t_1) \tag{7}$$

and we call it the maximum acceptable commuting time.[15] For $t_2 \leq \bar{t}_2$, the woman participates and commutes. Participation is affected by preferences, primitives of the production function and parameters (w_1, w_2, t_1).

3 Theoretical predictions

The aim of this section is to illustrate how an increase in the husband's commuting time might affect the wife's participation decision, her propensity to commute, and the family's time allocation.

By using time constraints (4) and (5), we can rewrite the income constraint as follows:

$$X_m + w_1(l_1 + h_1) + w_2(l_2 + h_2) = w_1(1 - t_1) + w_2(1 - t_2)1\{m_2 > 0\} \tag{8}$$

where the right-hand side is what Becker (1981) defines the household's full income I, when all the time endowment is spent at work. Full income is spent on five goods: market purchases, partners' leisure and housework times. A unitary increase in t_1 reduces the family's income by its opportunity cost, namely w_1, affecting both time allocation and participation decisions as shown in the next subsections.

3.1 Effects on time allocation

We first analyze how the increase in the husband's commuting time affects the family's time allocation without modifying the wife's participation decision, distinguishing between the cases in which she works and those in which she does not.

[14] This implies she is employed, since in the model there is not unemployment.

[15] Usually the participation decision is analyzed looking at the reservation wage. Since we are interested in participation and commuting behaviours, we take a different perspective in the analysis. Instead of computing the reservation wage (the minimum wage offered to accept the job), we build our analysis on the maximum acceptable commuting time.

3.1.1 Two-earner couple

When both agents work the inequality in (6) holds with equality for both partners: the household consumes leisure up to the point where marginal utilities are proportional to market prices $(1, w_1, w_2)$.[16] Production inputs are selected in the same way, according to the first equality in (6): the ratio of marginal productivities must be equal to the corresponding price ratio.

By solving (6), we obtain the household's demand for leisure, l_s, and domestic times, h_s, the demand for market purchases, X_m, and the marginal utility of income at equilibrium, λ_3.

The demand for leisure is:

$$l_s = l_s(w_1, w_2, I) \qquad \text{for } s = 1, 2. \tag{9}$$

By using the definition of full income I in (8), the derivatives of leisure times with respect to the husband's commuting time t_1 are:

$$\frac{\partial l_1}{\partial t_1} = \frac{\partial l_1}{\partial I}\frac{\partial I}{\partial t_1} = -w_1\frac{\partial l_1}{\partial I} \tag{10}$$

$$\frac{\partial l_2}{\partial t_1} = \frac{\partial l_2}{\partial I}\frac{\partial I}{\partial t_1} = -w_1\frac{\partial l_2}{\partial I} \tag{11}$$

which are negative if leisure is a normal good, and they depend on the husband's opportunity cost of time, w_1.

As for time input in household production, the derivatives are:[17]

$$\frac{\partial h_1}{\partial t_1} = \frac{\partial h_1}{\partial I}\frac{\partial I}{\partial t_1} = -w_1\frac{\partial h_1}{\partial I} \tag{12}$$

$$\frac{\partial h_2}{\partial t_1} = \frac{\partial h_2}{\partial I}\frac{\partial I}{\partial t_1} = -w_1\frac{\partial h_2}{\partial I}. \tag{13}$$

The sign of these derivatives is ambiguous, as shown in Appendix B. It depends on whether marginal productivities are increasing or decreasing in either input (complements vs. substitutes) and on wage rates. The sign of (12) is negative while that of (13) is positive if inputs are complements or the production function is separable in its arguments. Signs may be the opposite (respectively, positive and negative) if we allow for substitutability in inputs and when women earn low wages.

As for working hours, by using the time constraint we get:

$$m_s = 1 - t_s - l_s(w_1, w_2, I) - h_s(w_1, w_2, I) \qquad \text{for } s = 1, 2, \tag{14}$$

[16] The price of X is normalized to 1.

[17] A complete characterization of comparative statics is available in Appendix B.

and the derivatives of interest are:

$$\frac{\partial m_1}{\partial t_1} = -1 + w_1 \left(\frac{\partial l_1}{\partial I} + \frac{\partial h_1}{\partial I} \right) \tag{15}$$

$$\frac{\partial m_2}{\partial t_1} = w_1 \left(\frac{\partial l_2}{\partial I} + \frac{\partial h_2}{\partial I} \right). \tag{16}$$

They are both ambiguous in sign, but they have a different interpretation.

As for (15), the first term is due to the fact that going to work involves a greater time cost and reduces total (own) available time, also for working. The second term is the income effect of an increase in t_1 on l_1 and h_1. In our general framework, the sign is ambiguous and depends on the primitives of the model, namely on assumptions related to marginal productivities between inputs, F_{jk}, and wages. It is negative when inputs are complements, it may be positive when they are substitutes and for low wage rates for women.

The sign of (16) depends instead on how h_2 responds to variations of t_1, if it is increasing or decreasing in income. In the simple work vs. leisure models, this sign was positive. In our model, it is still positive if inputs are complements, it may be negative in the case of substitutability between inputs.

Intuitively, the mechanism is the following. An increase in t_1 reduces consumption of leisure, l_1 and l_2, and of market purchases, X_m, if it is a normal good (standard in the previous literature). The response of partners' working hours and housework times depends on the assumptions on the production function F.

Without household production consumption is only monetary ($X = X_m$): the increase in t_1 is smoothed between the husband's leisure and working hours, which both decrease, while the wife supplies more hours on the market. The same mechanism is still at work when home production is separable in the market and home produced goods ($X = X_m + F(h_1, h_2)$) or when inputs are complements.

By introducing some substitutability among inputs, we may obtain different responses of the endogenous variables. For example, the reduction of X_m might be associated with an increase in the wife's domestic time, especially if she earns low wages, and a reduction in the husband's domestic time.[18] This leaves scope for higher (lower) husband (wife) working hours in response to the shock in the husband's commuting time.

Table 1 sums up our main results.

3.1.2 Single-earner couple

We now consider the case in which agent 2, the wife, does not work while her partner does ($1\{m_2 > 0\} = 0$). The optimal allocation for 1 is computed as before, and the same derivatives for own commuting time are valid. For individual 2, only the first equality in (6) holds and defines the demand for leisure: $l_2(w_1, I)$, where now full income is $I = w_1(1 - t_1)$. h_2 is determined as:

$$h_2(w_1, I) = 1 - l_2(w_1, I). \tag{17}$$

[18] Under $F_{X_m h_2} < 0$ and $F_{X_m h_1} > 0$.

When t_1 changes alone, we have:

$$\frac{\partial h_2}{\partial t_1} = -\frac{\partial l_2}{\partial I}\frac{\partial I}{\partial t_1} = w_1 \frac{\partial l_2}{\partial I} \tag{18}$$

which is positive if leisure is a normal good.

3.2 Effects on participation

Longer commuting time for husbands might push women to change their participation decisions (we assume that there are no fixed costs associated with quitting the job). As stated in subsection (2.2), the wife participates in the labour market if $t_2 \leq \bar{t}_2$, defined by (7). Differentiating this last equation and using Roy's identity, we get:[19]

$$\frac{\partial \bar{t}_2}{\partial t_1} = \frac{w_1}{w_2}\frac{U_I^* - \hat{U}_I}{\hat{U}_I} \tag{19}$$

where $U_I = \lambda_3 = U_X F_{X_m}$ is the marginal utility from income (Appendix A).

Longer commuting time for husbands causes a drop in total income and a reduction in family utility both when the woman works and when she does not. Her decision will depend on the relative cost, in terms of the family's utility, of t_1's increase when she works and when she does not, represented by the numerator in (19). If the cost is higher when the woman works, longer t_1 will reduce 2's participation and her propensity to commute.

To understand the intuition, consider the case of separable utility function and no household production (or X is quasi-linear in X_m). Consumption is only monetary and the drop of income is unambiguously more costly, in terms of utility, when the wife does not work.[20] The only way in which the wife can smooth and adjust the drop in utility is by agreeing to work and commute. In this case, for higher t_1 participation always increases even accepting longer commutes (see Figure 3 for a graphical description). This result is predicted also by means of single agent models (it corresponds to a reduction in non-labour income).

By introducing a general household production for good X, it may no longer be the case that the husband's longer commuting time pushes his wife to participate in the labour market. Unlike models in which only leisure is considered, the woman has an alternative to work in order to compensate for the drop in utility caused by the increased commuting time of her husbands: by staying at home she can contribute to the production of X.

[19]Moreover, we have

$$\frac{\partial \bar{t}_2}{\partial w_2} = \frac{\hat{m}_2}{w_2} > 0 \tag{1'}$$

$$\frac{\partial \bar{t}_2}{\partial w_1} = \frac{m_1^* - \hat{m}_1}{w_2} + \frac{1}{w_1}\frac{\partial \bar{t}_2}{\partial t_1} \tag{2'}$$

$\bar{t}_2$ is an increasing function of w_2: for higher wages, individual 2 is willing to commute more. This is in line with the literature on the wage effect of commuting (Manning, 2003; Mulalic et al., 2010). The sign of the second derivative is, instead, ambiguous.

[20]It is likely that, when the wife is not working, the household will consume more leisure and less X.

The consumption of X when both spouses work may now be lower than when only the husband works, especially when female time input is substitute of X_m. In this case the utility cost associated with the longer commuting time of the husband is higher when both spouses work and it may be worthwhile for the wife to increase housework (and exit the labour force) rather than to work in the market and incur in t_2 (Figure 4). This effect is expressed by the fact that F_{X_m} is smaller for higher values of h_2. The result is given by the fact that the presence of household production breaks the perfect correlation between income, consumption and utility.

Delving into (19), the relationship between the wife's propensity to participate and commute depends on her wage and on that of her husband:

$$\frac{\partial^2 \bar{t}_2}{\partial t_1 \partial w_2} = -\frac{w_1}{w_2^2}\left(\frac{U_I^*}{\hat{U}_I} - 1\right) - \frac{w_1}{w_2}\frac{U_I^*}{\hat{U}_I}\frac{\partial \hat{U}_I}{\partial w_2} \tag{20}$$

$$\frac{\partial^2 \bar{t}_2}{\partial t_1 \partial w_1} = \frac{1}{w_2}\left(\frac{U_I^*}{\hat{U}_I} - 1\right) + \frac{w_1}{w_2}\frac{1}{\hat{U}_I}\left(\frac{\partial U_I^*}{\partial w_1} - \frac{U_I^*}{\hat{U}_I}\frac{\partial \hat{U}_I}{\partial w_1}\right). \tag{21}$$

Since $\hat{U}_I$ is decreasing in w_2 by concavity of the utility function, for women receiving low wage offers[21] the relationship of interest (19) is likely to be negative: if the wage offer is low, the wife can contribute more to the family's utility by staying at home rather than by working on the market and incurring in the fixed time cost t_2 (the first term in (20) is negative and dominates the second one). For higher wage offers the effect of the husband's commuting time on the wife's participation is smaller in absolute value, up to the point equation (19) becomes positive. For even higher wage offers, the propensity to participate, as t_1 increases, becomes greater up to the point where the marginal increase in utility for the higher wage is so low that it cannot compensate for the longer commute (the first term in (20) dominates the second one).
The contrary happens with respect to the husband's wage. When the husband's wages are low, the wife has a higher incentive to participate, reducing the negative effect of the husband's longer commuting time on family utility, such that (19) is positive ($U_I^* > \hat{U}_I$). For higher w_1, the relationship becomes negative, since her contribution in terms of family income becomes negligible and she prefers to save t_2 and be more involved in home production.

