Market hours, household work, child care, and wage rates of partners: an empirical analysis

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Abstract

The aim of this paper is to provide new evidence on the effect of partners' wages on partners' allocation of time. Earlier studies concluded that wage rates are an important determinant of partners' hours of market and non-market work and also that house work may lower married women's wage rates. However, the bulk of earlier literature in this area failed to account for the endogeneity of wages or the simultaneity of partners' time allocation choices. Here we take a reduced form approach and specify a ten simultaneous equations model of wage rates, employment and hours of market work, house work and childcare of parents. Non-participants are included in the model. We exploit a rich time use dataset for France to estimate the model. We find that the own wage affects positively own market hours and negatively own house work and childcare hours. The wage of the father has a significantly negative effect on the mother's market hours while her wage rate has a significantly positive effect on his house work hours.

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1 Introduction

Earlier studies concluded that wage rates are an important determinant of partners' hours of market and non-market work and also that house work may lower married women's wage rates. However, the bulk of earlier literature in this area failed to account for the endogeneity of wages or the simultaneity of partners' time allocation choices. Therefore, in this study we investigate the effect of partners' wages on partners' time allocation decisions, allowing for the potential endogeneity of wage rates as well as the simultaneity of partners' time allocation decisions. We take a reduced form approach and estimate a ten simultaneous equations model of parents' hours of market work, house work, childcare and wage rates, controlling for selection into employment and instrumenting both partners' wages.

There is considerable evidence that partners' earnings may affect partners' house work hours and *vice-versa*, house work hours may (negatively) affect earnings (see for example, Hersh and Stratton, 1994 and 1997; Jens Bonke, Nabanita Datta Gupta and Nina Smith (2003) and Jens Bonke, Mette Deding, Mette Lausten and Leslie Stratton, 2007; or Mark Bryan and Almudena Sevilla-Sanz, 2011, for more recent evidence). Therefore, it is important to allow for endogeneity of own and partner's wage rates in models of partners' time allocation. Earlier empirical studies on the effect of own and partners' wages on non-market hours allowed for endogeneity of wage rates by instrumenting wage rates, without however, taking the simultaneity of partners' decisions into account. Because partners' decisions are not independent from each other (see, for example, Pollak, 2003 and Lundberg and Pollak, 2008) neglecting the simultaneity of partners' decisions may bias the estimates of the cross wage elasticity of hours. In particular, most earlier literature concluded for little effect of the wage of the partner on the individual hours of housework or childcare (see, for example, Hallberg and Klevmarken (2002), Kimmel and Connelly (2009), Charlene Kalenkoski, David Ribar and Leslie Stratton (2008), Rachel Connelly and Jean Kimmel (2009), Hans Bloemen et al. (2010)). An exception is the pioneering study of Jean Kimmel and Rachel Connelly (2007) who studied the allocation of time of mothers to market work, house work, child care and leisure, to conclude that the husband's earnings reduced mothers' employment hours and increased mothers' childcare time.

Here, we estimate a ten simultaneous equations model of parents' hours of market work, house work, childcare and wage rates, controlling for selection into employment. We include also non-participants into the model. We use job characteristics, namely past and current occupation, as well as potential experience to identify partners' wage rates. Moreover, we use two alternative definitions of domestic work. Both definitions include standard household chores such as cleaning, shopping, cooking, doing the laundry, ironing, and doing administrative paper work. The broader definition also includes activities such as taking care of pets, gardening, doing house repairs, making jam, hand knitting, sewing.

Using French time use data to estimate the model, we conclude that parents' market and non-market hours respond significantly to changes in the own wage. An increase in the own wage rate is found to increase own market hours and to reduce hours of house work or childcare of both parents. We also conclude that the wife's wage rate has a significant and positive effect on the husband's house work and childcare hours. Finally, the correlations across the errors of the ten equations of the system are strongly significant, which supports our specification strategy, suggesting that neglecting the simultaneity of partners' decisions may produce inefficient estimates of the effect of partners' wage rates on partners' hours of market and non-market work.

The structure of the paper is as follows. Section 2 presents the empirical model. The data and the sample selection are described in Section 3. The results of estimation are given in Section 4. The last section concludes the paper.

2 The empirical model

The theoretical set up for our empirical model is Becker's time allocation model (Becker 1973) that was further developed by Grossbard-Shechtman (1984) and later on also by Apps and Rees (1997) and Chiappori (1997) and, more recently, Benoit Rapoport, Caterine Sofer and Anne Solaz (2011).

In particular, let us focus on the model put forward by Grossbard-Shechtman (1984) from which we borrow the chart (Figure 1) that depicts the supply and demand of hours of house work by both men and women. House work includes household chores or childcare that are

appreciated by the spouse. The core concept of Grossbard-Shechtman's model is Work-In-Household (WIH), which is defined as an (unpaid) activity that has an opportunity cost and benefits also another household member who could potentially compensate the individual that produced WIH. Figure 1 depicts the equilibria for Work-in-Household of wife (WIH_f) and husband (WIH_m). The upper figure shows the wife's supply curve of work in household ($S_{w_{f0}}$) and the demand for her hours by her husband ($D_{w_{m0}}$), at market wages w_{f0} and w_{m0}, as a function of the price of her hours of Work-in-Household, y_f.[1] Grossbard-Shechtman (1984) shows that this price is not necessarily equal to the wage of market work, since leisure time and time spent on Work-in-Household can have different marginal utility. In Grossbard-Shechtman (1984) higher wages lead to a movement along the supply of labor (not depicted here) and also to a leftward shift in the supply of house work (including household chores or childcare that are appreciated by the spouse). As an example, Figure 1 shows a leftward shift in the supply of the wife's work in the household as a result of an increase in her wage rate from w_{f0} to w_{f1}, resulting in a lower equilibrium value of WIH_f. This leftward shift reflects preference for own leisure (regardless of whether the individual is actually married and who the spouse is), as well as higher bargaining power within the household (also see, for example, Pollak and Lundberg (2008) for an overview of household bargaining models). The income effect is also likely to include a rightward shift in the demand for spouse's house work, depicted in the lower part, by a shift from $D_{w_{f0}}$ to $D_{w_{f1}}$, resulting in an increase in WIH_m. Furthermore, a higher wage also implies a higher cost of time, affecting demand for spouses' house work and supply of own house work as a function of whether the spouses are substitutes or complements in household production. If they are substitutes and the income and substitution effects reinforce each other, observed matches in our cross-sectional study may involve specialization, with one spouse having a low wage and supplying the WIH demanded by the other. The leftward shift in own supply of house work as a result of higher wage or income may be larger for women than for men given that they start out supplying much more Work-In-Household (WIH) than men (the share of WIH in total costs is a factor influencing the size of the shifts, see Grossbard-Shechtman 2003). Shifts in demand for spouse's house work as a result of higher own wage also include an income effect and a

[1] At the equilibrium value, where supply and demand meet, a marriage agreement will be reached.

substitution effect. The same income change may cause a larger shift in men's demand for house work by the spouse than in women's demand, if men are not as available to perform WIH as is the case with women. But if women have already reached a ceiling in terms of how much WIH they can handle (perhaps because the supply of house work by women is already in its vertical stage) but men have not, then a given change in spouse's wage is likely to cause a larger rightward shift in demand for spouse's house work in the case of an increase in women's wage than in the case of an increase in men's wage. Figure 1 illustrates such a situation: an increase in the husband's wage from w_{m0} to w_{m1} results in a leftward shift of his supply of WIH (from $S_{w_{m0}}$ to $S_{w_{m1}}$) and in a rightward shift of the demand for his WIH (from $D_{w_{m0}}$ to $D_{w_{m1}}$). The figure shows a situation in which changes in his wage cause smaller shifts in demand and supply than changes in her wage. If commercial help is expensive or hard to get, inter-spousal substitution of WIH is more likely to occur (see Stancanelli and Stratton 2013).