4 Data

We now empirically solve the theoretical ambiguities that arise in the previous section. We aim to shed light on which mechanism is at play when there is a variation in husbands' commuting time. Our empirical application is based on information from the German

[21] If we assume that wage offers reflect individual productivity, we also interpret w_2 as the wife's education, as tested in the empirical part.

Socio-Economic Panel (GSOEP) for the years 1997-2010.[22] The GSOEP is a representative longitudinal survey conduced by the German Institute for Economic Research (DIW Berlin) covering about 11,000 households and more than 20,000 individuals starting from 1984. It contains detailed yearly information on individual socio-demographic characteristics, labour market experience, gross wages, working hours, self-reported commuting distance (in km) and household structure. Furthermore, in every wave, household members are asked about the amount of hours they spend on some activities in a typical working day (i.e. Monday to Friday). These include: "job, apprenticeship, second job (including travel time to and from work)", "errands (shopping, trips to government agencies, etc.)", "housework (washing, cooking, cleaning)", "childcare", "care and support for persons in need of care", and "repairs on and around the house, car repairs, garden work", "hobbies and free time activities" and "education or further training (also school, university)".

Models of time allocation within families are usually estimated using time use data. Our data differ from standard time use data because the GSOEP does not exhaustively describe time allocation in every moment of the usual week-day. It only reports time usually spent in the aforementioned activities. However, our data improve on the usual time use surveys in several ways. First, the GSOEP is a longitudinal survey, while time use data are usually repeated cross sections or, if panels, the number of observations and years is small and there may be only one respondent per household (as in the ATUS).[23] Second, the GSOEP contains much more detailed information on earnings, family structure, job and residential histories.

We focus on married (or cohabiting) individuals, aged between 18 and 60. As stated in the Introduction, we employ self-reported commuting distance (in km) from home to work as a proxy for commuting time.

Panel 1 of Table 2 reports descriptive statistics for the entire sample of married couples. As shown by Figures 1 and 2, time allocation differs between wives and husbands. Wives spend more time in housework and childcare and less time working and commuting with respect to their husbands. Panel 2 of Table 2 reports the same descriptives for the sample we are actually using for our empirical analysis (where the husband works). The figures obtained are very similar.

5 Empirical Strategy

The main equation of our reduced form empirical model estimates the sign of equation (19). No specific assumptions from the theoretical model are imposed in the empirical one. We do not assume any specific utility or production function. The estimation of a complete structural model is unfeasible in this case, because we do not have information on all price variables or on consumption goods, X.

[22] These are the only consecutive years for which we have information on commuting distance. Actually there is no information on the exact km distance for respondents who reside and work in the same town during the years 1997, 1999 and 2000. For these few cases, we impute their distance they declare in the closest available year (either 1998 or 2001). The results are robust to alternative imputation methods.

[23] American Time Use Survey.

One obvious concern, when analyzing the relationship between labour supply and commuting time, is that it may be endogenous. First, residential location and partners' labour supply choices are often made simultaneously. Second, couples where the husband is willing to commute long distances may be (unobservably) different from other couples. A simple OLS regression will probably be biased, and the direction of the bias is not clear a priori. We address this issue by analyzing time allocation responses when there is an arguably exogenous change in commuting time, while residence is fixed. In particular, we want to use employer-driven changes in commuting distance. We believe that this type of change is more likely to be exogenous.

Unfortunately, we do not have any explicit information on whether the firm in which the worker is employed relocated in the period under consideration. We therefore follow Gutiérrez-i Puigarnau and Van Ommeren (2010) and indirectly infer that any yearly change in reported commuting distance for an individual whose residential location and job[24] did not change, is employer-induced.[25] In order to exclude variations in home to work distance driven by changes of residence and employer, our preferred specification will include fixed effects for every (household-specific) combination of residential location-husband's job.[26] We, indirectly, conclude that any other change in reported distance is most likely to be employer-induced. One obviously important concern, of which we take extensive care in Subsection 6.2, is that these changes in commuting distance are actually due to measurement error in reporting km distances to work.

Firm relocations have been previously used in the literature (Gutiérrez-i Puigarnau and Van Ommeren, 2010; Mulalic et al., 2010; Zax and Kain, 1996; Fernandez, 1994, 2008) as a quasi-natural experiment for changes in commuting distance.

In order to understand the reliability of the variation we are exploiting, it is important to validate it by using external evidence that describes the actual frequency of firm/plant relocations and the type of firms that relocate. Brixy (2008) describes the frequency of firm relocation from one German municipality to another. Between 1994 and 2003, around 20,200 firms relocated each year, which is around 1% per year. This 1% is a lower bound of the changes in km distance we find in our data, because we also include changes of locations within the municipality and changes in location for the worker only (and not for the entire office/plant/firm).

Table 3 reports the within individual (for each job/residence combination) changes in commuting distance in our sample. These changes in distance are what we consider as employer-induced and we use them in our empirical analysis. Some 42% of individuals report variations in distances from one year to the next. However, only 8% report a change of more than 5 km, less likely to be due to measurement error, and only 4% report a change of more than 10 km. Finally, 7% of individuals report a change in municipality (from working in the town of domicile to working in another town and viceversa) within the same job/residence combination. This number is very unlikely to be due to misreporting. These figures are in line with those found by Gutiérrez-i Puigarnau and Van Ommeren

[24] By job we mean both position and employer.

[25] This clarifies why it is better for our empirical strategy to use commuting distance instead of time. Commuting time may change for many other reasons (traffic, improvement in public transport etc). Therefore it would difficult to infer plants/office relocations from changes in commuting time.

[26] Notice that our fixed effects exclude any change in commuting time due to a promotion or a job/task change.

(2010). Figure 5 provides a visual description of the variation we are actually using. The first panel shows the frequency of changes in commuting distance (keeping job and residence fixed). The second panel displays how commuting distances are correlated over time (always keeping residence and job fixed). From the first panel it is clear that in most cases the difference is 0, 1 or -1 km, presumably due to measurement error. However, the second panel shows that there is still some variation to be exploited. Subsection 6.2 will describe how we disentangle misreporting from true variations in commuting distances.

Finally Table 4 shows how couples experiencing shocks[27] in commuting times differ from other couples in terms of observable characteristics. Our identification strategy does not rely on the assumption that these couples should be similar, since we use individual fixed effects, however the fact that they do not appear to be different with respect to any (observable) dimension is reassuring: the (local) effects that we find do not refer to some particular small group of the population.

Let P^2_{qy} be a dummy equal to one if household member 2 (the wife),[28] within the residence-husband's (member 1) employer combination q[29] in year y, is employed. The reduced form of the wife's employment decision is:

$$P^2_{qy} = \beta_1 t^1_{qy} + \beta_2 W_{qy} + \alpha_y + \alpha_q + \epsilon_{qy} \tag{22}$$

where t^1_{qy} is the (log of) husband's commuting distance[30] in the residence/job combination q in year y; W_{qy} is a vector of time varying controls at the individual level;[31] α_y represents year fixed effects. Finally, α_q is the household-specific fixed effect for each combination (q) of residential location and husband's job. They capture time-invariant characteristics that are specific to each family residence-husband's job combination and allow us, therefore, to use only within-family variation for a given residential location and husband's job.[32] The fixed effect α_q represents our main identification strategy and allows us to exploit plausibly employer-induced variation in commuting distance. We exclude individuals with self-employed partners since self-employed individuals are likely to choose themselves where to work. In total we use about 32,000 observations referring to 6,500 individuals. In our preferred specifications, we include in total 10,500 fixed effects.

The coefficient β_1 of equation (22) gives the sign of equation (19) of our model. A

[27]We define couples as shocked by commuting time if they experience a change in work to home distance (keeping constant residence location and employer) of more than 5 km.

[28]Since we observe commuting time only for employed individuals, we may incur in the standard selection problem of the labour supply literature. For this reason, we exploit the fact that men suffer less from selection. In our sample about 84% of men are employed. We therefore only look at shocks in husband's commuting time. We only focus on the effect of commuting time for husbands on wives participation and on family time allocation.

[29]$q = irj^1$ where i denotes the couple, r is their residential location and j^1 is the husband's job/employer. This is the level of our fixed effects.

[30]We dropped all distances larger than 200 km (0.57% of the sample) in order to prevent a small number of observations from driving the results.

[31]In the main specification we only include both spouses' age. We do not include education, income and presence of children because they may be potentially endogenous. The results are very similar if we include these controls.

[32]In particular we code a household as having changed residence if it responds that they have changed domicile in the past year. We code an individual as having changed job/employer if the individual declares he has started a new job since the previous year.

negative β_1 implies that the husband's longer commuting time reduces his wife's propensity to work and commute. This is only generated by a model with household production and some substitutability between consumption inputs.

We also analyze the impact of the husband's commuting time on the entire family time allocation between leisure, market work, childcare and housework. In particular, we estimate the following set of equations for both partners:

$$z^s_{qy} = \theta_1 t^1_{qy} + \theta_2 W_{qy} + \delta_y + \delta_q + \eta_{qy} \tag{23}$$

where z^s_{qt} is the number of hours spent in leisure (l)/housework (h)/childcare/market work (m)[33] by spouse s (s=1,2) and other variables are defined as before.

The coefficient θ_1 of equation (23) combines the response to longer t^1_{qy} of families where the wife works (Subsection 3.1.1), where she does not work (Subsection 3.1.2) and where she changes her labour participation decision in response to the shock in t^1_{qy}. While on the hone hand, this means that we are unable to analyze the sign of each comparative statics of our model separately, on the other hand this is the parameter of policy interest as it tells us the aggregate time allocation response to a shock in the husband's commuting time.

Note that the use of δ_q fixed effects prevents us from analyzing possible effects of shocks in t^1_{qy} on the household's residence location or on the husband's job. We only capture employer-induced variations in commuting distance on households who did not change residence or (the husband's) job in response to a shock in t^1_{qy}. However, if anything, these effects should be small. In the GSOEP data, only 0.8% of individuals declare that they changed domicile from last year for job reasons.[34]

6 Results

The top panel of Table 5 reports some empirical results from estimating equation (22).[35]

The first column shows the OLS results. A 1% increase in the husband's commuting distance is associated with a 1 percentage point lower probability of the wife's labour force participation. Column 2 controls for individual fixed effects. The coefficient is similar. However, it may include the effect of endogenous job or residential location changes. Column 3 shows our preferred specification: it includes fixed effects for every residence/husband's job combination (α_q). We find that a 1% increase in husband's commuting distance generates a reduction in the wife's probability of participating into the labour market of 1.7 percentage points. This is 2% over the average (67% of women in our selected sample are in employment). This number is very similar when we compare estimates that include and exclude fixed effects.

In order to interpret our estimate of β_1 as the direct effect of the husband's commuting time on his wife's participation (equation (19) of our model), we need to assume that the

[33] m^s_{qt}=0 if s is out of the labour force

[34] For a detailed analysis of possible effects of commuting costs on residential and job decisions see Boehm (2013).

[35] Since we do not distinguish between non-working mothers actively looking for a job and those who are not looking for it, participation in the labour force coincides with being employed.

relocation only affects the family time allocation and the wife's participation through the change in the husband's commuting distance (exclusion restriction). We therefore check whether shocks in commuting distance are correlated with changes in the husband's job characteristics. In particular, the bottom panel of Table 5 displays the relationship between the logarithm of husband's hourly wage[36] and commuting distance. Some papers (Manning, 2003; Mulalic et al., 2010) document the presence of a wage gradient based on commuting distance. We want to check whether our results on the wife's labour force participation are driven by higher wages for husbands, implied by longer t_1.[37] This does not seem to be the case: the relationship is positive and significant in Columns 1 and 2 but it collapses to 0 when our fixed effects are introduced. The negative effect of a wife's labour supply is not driven by a (positive) shock in her husband's hourly wage.