Our approach here is reduced form. We specify a simultaneous equations model of partners' wage rates, employment and hours of market work, house work and childcare. To predict wages we condition on employment participation and thus, we predict wage rates of non-participants within the model. We distinguish three activities: market work, domestic work, and child care.[2] Ideally, one would like to disaggregate non-market activities as much as possible, as wage and income effects may differ for different subsets of activities. To test for some of this variation, we experiment with two alternative definitions of house work.

Let t_{ijk} denote the hours spent on activity j $(j = 1, ..., 3)$ by partner k $(k = m, f)$ of household i $(i = 1, ..., N)$ -where $t_{i1k} = h_k$ stands for paid work. We allow partners' hours of market work, house work and childcare to depend on the own and the partner's wage rate[3] w_{im} and w_{if} , household non-labor income μ_i, observed characteristics x_{ik}, and an error

[2] In terms of the solutions of the underlying structural model, the remainder includes leisure. Leisure is not modeled explicitly because of the adding-up condition built-in into the model: the total time allocated by each partner to the different activities considered cannot exceed 24 hours a day.

[3] See also Pollak (2005) for a discussion of the importance of using wage rates rather than earnings.

term ϵ_{ijk}:

$$t^*_{ijk} = \alpha^m_{jk} \ln w_{im} + \alpha^f_{jk} \ln w_{if} + \psi_{jk}\mu_i + x'_{ik}\beta_{jk} + \epsilon_{ijk}$$

$$t_{ijk} = t^*_{ijk} \text{ if } t^*_{ijk} > 0 \tag{1}$$

$$t_{ijk} = 0 \text{ otherwise } i = 1, ..., N, j = 1, ..., 3, k = m, f$$

This system of equations allows for corner solutions: the zeros in child care or household work are modeled as censored observations. We have restricted the sample for analysis to two-parent couples, like, for example, in Kalenkoski, Ribar and Stratton, 2008.

If no time is allocated to a given activity on a given day, this reflects either that an individual never carries out that activity or the infrequency of the activity. Accordingly, one should use a censored probability model to allow for never performing a certain activity but a linear equation model to capture infrequencies (see Cragg, 1971, on infrequent purchases or Stewart, 2009, for a recent discussion of using a linear versus a Tobit specification for the time uses). To test for the robustness of our estimates to either specification, we specify the hours equations first, as censored and, alternatively, as linear equations (see Section 4).

In this model, partners' wage rates are estimated simultaneously with hours, to control for possible selection in unobservable variables that may affect both the wages and the time-allocation choices of partners. Therefore, we allow for non-zero correlations between the error terms in the time-use and the wage equations:

$$\ln w_{ik} = z'_{ik}\eta + u_{ik}, i = 1, ..., N, k = m, f \tag{2}$$

Since wages are only observed for individuals that are employed, we estimate wages of non-employed partners by a) specifying the joint density function for time use and wages, and b) integrating over wage rates for partners for whom wages were not observed, when writing the likelihood function for those observations (see the Appendix for the specification of the likelihood function). Identification of the wage rate is discussed below. The model also includes partners' participation into employment equations - because the diary was collected on a week or weekend day and therefore for some employed parents we observe zero hours.

The employment equation and the hours equations contain the same explanatory variables as the wage equation and, additionally, household composition variables and non-labor income (see section 3.1 for more details). We define employment as e_{ik}, with $e_{ik} = 1$ if spouse k of household i is employed, and zero otherwise.[4]

$$e^*_{ik} = q'_{ik}\gamma_k + \nu_{ik}$$

$$e_{ik} = 1 \text{ if } e^*_{ik} > 0 \tag{3}$$

$$e_{ik} = 0 \text{ otherwise}$$

The errors of the employment equation (Equation 3) can be correlated with the errors of the time-use equations (Equation 1) and the wage equations (Equation 2), as follows:

$$\omega_i = (\epsilon'_{im}, \epsilon'_{if}, \nu_{im}, \nu_{if}, u_{im}, u_{if})' \tag{4}$$

We assume that:

$$\omega_i \sim N(0, \Sigma) \tag{5}$$

where Σ is the unrestricted variance-covariance matrix of dimension 10×10 of the errors of this equation system. The errors are assumed to be normal. By letting the covariance matrix Σ be unrestricted and estimating all of its elements, we allow for the simultaneity of spouses' time-allocation choices and wages. Correlations of the errors of the time-use equations may reflect unobserved household-specific correlations in preferences and productivity. They may also capture household-specific heterogeneity in market prices for household work and child care services or in (quasi)prices established in marriage markets as defined in Grossbard-Shechtman (1984).