In Table 6 we analyze how a shock in the husband's commuting distance affects time allocation within the family, equation (23). Our dependent variable is now the total number of hours usually spent in different activities during weekdays by each spouse, z^s_{qt}. For working hours we employ usual weekly hours of work (including overtime).[38] The reason is that in the time use section of the questionnaire daily working time is reported including commuting time; therefore, we prefer not to use this definition of working hours. Moreover, in the labour supply section of the questionnaire, while weekly working hours are available for all years, daily working hours and days of work are not available for 1998, 2001, 2003 and 2010. We prefer not to drop these years and use weekly working hours.[39]

Columns 1 and 2 show labour supply responses on the extensive and intensive margin, Column 3, 4 and 5 look, respectively, at responses on hours of housework, leisure and childcare. We consider childcare and housework separately because there is still an open discussion in the time use literature on whether childcare should be assimilated to housework or leisure (Guryan et al., 2008). Results do not change much if we jointly consider childcare and housework.

The top panel displays aggregate responses of the wife's time allocation. On average, a 1% increase in the husband's commuting time generates a reduction of 1.7 percentage points in his wife's labour force participation, and a reduction of 0.44 working hours per week.[40] The effect on housework and childcare is positive, but not significant at a conventional level. The bottom panel analyzes the husband's time allocation. An increase in his own commuting distance pushes the husband to work more hours in the labour market. Leisure time, childcare and housework decrease; coefficients are significant. Our results are consistent with an increase in specialization within the household.

[36]Net wages include any type of monetary benefit and bonus. This is computed as the ratio of monthly labour earning over weekly usual hours of work times 4.

[37]If the husband's wage increases as well as a consequence of employer-induced longer commuting distance, the estimated effect will be a combination of equation (19) and (2').

[38]To avoid sample selection we include the entire sample and we impute 0 working hours for non-working women. The effect will therefore be a combination of the effect on the extensive and intensive margin.

[39]This means that our coefficient in this case will combine the effect of commuting time on daily hours of work and on working days . Notice however that Gutiérrez-i Puigarnau and Van Ommeren (2010) use a similar identification strategy and the same dataset and find no effect of commuting distance on the number of working days per week; thus, we can infer the effect is mainly driven by daily working hours.

[40]Note that this effect combines responses on the intensive and on the extensive margin: m^2_{qt} is =0 if the woman does not work.

Our model supports these results only once we include household production. As shown in Section 2, only the presence of household production justifies the negative effect of longer t^1_{qt} on the wife's participation and the positive effect on the husband's labour supply.

6.1 Heterogeneity

Table 7 analyzes heterogeneity in the household's response to the husband's longer commuting time.

In Column 2 we investigate the sign of equations (20) and (21) of the model. We look at how our effect differs depending on the spouses' potential wages. We use education level[41] in the first year we observe each individual as a proxy for potential wages. We do not use current education levels because we are afraid it may endogenously respond to shocks in commuting time.[42] We find that the effect is mostly driven by couples with highly educated husbands. A 1% increase in the husband's commuting distance reduces his wife's labour force participation by 3 percentage points if the husband has postsecondary education.

In Columns 3 and 4 we analyze how our main effect varies in the presence of children. Column 4 looks at the current number of children, but, in order to address the problem of potential endogenous responses to shocks in commuting time, we only consider individuals aged between 30 and 45, very likely to still be living with their children but also to have already decided how many children to have. Column 3 reports the main estimates using the new sample. As expected, the effect is mostly driven by couples with children.

6.2 Dealing with Measurement Error

As pointed out in Section 4, measurement error in reported distances may be important in our setup. Workers may report small changes in distance from one year to the next, just because of measurement error. It is difficult to distinguish between misreporting and true changes in workplace location. We address the problem of measurement error in three ways.

First, as in Gutiérrez-i Puigarnau and Van Ommeren (2010), we use the logarithm of commuting distance throughout our analysis. This reduces the problem of measurement error because, even if it may be quite frequent, as long as it is small relative to the average commuting distance the (attenuation) bias in our estimates is likely to be small.

Second, we keep only the changes in commuting distance that seem more likely to be driven by true plant relocations. In particular, we build a new variable that flattens away all spikes in commuting distance that appear from one year to the next.[43] Figure 6 shows how the new variable works. The solid line displays reported commuting distance. The dashed line displays the 'adjusted' commuting distance. Panel *a* refers to an individual

[41] In particular, a dummy=1 if they have post-secondary education in the first year we observe them in our panel. This is because we do not want to include potentially endogenous changes in education. However, the results do not change.

[42] The results are even stronger if we use current educational levels.

[43] In practice we generate two of these variables, one that flattens away spikes in commuting time of less than 5 km and the other that flattens away any spikes in commuting distance.

who has never changed reported commuting distance. In this case the two variables are identical. Panel *b* refers to an individual who has changed commuting distance, but the change is temporary. In this case the dashed line does not consider the change. Finally, panel *c* refers to an individual who reports a change in commuting distance and the change lasts for more than one time period. Again, the two lines behave identically. Table 8 reports the results using the adjusted measure of commuting distance. The results are almost unchanged. The estimate of β_1 is slightly more negative, because of the reduction in the attenuation bias.

The third way we deal with measurement error is by instrumenting commuting distance with a proxy of commuting time (Griliches, 1979). In particular, our commuting time proxy is built as the difference between reported daily working hours (including overtime and commuting time), taken from the time use section of the questionnaire and usual daily working hours, taken from the labour supply section of the questionnaire.[44]

Columns 5 and 6 of Table 9 show our first stage. The correlation between our proxy of commuting time and commuting distance, with and without fixed effects, is positive and significant. The F statistics for the excluded instrument are 484 and 22 respectively. Columns 1 and 3 report the usual estimates (with and without fixed effects), as a benchmark. Columns 2 and 4 report results from the IV estimation. The coefficient is still negative, and, as expected, the size increases in absolute value. However, once we include fixed effects we lose some precision and our IV coefficient is not significant anymore.

7 Conclusion

This paper enriches the literature on the relationship between commuting time and labour supply by analyzing some hitherto unexplored aspects: we analyze the effect of shocks to husbands' commuting time on their wives' labour market participation and on families' time allocation.

We build a unitary family model in which partners decide whether the wife participates or not participate in the labour force and how to allocate their time between leisure, housework and market work. A key ingredient of our model is the inclusion of household production. Household production implies the existence of another margin of adjustment to shocks to husbands' commuting time. Consider an increase in a husband's commuting time, which generates a drop in the family's total income. In the absence of household production, the standard labour supply model unambiguously predicts an increase in the wife's labour supply (both in terms of intensive and extensive margin) and a decrease in the husband's working hours. With household production it may be more advantageous for the household to have only one working partner: the wife will stay out of the labour force, save her commuting time and increase housework; the husband will increase his

[44] In particular we obtain total time spent working from the time use question: "How many hours do you spend on the job, apprenticeship, second job (including travel time to and from work) on a typical weekday?". We obtain hours spent working from the question "And how much on average does your actual working week amount to, with possible overtime?" divided by 5 (we are therefore assuming that weekly workdays are five for everybody). We do not use the question in the labour supply survey on daily working hours because it is not available for the years 1998, 2001, 2003 and 2010. But, when we check using available data, the number of working days is usually five per week.

working hours. This is exactly the mechanism we find in place in the empirical part.

We solve the theoretical ambiguities in the relationships of interest by using data from the German Socio-Economic Panel between 1997 and 2010. The panel structure of our data allows us to take care of possible endogeneity in commuting distance by using fixed effects and considering only those husbands who experienced plausibly employer-induced changes in commuting distance. Specifically, we only exploit within family variation of commuting distance, when there are no changes in the household's residence and husband's job. The results show that the husband's longer commuting time increases labour specialization within the couple, by reducing women's labour supply on the extensive margin. A 1% increase in men's commuting distance decreases women's labour supply on the extensive margin by 1.7 percentage points, 2% over the average. Moreover, we find that an increase in the husband's commuting time positively affects his working hours, as found in Gutiérrez-i Puigarnau and Van Ommeren (2010) and Gimenez Nadal and Molina (2011).

The average effect masks substantial heterogeneity: reductions in participation are concentrated in couples with children and where the husband has higher levels of education. These results are consistent with a family model in which the consumption good is obtained by combining market and time inputs and when there is a significant gender pay gap among partners.

We view our results here as potentially relevant for evaluating policies aimed at reducing commuting time and, more broadly, policies that affect any family member's time allocation. In designing such policies governments should take into account their indirect effect on other family members. Our analysis sheds light on the importance of looking at labour supply decisions in a family context and including household production in labour supply models (Becker, 1981).

Appendices

A Kuhn-Tucker conditions for the household problem

$$\begin{aligned}
U_{l_s} &= \lambda_s \\
U_X F_{h_s} &= \lambda_s \\
U_X F_{X_m} &= \lambda_3 \\
\lambda_3 w_1 &= \lambda_1 \\
\lambda_3 w_2 + \mu_2 &= \lambda_2 \\
\mu_2 &\geq 0 \\
\mu_2 m_2 &= 0
\end{aligned}$$

for $s = 1, 2$, time and budget constraints are satisfied.

B Comparative statics

For tractability of the problem we assume separability in the utility function, namely in X, l_1 and l_2, and equality in cross derivatives of inputs, i.e. $F_{jk} = F_{kj}$, $j \neq k$, $j, k = X_m, h_1, h_2$. The Hessian matrix of the problem in Subsection 2.1, defined for m_i and h_i, $i = 1, 2$, is as follows.

$$H = \begin{bmatrix} F_{h_1}^2 U_X'' + w_1^2 U_X F_{X_m}'' + U_{l_1}'' & F_{h_1}^2 U_X'' + w_1 U_X F_{X_m h_1} + U_{l_1}'' & w_1 w_2 U_X'' F_{X_m}^2 + w_1 w_2 U_X F_{X_m}'' & w_1 U_X'' F_{X_m} F_{h_2} + w_1 U_X F_{X_m h_2} \\ F_{h_1}^2 U_X'' + w_1 U_X F_{X_m h_1} + U_{l_1}'' & U_X'' F_{h_1}^2 + U_X'' F_{h_1} \tilde{A},0\hat{A} + U_{l_1}'' & U_X'' F_{h_1} F_{h_2} + w_2 U_X F_{h_1 X_m} & U_X'' F_{h_1} F_{h_2} + U_X F_{h_1 h_2} \\ w_1 w_2 U_X'' F_{X_m}^2 + w_1 w_2 U_X F_{X_m}'' & U_X'' F_{h_1} + F_{h_2} + w_2 U_X F_{h_1 X_m} & F_{h_2}^2 U_X'' + w_2^2 U_X F_{X_m}'' + U_{l_2}'' & F_{h_2}^2 U_X'' + w_2 U_X F_{X_m h_2} + U_{l_2}'' \\ w_1 U_X'' F_{X_m} F_{h_2} + w_1 U_X F_{X_m h_2} & U_X'' F_{h_1} F_{h_2} + U_X F_{h_1 h_2} & F_{h_2}^2 U_X'' + w_2 U_X F_{X_m h_2} + U_{l_2}'' & U_X'' F_{h_2}^2 + U_X F_{h_2}'' + U_{l_2}'' \end{bmatrix}$$

To focus on the role of household production played in determining the optimal responses of endogenous variable to variations in commuting time, we assume a quasi-linear utility function in X. Thus, the Hessian matrix simplifies as follows:

$$H = \begin{bmatrix} w_1^2 F_{X_m}'' + U_{l_1}'' & w_1 F_{X_m h_1} + U_{l_1}'' & w_1 w_2 F_{X_m}'' & w_1 F_{X_m h_2} \\ w_1 F_{X_m h_1} + U_{l_1}'' & F_{h_1}'' + U_{l_1}'' & w_2 F_{h_1 X_m} & F_{h_1 h_2} \\ w_1 w_2 F_{X_m}'' & w_2 F_{h_1 X_m} & w_2^2 F_{X_m}'' + U_{l_2}'' & w_2 F_{X_m h_2} + U_{l_2}'' \\ w_1 F_{X_m h_2} & F_{h_1 h_2} & w_2 F_{X_m h_2} + U_{l_2}'' & F_{h_2}'' + U_{l_2}'' \end{bmatrix}$$

Deriving (6) with respect to t_1 we get:

$$H \begin{bmatrix} m_1' \\ h_1' \\ m_2' \\ h_2' \end{bmatrix} = \begin{bmatrix} -U_{l_1}'' \\ -U_{l_1}'' \\ 0 \\ 0 \end{bmatrix}$$

and using Cramer's rule we get the derivatives of interest ($\det(H) > 0$ since the maximum problem is well-defined). The signs are ambiguous and they depend on the complementarity/substitutability assumptions between inputs, more specifically on marginal productivities being increasing or decreasing in other inputs, and on wage rates.

The derivatives are as follows:

$$m_1' < 0$$
$$h_1' < 0$$
$$m_2' > 0$$
$$h_2' < 0$$

if F is separable in its arguments. The derivatives are likely to be the same if $F_{jk} > 0$. The signs may be different if $F_{jk} < 0$, when there is some degree of substitutability among inputs.

In case of perfect substitutability only the cheapest input is used. To have both individuals work, we assume $1 < w_1$ and $1 < w_2$, where the price of X_m is normalized to 1. Under perfect substitutability, $h_1 = h_2 = 0$ and $m_1' < 0, m_2' > 0$.

Numerical example:

$$F = \left[aX_m^{\frac{\rho-1}{\rho}} + bh_1^{\frac{\rho-1}{\rho}} + ch_2^{\frac{\rho-1}{\rho}} \right]^{\gamma \frac{\rho}{\rho-1}}$$

where $\rho > 0$ and $0 < \gamma < 1$.

$$F_{jk} = F_{kj} = \gamma \frac{\rho(\gamma-1)+1}{\rho-1} \epsilon_j \epsilon_k (jk)^{\frac{-1}{\rho}} \left[aX_m^{\frac{\rho-1}{\rho}} + bh_1^{\frac{\rho-1}{\rho}} + ch_2^{\frac{\rho-1}{\rho}} \right]^{\frac{\rho\gamma-2(\rho-1)}{\rho-1}}$$

where ϵ_j, ϵ_k are, respectively, productivity of input j and k. The cross marginal productivity is decreasing in ρ. It is negative for $\rho > 1/(1-\gamma)$.

C Discussion: alternative models of household decision making

Dealing with a two-person household rather than a single agent is a difficult task, since it requires explicit assumptions on how partners interact in taking decisions. In this paper we adopt the simplest possible framework, the unitary model: the household is treated as a single decision unit, in which partners' leisure is an argument of the household's utility function (Samuelson, 1956). In this section, we discuss whether our results are driven by the specific setting assumed. An alternative and more general framework for analyzing household behaviour is Chiappori (1992)'s collective model. Departing from the specific way through which partners bargain over time and consumption allocations, in this model any decision process leads to Pareto-efficient solutions, while partners maintain their individual utility. The Pareto efficient solution is decentralized by: first, the fact that partners establish the sharing rule according to which they share family income, second, that they maximize their respective utility given the sharing rule.

In the collective model without household production, a reduction in the husband's commuting time reduces total family income. The effect on partners' labour supply depends on how the sharing rule reacts to the lower family income. If both partner's have less disposable income, labour supply responses are the same as in the unitary model: the wife works more, the husband less. The only way to obtain the opposite result is that the share of income addressed to the wife increases along with the husband's commuting time, consistent with a bargaining power tilted in favour of the wife for longer husbands' commuting time. However, no model has shown bargaining power being dependent on commuting times and it seems quite unrealistic that the more effort the husband is exerting to reach the workplace, the less he is influential in the household decision process. The only way through which is plausible to observe different responses of labour supplies is by introducing household production. However, aside from making the model very complicated, the same mechanism we covered in the paper would apply as well as in a collective model with corner solutions.

References

Abe, Y. (2011). Family labor supply, commuting time, and residential decisions: The case of the tokyo metropolitan area. *Journal of Housing Economics 20*(1), 49–63.

Barron, J. M., D. A. Black, and M. A. Loewenstein (1993). Gender differences in training, capital, and wages. *Journal of Human Resources*, 343–364.

Becker, G. S. (1981, October). *A Treatise on the Family.* Number beck81-1 in NBER Books. National Bureau of Economic Research, Inc.

Black, D. A., N. Kolesnikova, and L. J. Taylor (2013). Why do so few women work in new york (and so many in minneapolis)? labor supply of married women across us cities. *Journal of Urban Economics*.

Blau, F. D. and L. M. Kahn (2007). Changes in the labor supply behavior of married women: 19802000. *Journal of Labor Economics 25*, 393–438.

Bloemen, H. and E. G. F. Stancanelli (2008, September). How do parents allocate time? the effects of wages and income. IZA Discussion Papers 3679.

Blundell, R., A. Bozio, and G. Laroque (2011). Extensive and intensive margins of labour supply: working hours in the us, uk and france. Technical report, IFS working papers.

Boehm, M. J. (2013). Concentration versus re-matching? evidence about the locational effects of commuting costs.

Brixy, U. (2008, October). Welche betriebe werden verlagert? : Beweggrnde und bedeutung von betriebsverlagerungen in deutschland. IAB Discussion Paper 200839.

Browning, M. and C. Meghir (1991). The effects of male and female labor supply on commodity demands. *Econometrica: Journal of the Econometric Society*, 925–951.

Buchinsky, M., C. Gotlibovski, and O. Lifshitz (2014). Residential location, work location, and labor market outcomes of immigrants in israel. *Econometrica 82*(3), 995–1054.

Chiappori, P.-A. (1992). Collective labor supply and welfare. *Journal of political Economy*, 437–467.

Cogan, J. F. (1981). Fixed costs and labor supply. *Econometrica 49*(4), 945–964.

Fernandez, R. M. (1994). Race, space, and job accessibility: Evidence from a plant relocation. *Economic Geography*, 390–416.

Fernandez, R. M. (2008). Race, spatial mismatch, and job accessibility: Evidence from a plant relocation. *Social Science Research 37*(3), 953–975.

Gimenez, J. I. and J. A. Molina (2015). Commuting time and household responsibilities: Evidence using propensity score matching.

Gimenez Nadal, J. and J. Molina (2011). Commuting Time and Labour Supply: A Causal Effect? Technical report, Institute for the Study of Labor (IZA).

Goux, D. and E. Maurin (2010). Public school availability for two-year olds and mothers' labour supply. *Labour Economics 17*(6), 951–962.

Graham, J. W. and C. A. Green (1984). Estimating the parameters of a household production function with joint products. *The Review of Economics and Statistics 66*(2), 277–82.

Griliches, Z. (1979). Sibling models and data in economics: Beginnings of a survey. *Journal of Political Economy 87*(5), S37–64.

Gronau, R. (1977, December). Leisure, home production, and work-the theory of the allocation of time revisited. *Journal of Political Economy 85*(6), 1099–1123.

Guryan, J., E. Hurst, and M. Kearney (2008). Parental education and parental time with children. *The Journal of Economic Perspectives 22*(3), 23.

Gutiérrez-i Puigarnau, E. and J. Van Ommeren (2010). Labour supply and commuting. *Journal of Urban Economics 68*(1), 82–89.

Heim, B. T. (2007). The incredible shrinking elasticities: Married female labor supply, 19782002. *Journal of Human Resources 42*(4).

Kleven, H. J., C. T. Kreiner, and E. Saez (2009). The optimal income taxation of couples. *Econometrica 77*(2), 537–560.

Kooreman, P. and A. Kapteyn (1987). A disaggregated analysis of the allocation of time within the household. *The Journal of Political Economy 95*(2), 223.

Lundin, D., E. Mörk, and B. Öckert (2008). How far can reduced childcare prices push female labour supply? *Labour Economics 15*(4), 647–659.

MacDonald, H. I. (1999). Women employment and commuting: explaining the links. *Journal of Planning Literature 13*(3), 267–283.

Madden, J. F. and M. J. White (1980). Spatial implications of increases in the female labor force: a theoretical and empirical synthesis. *Land Economics*, 432–446.

Manning, A. (2003, April). The real thin theory: monopsony in modern labour markets. *Labour Economics 10*(2), 105–131.

Mulalic, I., J. N. van Ommeren, and N. Pilegaard (2010, September). Wages and commuting: Quasi-natural experiments' evidence from firms that relocate. Technical Report 10-093/3, Tinbergen Institute.

OECD (2010). Family database LMF2.6: Time spent travelling to and from work, http://www.oecd.org/social/soc/oecdfamilydatabase.htm.

Rouwendal, J. (1999). Spatial job search and commuting distances. *Regional Science and Urban Economics 29*(4), 491–517.

Samuelson, P. A. (1956). Social indifference curves. *The Quarterly Journal of Economics*, 1–22.

Solberg, E. J. and D. C. Wong (1992). Family time use: Leisure, home production, market work, and work related travel. *The Journal of Human Resources 27*, 485–510.

Turner, T. and D. Niemeier (1997). Travel to work and household responsibility: new evidence. *Transportation 24*(4), 397–419.