Thus, the empirical model consists of six equations for market hours, house work and child care hours of each partner, (Equation 1), two employment equations (Equation 3), two

[4] To be more precise, combining the employment equations (3) with the paid work equations from (1) we have $e_{ik} = 1, t^*_{i1k} > 0$ for the employed with a positive diary response for paid work and $e_{ik} = 1, t^*_{i1k} \leq 0$ for the employed with a zero diary response. For the nonemployed, we simply have $e_{ik} = 0$, as t_{i1k} is not observed, and the underlying value could be either zero or positive.

wage equations (Equation 2) and the joint density (Equation 5) of the errors. The likelihood contribution of each spouse differs depending on whether wages are observed or not. The model is estimated by simulated maximum-likelihood (see Appendix for details).

2.1 Identification and exclusion restrictions

To identify the estimates of the partners' wages on partners' time uses, we rely on the following exclusion restrictions.[5] We use job characteristics (past and current occupation types) aggregated into four broad occupational group dummies to identify wages. Occupations are coded in the survey we use for anyone who ever worked using information on their last occupation. The estimation results clearly show that they satisfy the first stage requirement for instruments as they significantly affect wages.[6]

According to Mincer (Mincer, 1974) experience determines wages. Thus, we enter potential experience (constructed combining information on years of schooling and age) in the wage equation. Potential experience[7] significantly affects wages and this provides functional form (thus, non-parametric) identification. We also use the local unemployment rate to identify wages, like, for example, in Blanchflower and Oswald (1994) and we find evidence of a significant negative relationship between wage rates and the regional unemployment rate (strongly significant for fathers and weakly significant for mothers). These (parametric and non-parametric) exclusion restrictions identify the direct effect of the own and cross wage rates on the hours of market and non-market work of partners from the correlations of the unobservables of the wage rates and the hours equations.[8]

[5] Since the seminal work of Blundell, Duncan, and Meghir (1998), it has become customary in the labor supply literature to identify the effect of wages on working hours by exploiting exogenous sources of variation in wages, due, for example, to law changes. Here, we do not have an exogenous source of variation at hand.

[6] However, one could argue that individuals choose their time allocation and their occupation together. Therefore, we re-estimate the model including occupational qualification dummies also in the time use equations (both including and excluding wages) and find that the coefficients are not statistically significant. Possibly because in France hours are quite strictly regulated and thus occupations do not drive working hours. Therefore, the empirical evidence supports our identification strategy.

[7] We do not use actual work experience as this is endogenous in our set up.

[8] Last, we need to assume that the wage equations, together with the selectivity into employment equations, can be used to recover the wage rates for the non-employed, for whom we do not observe wage rates. Flinn and Heckman (1982) address this recoverability problem in the context of a job search model and show that, in general, this requires parametric assumptions about the distribution of wage offers. The assumption of log-normally distributed wage rates is sufficient to pin down the wage rates for the non-employed.

We carry out a number of sensitivity checks for the robustness of the estimates. We use different sample cuts; we include only the wage rates among the regressors of the hours equations; we adopt a larger definition of house work; and we exclude couples that filled in the diary on a weekend. The estimates of the effects of own and cross wages on the partners' time allocation appear robust to all these checks. Moreover, to check the robustness of the estimates to using a different set of instruments, we use industry dummies (see Pischke, 2011, for a discussion of using such instruments for wages) and firm size instead of occupation dummies. Finally, even if our estimates are robust to various checks, We do not claim to estimate causality relations although we use the standard terminology for ease of exposition (see also Blundell, Duncan, and Meghir (1998)).