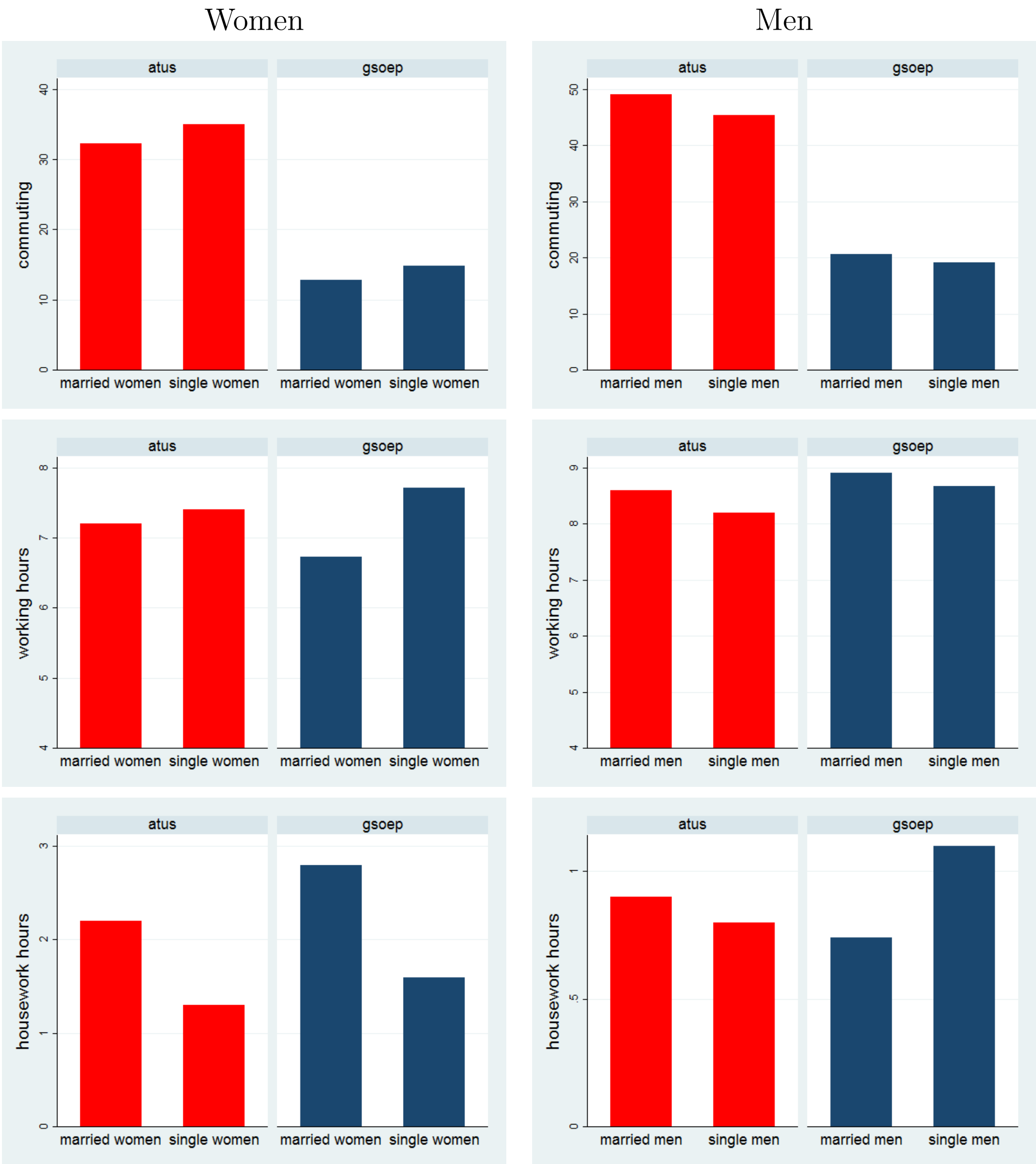
Van den Berg, G. J. and C. Gorter (1997). Job search and commuting time. *Journal of Business & Economic Statistics 15*(2), 269–281.

Wales, T. J. (1978). Labour supply and commuting time: an empirical study. *Journal of Econometrics 8*(2), 215–226.

Zax, J. S. and J. F. Kain (1996). Moving to the suburbs: do relocating companies leave their black employees behind? *Journal of Labor Economics*, 472–504.

Figures

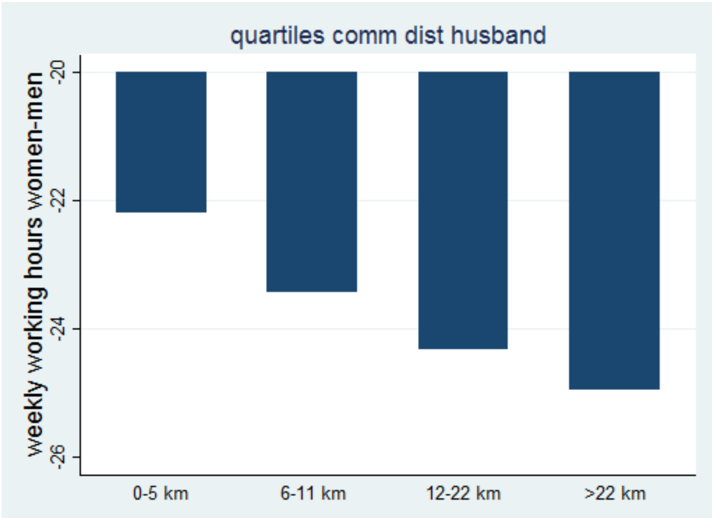
Figure 1: Gender differences in time allocation, by marital status



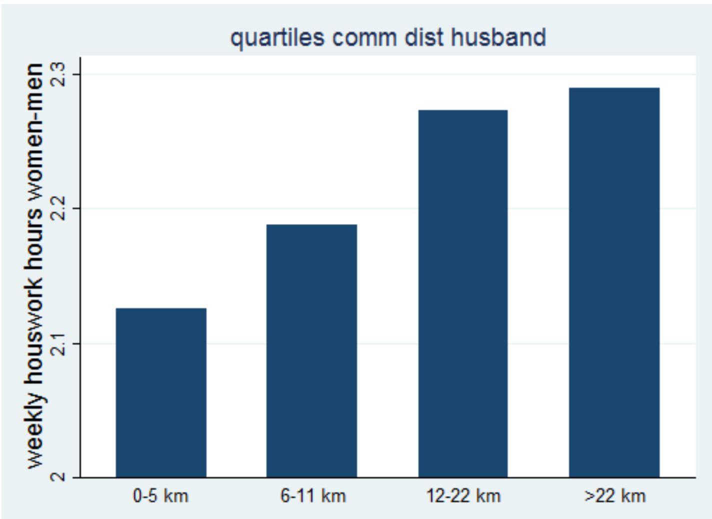
Source: ATUS (2012) and GSOEP (1997-2010). In GSOEP we compute daily working hours by dividing weekly working hours by the average number of workdays, approximately five.

Figure 2: Gender differences in time allocation, by the husband's commuting time - married individuals

Difference in working hours



Difference in housework



Source: GSOEP (1997-2010). The difference is between the hours devoted by the wife to some activity and those of the husband.

Figure 3: When the husband's commuting time increases, the wife's participation and propensity to commute are higher

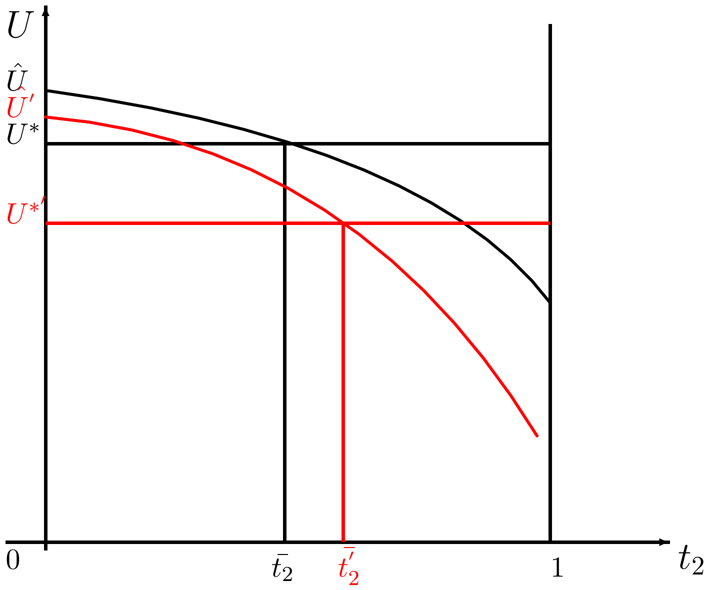


Figure 4: When the husband's commuting time increases, the wife's participation and propensity to commute are lower

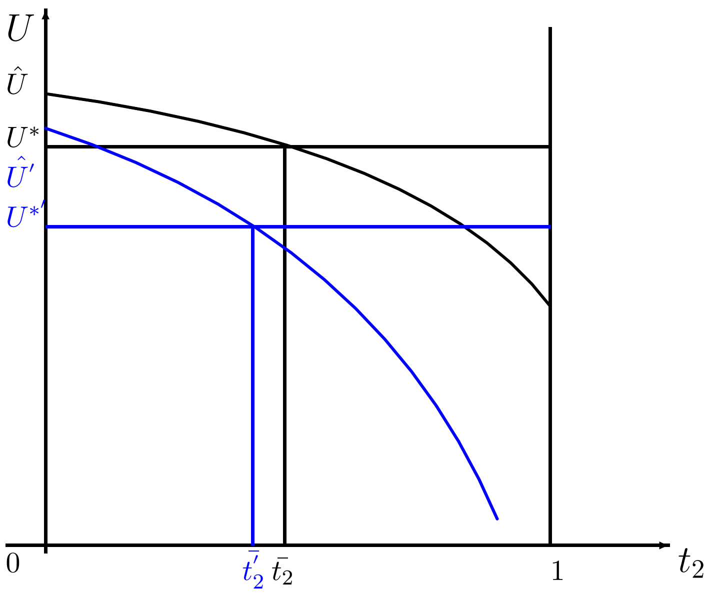
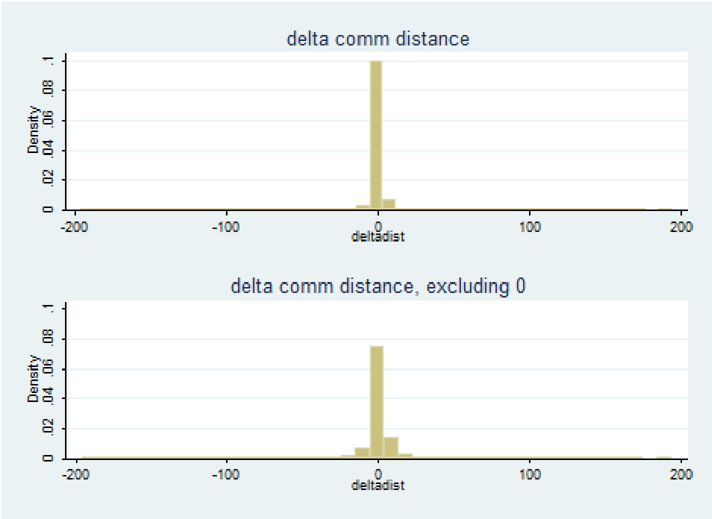
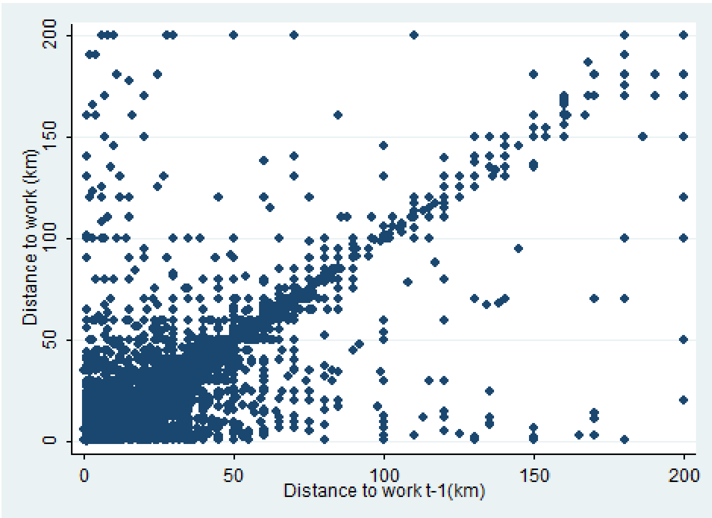


Figure 5: Variation in commuting distances (keeping residence and job fixed)

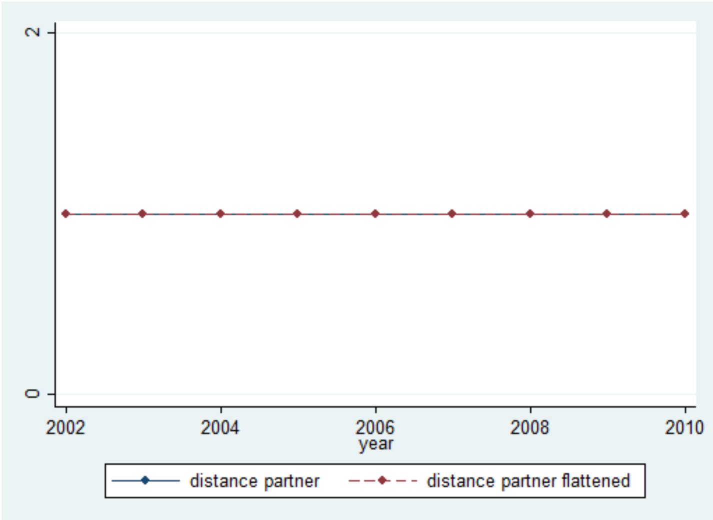


histogram of changes

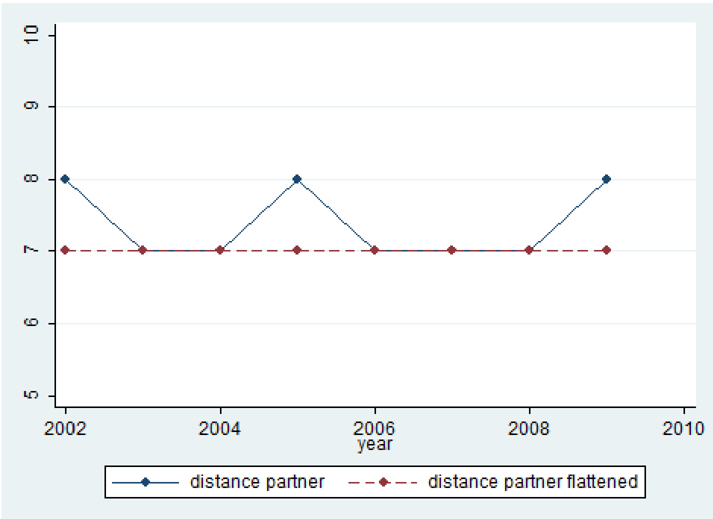


scatter commuting distances over time

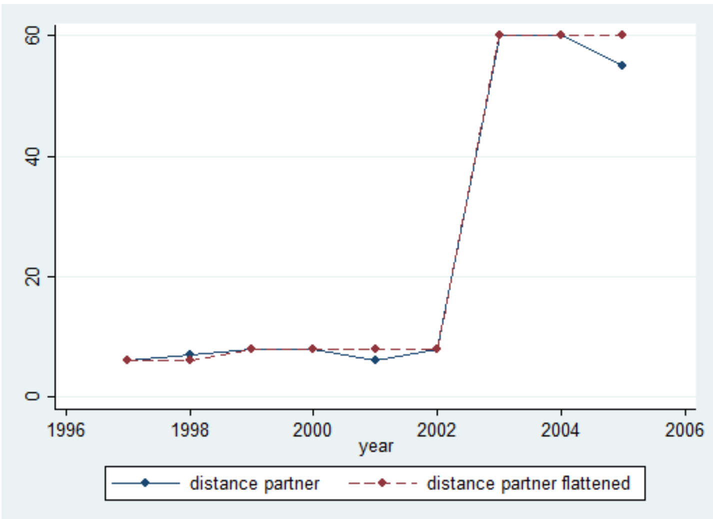
Figure 6: Correction for measurement error in reported commuting distances



a



b



c

Tables

Table 1: Effects of changes in the husband's commuting time on families' time allocation, two-earner couples

Results for $F_{jk} = 0$ and consistent with $F_{jk} > 0$	Results consistent with $F_{jk} < 0$
$m_1' < 0$	$m_1' > 0$
$h_1' < 0$	$h_1' < 0$
$l_1' < 0$	$l_1' < 0$
$m_2' > 0$	$m_2' < 0$
$h_2' < 0$	$h_2' > 0$
$l_2' < 0$	$l_2' < 0$

Table 2: Summary statistics

	mean women	mean men	diff
	[1]	[2]	[3]
All married couples			
employed	0.674	0.882	-0.208***
	(0.001)	(0.002)	(0.003)
h work (incl. overtime)[a] (weekly)	30.106	44.788	-14.682***
	(0.045)	(0.072)	(0.081)
h housework (daily)	2.817	0.697	2.120***
	(0.008)	(0.004)	(0.009)
h leisure (daily)	1.690	1.696	-0.006***
	(0.006)	(0.007)	(0.009)
h childcare (daily)	3.445	0.893	2.552***
	(0.022)	(0.007)	(0.021)
distance[a] (km)	12.138	19.664	-7.526***
	(0.087)	(0.119)	(0.154)
education (isced[b])	3.632	3.897	-0.266***
	(0.006)	(0.006)	(0.009)
hh size	3.394		-
	(1.114)		
Regression sample			
employed	0.673	1	-0.327***
	(0.002)	(0.000)	(0.002)
h work (incl. overtime)[a] (weekly)	29.11	43.296	-14.186***
	(0.089)	(0.054)	(0.103)
h housework (daily)	2.850	0.597	2.253***
	(0.010)	(0.004)	(0.011)
h leisure (daily)	1.65	1.515	0.140***
	(0.008)	(0.007)	(0.008)
h childcare (daily)	3.581	0.854	2.727***
	(0.029)	(0.008)	(0.026)
distance[a] (km)	11.980	19.574	-7.593***
	(0.105)	(0.167)	(0.180)
education (isced[b])	3.664	3.929	-0.266***
	(0.008)	(0.008)	(0.008)
hh size	3.438		-
	(1.090)		

Estimated standard errors of the sample mean in parenthesis. The sample includes all married individuals between 18 and 60. * p<0.10, ** p<0.05, *** p<0.01.

[a] conditional on working.

[b] 0=in school; 1= inadequately; 2= general elementary; 3=middle vocational; 4= vocational; 5=higher vocational; 6=higher education.

Table 3: Changes in husbands' commuting distances

Frequency	
Changes in distance[a]	42.19%
Changes in distance (of more than 5 km)[b]	8.20%
Changes in distance (of more than 10 km)[c]	3.91%
Stop working and residing in the same town[d]	6.72%

[a] 1 if km distance in $t-1$ is different from km distance in t (in the same job-residence combination).

[b] 1 if km distance in $t-1$ is more than 5 km different from km distance in t (in the same job-residence combination).

[c] 1 if km distance in $t-1$ is more than 10 km different from km distance in t (in the same job-residence combination).

[d] 1 if changes in the answer to the question: "do you work and reside in the same town?" (in the same job-residence combination).

Table 4: Characteristics of different households, by employer-induced changes in husbands' commuting distances

Variable	mean if $\|\Delta t_1\| < 5km$	mean if $\|\Delta t_1\| > 5km$	diff
1=uni woman	0.345	0.337	0.008
	(0.003)	(0.011)	(0.012)
1=uni man	0.420	0.426	-0.007
	(0.003)	(0.012)	(0.012)
n children	0.982	1.005	-0.023
	(0.007)	(0.025)	(0.026)
log wage man	2.456	2.451	0.005
	(0.003)	(0.013)	(0.010)

Group 1 is composed by households whose husband did not experience a change of at least 5 km in commuting distance. Group 2 is composed by households whose husband experienced a change in commuting distance of more than 5 km.
* p<0.10, ** p<0.05, *** p<0.01.

Table 5: Effects of changes in husbands' commuting distance on wives' employment and their own wage

	[1]	[2]	[3]
Dep. variable: 1=wife is employed			
log dist husb	-0.010**	-0.009*	-0.017**
	(0.004)	(0.005)	(0.007)
age	0.003*	-0.034	-0.039
	(0.002)	(0.024)	(0.026)
age husb	0.005***	-0.012	-0.008
	(0.001)	(0.010)	(0.014)
Dep. variable: husband log(hourly wage)			
log dist husb	0.061***	0.009**	0.006
	(0.005)	(0.004)	(0.004)
age	-0.001	-0.004	-0.004
	(0.002)	(0.007)	(0.006)
age husb	0.008***	0.010	0.009
	(0.002)	(0.011)	(0.010)
N	31735	31735	31735
N individuals	6508	6508	6508
Fe	no	i^a	q^b

Robust standard errors, clustered by household, in parentheses. The sample includes all married individuals between 18 and 60. Additional control: year fixed effects. * p<0.10, ** p<0.05, *** p<0.01.

[a] This refers to household fixed effects.

[b] This refers to fixed effects for household's specific combination of residential location and husband's job.

Table 6: Effects of changes in husbands' commuting distance on partners' time allocation

Variables	1=employed	h work[a] (m)	h housework[b] (h)	h leisure[b] (l)	h childcare[b]
	[1]	[2]	[3]	[4]	[5]
			married women on husband distance		
log dist husb	-0.017**	-0.435**	0.013	-0.014	0.079
	(0.007)	(0.200)	(0.025)	(0.024)	(0.068)
			married men on own distance		
log dist husb	-	0.221**	-0.023*	-0.063***	-0.047**
	-	(0.110)	(0.013)	(0.020)	(0.022)
N	-	31735	31735	31735	31735
Fe (q)	yes	yes	yes	yes	yes

Robust standard errors, clustered by household, in parentheses. Additional control: wife's age; husband's age; year fixed effects. The sample contains only married women between 18 and 60. * p<0.10, ** p<0.05, *** p<0.01.

[a] This refers to weekly usual working hours (including overtime). The daily working hours, as reported in the time use section, include commuting time and it is therefore inconsistent to use them.

[b] This refers to hours usually spent in a typical work day.

Table 7: Heterogeneity by partners' level of education and number of children in the family

Variables	Dependent variable: 1=wife is employed				
	[1]	[2]	[3][c]	[4][c]	[5][c]
log dist part	-0.017**	-0.011	-0.018*	0.005	0.013
	(0.007)	(0.009)	(0.010)	(0.013)	(0.017)
l dist part*(1=wife uni)[a]		0.016			0.009
		(0.014)			(0.020)
l dist part*(1=husb uni)[a]		-0.029**			-0.036*
		(0.014)			(0.020)
l dist part*n children[b]				-0.016**	-0.015**
				(0.008)	(0.007)
N	31735	31735	16132	16132	16132
Fe (q)	yes	yes	yes	yes	yes

[a] Dummy=1 if wife (or husband) has postsecondary education. Education refers to the first period we observe the wife (w) or the husband (h), usually 1997.

[b] This refers to the number of children in the initial period.

[c] Only for individuals between 30 and 45 year old. Results do not change if we run the same regression for the entire sample.

Robust standard errors, clustered by household, in parentheses. Additional control: wife's age; husband's age; year fixed effects. The sample contains only married women between 18 and 60. * p<0.10, ** p<0.05, *** p<0.01.

Table 8: First method to control for measurement error in reported commuting distances

Variables	Dependent variable: 1=employed					
	[1]	[2]	[3]	[4]	[5]	[6]
log dist husb	-0.010**	-0.017**				
	(0.004)	(0.007)				
log dist husb[a]			-0.010**	-0.019**		
(adj. 10 km spikes)			(0.004)	(0.008)		
log dist husb[b]					-0.008*	-0.032***
(adj. any spikes)					(0.004)	(0.012)
N	31735	31735	31735	31735	31259	31259
Fe (q)	no	yes	no	yes	no	yes

Robust standard errors, clustered by household, in parentheses. Additional control: year fixed effects; wife's age and husband's age. The sample contains only married women between 18 and 60. * p<0.10, ** p<0.05, *** p<0.01.

[a] All spikes in commuting distance (for a give residence location and job combination) that last only 1 year and are of less than 10 km are flattened away.

[b] All spikes in commuting distance (for a give residence location and job combination) that last only 1 year are flattened away.

Table 9: Second method to control for measurement error in reported commuting distances

Variables	Dependent variable: 1=employed				log distance husband	
	[1]	[2]	[3]	[4]	[5]	[6]
	OLS	IV[a]	OLS	IV[a]	FS	FS
log dist husb	-0.010**	-0.022	-0.017**	-0.072		
	(0.004)	(0.014)	(0.007)	(0.162)		
dist husb proxy[b]					0.183***	0.011***
					(0.008)	(0.002)
age	0.003*	0.003*	-0.039	-0.034	0.011***	0.097
	(0.002)	(0.002)	(0.026)	(0.033)	(0.004)	(0.070)
age partner	0.005***	0.005***	-0.008	-0.012	-0.015***	-0.079*
	(0.001)	(0.001)	(0.014)	(0.019)	(0.004)	(0.043)
N	31735	31735	31735	31735	31735	31735
Fe (q)	no	no	yes	yes	no	yes

Robust standard errors, clustered by household, in parentheses. Additional control: year fixed effects, wife's age and husband's age. The sample contains only married women between 18 and 60. * p<0.10, ** p<0.05, *** p<0.01.

[a] Partner's distance from work (in km) is instrumented with a proxy for commuting time (see text, Section 6.2).

[b] See text, Section 6.2.

RECENTLY PUBLISHED "TEMI" (*)

N. 981 – *The academic and labor market returns of university professors*, by Michela Braga, Marco Paccagnella and Michele Pellizzari (October 2014).

N. 982 – *Informational effects of monetary policy*, by Giuseppe Ferrero, Marcello Miccoli and Sergio Santoro (October 2014).

N. 983 – *Science and Technology Parks in Italy: main features and analysis of their effects on the firms hosted*, by Danilo Liberati, Marco Marinucci and Giulia Martina Tanzi (October 2014).

N. 984 – *Natural expectations and home equity extraction*, by Roberto Pancrazi and Mario Pietrunti (October 2014).

N. 985 – *Dif-in-dif estimators of multiplicative treatment effects*, by Emanuele Ciani and Paul Fisher (October 2014).

N. 986 – *An estimated DSGE model with search and matching frictions in the credit market*, by Danilo Liberati (October 2014).

N. 987 – *Large banks, loan rate markup and monetary policy*, by Vincenzo Cuciniello and Federico M. Signoretti (October 2014).

N. 988 – *The interest-rate sensitivity of the demand for sovereign debt. Evidence from OECD countries (1995-2011)*, by Giuseppe Grande, Sergio Masciantonio and Andrea Tiseno (October 2014).

N. 989 – *The determinants of household debt: a cross-country analysis*, by Massimo Coletta, Riccardo De Bonis and Stefano Piermattei (October 2014).

N. 990 – *How much of bank credit risk is sovereign risk? Evidence from the Eurozone*, by Junye Li and Gabriele Zinna (October 2014).

N. 991 – *The scapegoat theory of exchange rates: the first tests*, by Marcel Fratzscher, Dagfinn Rime, Lucio Sarno and Gabriele Zinna (October 2014).

N. 992 – *Informed trading and stock market efficiency*, by Taneli Mäkinen (October 2014).

N. 993 – *Optimal monetary policy rules and house prices: the role of financial frictions*, by Alessandro Notarpietro and Stefano Siviero (October 2014).

N. 994 – *Trade liberalizations and domestic suppliers: evidence from Chile*, by Andrea Linarello (November 2014).

N. 995 – *Dynasties in professions: the role of rents*, by Sauro Mocetti (November 2014).

N. 996 – *Current account "core-periphery dualism" in the EMU*, by Tatiana Cesaroni and Roberta De Santis (November 2014).

N. 997 – *Macroeconomic effects of simultaneous implementation of reforms after the crisis*, by Andrea Gerali, Alessandro Notarpietro and Massimiliano Pisani (November 2014).

N. 998 – *Changing labour market opportunities for young people in Italy and the role of the family of origin*, by Gabriella Berloffa, Francesca Modena and Paola Villa (January 2015).

N. 999 – *Looking behind mortgage delinquencies*, by Sauro Mocetti and Eliana Viviano (January 2015).

N. 1000 – *Sectoral differences in managers' compensation: insights from a matching model*, by Emanuela Ciapanna, Marco Taboga and Eliana Viviano (January 2015).

N. 1001 – *How does foreign demand activate domestic value added? A comparison among the largest euro-area economies*, by Rita Cappariello and Alberto Felettigh (January 2015).

N. 1002 – *Structural reforms and zero lower bound in a monetary union*, by Andrea Gerali, Alessandro Notarpietro and Massimiliano Pisani (January 2015).

(*) Requests for copies should be sent to:
Banca d'Italia – Servizio Struttura economica e finanziaria – Divisione Biblioteca e Archivio storico –
Via Nazionale, 91 – 00184 Rome – (fax 0039 06 47922059). They are available on the Internet www.bancaditalia.it.

2012

F. CINGANO and A. ROSOLIA, *People I know: job search and social networks*, Journal of Labor Economics, v. 30, 2, pp. 291-332, **TD No. 600 (September 2006).**

G. GOBBI and R. ZIZZA, *Does the underground economy hold back financial deepening? Evidence from the italian credit market*, Economia Marche, Review of Regional Studies, v. 31, 1, pp. 1-29, **TD No. 646 (November 2006).**

S. MOCETTI, *Educational choices and the selection process before and after compulsory school*, Education Economics, v. 20, 2, pp. 189-209, **TD No. 691 (September 2008).**

P. PINOTTI, M. BIANCHI and P. BUONANNO, *Do immigrants cause crime?*, Journal of the European Economic Association , v. 10, 6, pp. 1318–1347, **TD No. 698 (December 2008).**

M. PERICOLI and M. TABOGA, *Bond risk premia, macroeconomic fundamentals and the exchange rate*, International Review of Economics and Finance, v. 22, 1, pp. 42-65, **TD No. 699 (January 2009).**

F. LIPPI and A. NOBILI, *Oil and the macroeconomy: a quantitative structural analysis,* Journal of European Economic Association, v. 10, 5, pp. 1059-1083, **TD No. 704 (March 2009).**

G. ASCARI and T. ROPELE, *Disinflation in a DSGE perspective: sacrifice ratio or welfare gain ratio?,* Journal of Economic Dynamics and Control, v. 36, 2, pp. 169-182, **TD No. 736 (January 2010).**

S. FEDERICO, *Headquarter intensity and the choice between outsourcing versus integration at home or abroad*, Industrial and Corporate Chang, v. 21, 6, pp. 1337-1358, **TD No. 742 (February 2010).**

I. BUONO and G. LALANNE, *The effect of the Uruguay Round on the intensive and extensive margins of trade,* Journal of International Economics, v. 86, 2, pp. 269-283, **TD No. 743 (February 2010).**

A. BRANDOLINI, S. MAGRI and T. M SMEEDING, *Asset-based measurement of poverty*, In D. J. Besharov and K. A. Couch (eds), Counting the Poor: New Thinking About European Poverty Measures and Lessons for the United States, Oxford and New York: Oxford University Press, **TD No. 755 (March 2010).**

S. GOMES, P. JACQUINOT and M. PISANI, *The EAGLE. A model for policy analysis of macroeconomic interdependence in the euro area,* Economic Modelling, v. 29, 5, pp. 1686-1714, **TD No. 770 (July 2010).**

A. ACCETTURO and G. DE BLASIO, *Policies for local development: an evaluation of Italy's "Patti Territoriali",* Regional Science and Urban Economics, v. 42, 1-2, pp. 15-26, **TD No. 789 (January 2006).**

E. COCOZZA and P. PISELLI, *Testing for east-west contagion in the European banking sector during the financial crisis,* in R. Matoušek; D. Stavárek (eds.), Financial Integration in the European Union, Taylor & Francis, **TD No. 790 (February 2011).**

F. BUSETTI and S. DI SANZO, *Bootstrap LR tests of stationarity, common trends and cointegration,* Journal of Statistical Computation and Simulation, v. 82, 9, pp. 1343-1355, **TD No. 799 (March 2006).**

S. NERI and T. ROPELE, *Imperfect information, real-time data and monetary policy in the Euro area,* The Economic Journal, v. 122, 561, pp. 651-674, **TD No. 802 (March 2011).**

A. ANZUINI and F. FORNARI, *Macroeconomic determinants of carry trade activity,* Review of International Economics, v. 20, 3, pp. 468-488, **TD No. 817 (September 2011).**

M. AFFINITO, *Do interbank customer relationships exist? And how did they function in the crisis? Learning from Italy*, Journal of Banking and Finance, v. 36, 12, pp. 3163-3184, **TD No. 826 (October 2011).**

P. GUERRIERI and F. VERGARA CAFFARELLI, *Trade Openness and International Fragmentation of Production in the European Union: The New Divide?,* Review of International Economics, v. 20, 3, pp. 535-551, **TD No. 855 (February 2012).**

V. DI GIACINTO, G. MICUCCI and P. MONTANARO, *Network effects of public transposrt infrastructure: evidence on Italian regions,* Papers in Regional Science, v. 91, 3, pp. 515-541, **TD No. 869 (July 2012).**

A. FILIPPIN and M. PACCAGNELLA, *Family background, self-confidence and economic outcomes,* Economics of Education Review, v. 31, 5, pp. 824-834, **TD No. 875 (July 2012).**

2013

A. MERCATANTI, *A likelihood-based analysis for relaxing the exclusion restriction in randomized experiments with imperfect compliance*, Australian and New Zealand Journal of Statistics, v. 55, 2, pp. 129-153, **TD No. 683 (August 2008).**

F. CINGANO and P. PINOTTI, *Politicians at work. The private returns and social costs of political connections*, Journal of the European Economic Association, v. 11, 2, pp. 433-465, **TD No. 709 (May 2009).**

F. BUSETTI and J. MARCUCCI, *Comparing forecast accuracy: a Monte Carlo investigation*, International Journal of Forecasting, v. 29, 1, pp. 13-27, **TD No. 723 (September 2009).**

D. DOTTORI, S. I-LING and F. ESTEVAN, *Reshaping the schooling system: The role of immigration*, Journal of Economic Theory, v. 148, 5, pp. 2124-2149, **TD No. 726 (October 2009).**

A. FINICELLI, P. PAGANO and M. SBRACIA, *Ricardian Selection*, Journal of International Economics, v. 89, 1, pp. 96-109, **TD No. 728 (October 2009).**

L. MONTEFORTE and G. MORETTI, *Real-time forecasts of inflation: the role of financial variables*, Journal of Forecasting, v. 32, 1, pp. 51-61, **TD No. 767 (July 2010).**

R. GIORDANO and P. TOMMASINO, *Public-sector efficiency and political culture*, FinanzArchiv, v. 69, 3, pp. 289-316, **TD No. 786 (January 2011).**

E. GAIOTTI, *Credit availablility and investment: lessons from the "Great Recession"*, European Economic Review, v. 59, pp. 212-227, **TD No. 793 (February 2011).**

F. NUCCI and M. RIGGI, *Performance pay and changes in U.S. labor market dynamics*, Journal of Economic Dynamics and Control, v. 37, 12, pp. 2796-2813, **TD No. 800 (March 2011).**

G. CAPPELLETTI, G. GUAZZAROTTI and P. TOMMASINO, *What determines annuity demand at retirement?,* The Geneva Papers on Risk and Insurance – Issues and Practice, pp. 1-26, **TD No. 805 (April 2011).**

A. ACCETTURO e L. INFANTE, *Skills or Culture? An analysis of the decision to work by immigrant women in Italy,* IZA Journal of Migration, v. 2, 2, pp. 1-21, **TD No. 815 (July 2011).**

A. DE SOCIO, *Squeezing liquidity in a "lemons market" or asking liquidity "on tap"*, Journal of Banking and Finance, v. 27, 5, pp. 1340-1358, **TD No. 819 (September 2011).**

S. GOMES, P. JACQUINOT, M. MOHR and M. PISANI, *Structural reforms and macroeconomic performance in the euro area countries: a model-based assessment,* International Finance, v. 16, 1, pp. 23-44, **TD No. 830 (October 2011).**

G. BARONE and G. DE BLASIO, *Electoral rules and voter turnout,* International Review of Law and Economics, v. 36, 1, pp. 25-35, **TD No. 833 (November 2011).**

O. BLANCHARD and M. RIGGI, *Why are the 2000s so different from the 1970s? A structural interpretation of changes in the macroeconomic effects of oil prices*, Journal of the European Economic Association, v. 11, 5, pp. 1032-1052, **TD No. 835 (November 2011).**

R. CRISTADORO and D. MARCONI, *Household savings in China,* in G. Gomel, D. Marconi, I. Musu, B. Quintieri (eds), The Chinese Economy: Recent Trends and Policy Issues, Springer-Verlag, Berlin, **TD No. 838 (November 2011).**

A. ANZUINI, M. J. LOMBARDI and P. PAGANO, *The impact of monetary policy shocks on commodity prices*, International Journal of Central Banking, v. 9, 3, pp. 119-144, **TD No. 851 (February 2012).**

R. GAMBACORTA and M. IANNARIO, *Measuring job satisfaction with CUB models,* Labour, v. 27, 2, pp. 198-224, **TD No. 852 (February 2012).**

G. ASCARI and T. ROPELE, *Disinflation effects in a medium-scale new keynesian model: money supply rule versus interest rate rule,* European Economic Review, v. 61, pp. 77-100, **TD No. 867 (April 2012).**

E. BERETTA and S. DEL PRETE, *Banking consolidation and bank-firm credit relationships: the role of geographical features and relationship characteristics,* Review of Economics and Institutions, v. 4, 3, pp. 1-46, **TD No. 901 (February 2013).**

M. ANDINI, G. DE BLASIO, G. DURANTON and W. STRANGE, *Marshallian labor market pooling: evidence from Italy,* Regional Science and Urban Economics, v. 43, 6, pp.1008-1022, **TD No. 922 (July 2013).**

G. SBRANA and A. SILVESTRINI, *Forecasting aggregate demand: analytical comparison of top-down and bottom-up approaches in a multivariate exponential smoothing framework,* International Journal of Production Economics, v. 146, 1, pp. 185-98, **TD No. 929 (September 2013).**

A. FILIPPIN, C. V, FIORIO and E. VIVIANO, *The effect of tax enforcement on tax morale,* European Journal of Political Economy, v. 32, pp. 320-331, **TD No. 937 (October 2013).**

2014

G. M. TOMAT, *Revisiting poverty and welfare dominance*, Economia pubblica, v. 44, 2, 125-149, **TD No. 651 (December 2007).**

M. TABOGA, *The riskiness of corporate bonds*, Journal of Money, Credit and Banking, v.46, 4, pp. 693-713, **TD No. 730 (October 2009).**

G. MICUCCI and P. ROSSI, *Il ruolo delle tecnologie di prestito nella ristrutturazione dei debiti delle imprese in crisi*, in A. Zazzaro (a cura di), Le banche e il credito alle imprese durante la crisi, Bologna, Il Mulino, **TD No. 763 (June 2010).**

F. D'AMURI, *Gli effetti della legge 133/2008 sulle assenze per malattia nel settore pubblico,* Rivista di politica economica, v. 105, 1, pp. 301-321, **TD No. 787 (January 2011).**

R. BRONZINI and E. IACHINI, *Are incentives for R&D effective? Evidence from a regression discontinuity approach,* American Economic Journal : Economic Policy, v. 6, 4, pp. 100-134, **TD No. 791 (February 2011).**

P. ANGELINI, S. NERI and F. PANETTA, *The interaction between capital requirements and monetary policy*, Journal of Money, Credit and Banking, v. 46, 6, pp. 1073-1112, **TD No. 801 (March 2011).**

M. BRAGA, M. PACCAGNELLA and M. PELLIZZARI, *Evaluating students' evaluations of professors,* Economics of Education Review, v. 41, pp. 71-88, **TD No. 825 (October 2011).**

M. FRANCESE and R. MARZIA, *Is there Room for containing healthcare costs? An analysis of regional spending differentials in Italy,* The European Journal of Health Economics, v. 15, 2, pp. 117-132, **TD No. 828 (October 2011).**

L. GAMBACORTA and P. E. MISTRULLI, *Bank heterogeneity and interest rate setting: what lessons have we learned since Lehman Brothers?,* Journal of Money, Credit and Banking, v. 46, 4, pp. 753-778, **TD No. 829 (October 2011).**

M. PERICOLI, *Real term structure and inflation compensation in the euro area*, International Journal of Central Banking, v. 10, 1, pp. 1-42, **TD No. 841 (January 2012).**

E. GENNARI and G. MESSINA, *How sticky are local expenditures in Italy? Assessing the relevance of the flypaper effect through municipal data,* International Tax and Public Finance, v. 21, 2, pp. 324-344, **TD No. 844 (January 2012).**

V. DI GACINTO, M. GOMELLINI, G. MICUCCI and M. PAGNINI, *Mapping local productivity advantages in Italy: industrial districts, cities or both?*, Journal of Economic Geography, v. 14, pp. 365–394, **TD No. 850 (January 2012).**

A. ACCETTURO, F. MANARESI, S. MOCETTI and E. OLIVIERI, *Don't Stand so close to me: the urban impact of immigration,* Regional Science and Urban Economics, v. 45, pp. 45-56, **TD No. 866 (April 2012).**

M. PORQUEDDU and F. VENDITTI, *Do food commodity prices have asymmetric effects on euro area inflation,* Studies in Nonlinear Dynamics and Econometrics, v. 18, 4, pp. 419-443, **TD No. 878 (September 2012).**

S. FEDERICO, *Industry dynamics and competition from low-wage countries: evidence on Italy*, Oxford Bulletin of Economics and Statistics, v. 76, 3, pp. 389-410, **TD No. 879 (September 2012).**

F. D'AMURI and G. PERI, *Immigration, jobs and employment protection: evidence from Europe before and during the Great Recession,* Journal of the European Economic Association, v. 12, 2, pp. 432-464, **TD No. 886 (October 2012).**

M. TABOGA, *What is a prime bank? A euribor-OIS spread perspective,* International Finance, v. 17, 1, pp. 51-75, **TD No. 895 (January 2013).**

L. GAMBACORTA and F. M. SIGNORETTI, *Should monetary policy lean against the wind? An analysis based on a DSGE model with banking,* Journal of Economic Dynamics and Control, v. 43, pp. 146-74, **TD No. 921 (July 2013).**

M. BARIGOZZI, CONTI A.M. and M. LUCIANI, *Do euro area countries respond asymmetrically to the common monetary policy?,* Oxford Bulletin of Economics and Statistics, v. 76, 5, pp. 693-714, **TD No. 923 (July 2013).**

U. ALBERTAZZI and M. BOTTERO, *Foreign bank lending: evidence from the global financial crisis,* Journal of International Economics, v. 92, 1, pp. 22-35, **TD No. 926 (July 2013).**

R. DE BONIS and A. SILVESTRINI, *The Italian financial cycle: 1861-2011,* Cliometrica, v.8, 3, pp. 301-334, **TD No. 936 (October 2013).**

D. PIANESELLI and A. ZAGHINI, *The cost of firms' debt financing and the global financial crisis,* Finance Research Letters, v. 11, 2, pp. 74-83, **TD No. 950 (February 2014).**

A. ZAGHINI, *Bank bonds: size, systemic relevance and the sovereign,* International Finance, v. 17, 2, pp. 161-183, **TD No. 966 (July 2014).**

M. SILVIA, *Does issuing equity help R&D activity? Evidence from unlisted Italian high-tech manufacturing firms,* Economics of Innovation and New Technology, v. 23, 8, pp. 825-854, **TD No. 978 (October 2014).**

G. BARONE and S. MOCETTI, *Natural disasters, growth and institutions: a tale of two earthquakes,* Journal of Urban Economics, v. 84, pp. 52-66, **TD No. 949 (January 2014).**

2015

G. BULLIGAN, M. MARCELLINO and F. VENDITTI, *Forecasting economic activity with targeted predictors,* International Journal of Forecasting, v. 31, 1, pp. 188-206, **TD No. 847 (February 2012).**

A. CIARLONE, *House price cycles in emerging economies,* Studies in Economics and Finance, v. 32, 1, **TD No. 863 (May 2012).**

G. BARONE and G. NARCISO, *Organized crime and business subsidies: Where does the money go?,* Journal of Urban Economics, v. 86, pp. 98-110, **TD No. 916 (June 2013).**

P. ALESSANDRI and B. NELSON, *Simple banking: profitability and the yield curve,* Journal of Money, Credit and Banking, v. 47, 1, pp. 143-175, **TD No. 945 (January 2014).**

R. AABERGE and A. BRANDOLINI, *Multidimensional poverty and inequality,* in A. B. Atkinson and F. Bourguignon (eds.), Handbook of Income Distribution, Volume 2A, Amsterdam, Elsevier, **TD No. 976 (October 2014).**

M. FRATZSCHER, D. RIMEC, L. SARNOB and G. ZINNA, *The scapegoat theory of exchange rates: the first tests,* Journal of Monetary Economics, v. 70, 1, pp. 1-21, **TD No. 991 (November 2014).**

FORTHCOMING

M. BUGAMELLI, S. FABIANI and E. SETTE, *The age of the dragon: the effect of imports from China on firm-level prices*, Journal of Money, Credit and Banking, **TD No. 737 (January 2010).**

G. DE BLASIO, D. FANTINO and G. PELLEGRINI, *Evaluating the impact of innovation incentives: evidence from an unexpected shortage of funds,* Industrial and Corporate Change, **TD No. 792 (February 2011).**

A. DI CESARE, A. P. STORK and C. DE VRIES, *Risk measures for autocorrelated hedge fund returns,* Journal of Financial Econometrics, **TD No. 831 (October 2011).**

D. FANTINO, A. MORI and D. SCALISE, *Collaboration between firms and universities in Italy: the role of a firm's proximity to top-rated departments,* Rivista Italiana degli economisti, **TD No. 884 (October 2012).**

M. MARCELLINO, M. PORQUEDDU and F. VENDITTI, *Short-Term GDP Forecasting with a mixed frequency dynamic factor model with stochastic volatility,* Journal of Business & Economic Statistics, **TD No. 896 (January 2013).**

M. ANDINI and G. DE BLASIO, *Local development that money cannot buy: Italy's Contratti di Programma,* Journal of Economic Geography, **TD No. 915 (June 2013).**

J. LI and G. ZINNA, *On bank credit risk: sytemic or bank-specific? Evidence from the US and UK,* Journal of Financial and Quantitative Analysis, **TD No. 951 (February 2015).**