3 Data

The data for the analysis are drawn from the 1998-99 French time-use survey (Enquête Emploi du temps), carried out by the National Statistical Office (INSEE).[9]

This survey covers about 8000 representative households, and it includes over 20,000 individuals of all ages from 0 to 103 years. Three questionnaires were collected: a household questionnaire, an individual questionnaire and the time diary. As usual, the diary collects information on individual activities over 24 hours span. Activities were coded into slots of ten minutes each. The diary was collected on the same day for both partners. The diary day was chosen by the interviewer and could be either a week or a weekend day. Over 140 main activity categories were defined by the survey designers, distinguishing between 'primary' activities and 'secondary' activities, where the latter are activities carried out simultaneously, such as cooking and watching the children, with the respondent deciding which activity was 'primary' and which 'secondary'. Unfortunately, few individuals reported secondary activities and thus we do not consider them.

For our analysis, we distinguish the following activities:

[9] The French Time Use Surveys are carried out roughly every twelve years. The 2010 time use survey has been released to researchers only in July 2012 and amended a number of times, the last of which in April 2013. Moreover, in the 2010 Time Use survey a child was often required to fill in the diary with a parent, which makes the sample of couples in which both partners filled in the diary less than half the size of the one we are analyzing here.

- Market hours

- Child care hours, including feeding the children, bathing them, dressing them, taking (or time spent going with) them somewhere, helping them with their homework and playing with them.

- Household work hours, including cleaning, shopping, cooking, doing the laundry, ironing, washing up dishes, setting the table, and doing paperwork-where this last variable included, by sample design construction, time spent going to administrative offices.

- Household work hours as above and including also making jams, knitting, gardening, doing household repairs, and taking care of pets.

We selected married or cohabiting partners according to the following criteria:

- the couple was heterosexual;

- both partners were under 60 -which is the early retirement age for most workers in France;

- both partners had filled in the time diary;

- neither partner had filled in the diary on an atypical day such as a vacation day, a special festivity, a wedding party, a funeral, a sickness day, and similar exceptional circumstances;

- neither partner was self-employed;

- the number of children (aged 18 or under) was positive;

- none of the partner was retired, early-retired, in full-time education or disabled.

Dropping single people made the sample size shrink from 8186 to 5287 households while eliminating older couples reduced it from 5287 to 3819 households. There was only one same-sex couple, which we deleted. Next, we dropped 245 couples where either the husband or the wife had not filled the diary and 295 that had filled in the diary on an atypical day.

Childless couples were dropped as otherwise non participation in child care would be difficult to interpret (mixing fertility issues with choice and infrequency).[10]

Applying the last conditions above, produced a sample of 1473 two-parent couples, including spouses who answered the diary question on a weekend day. Excluding this latter group, gives a sample of 1080 two-parent couples.

Individuals with less than compulsory schooling are the reference category for the the education dummies. We use information on the region of residence to construct a continuous variable for the regional unemployment rate in 1998, according to the INSEE-ILO definition. The unemployment rate varied considerably across regions, from 7% in Alsace to 17% in Languedoc-Roussillon, and to over 10% in the region of Paris (Ile-de-France). We also control for whether the couple resided in the region of Paris ('Ile-de-France'),[11] for whether the couple resided in a small village or a rural area, and for country of birth (the reference group being countries other than France). These variables may capture cultural differences, different access to jobs and other infrastructures like, notably, child care facilities. We control for presence and age of children.

Information on continuous gross monthly earnings and contractual hour of work was used to construct the hourly wage rate. This gave hourly wages for 797 men and 533 women. Total household income before taxes was collected at the household level (not for each individual separately) and only in intervals. There is no information in the survey on after-tax income. Income and earnings were collected in French Francs (equal to 1/6.55957 Euros). We set total household income (measured on a monthly basis) equal to the mid-point of each interval and equal to the lower (open) bound of the interval for individuals in the top bracket. The resulting total household income was compared to the sum of the spouses' earnings and non-labor income was set equal to the difference between total household income and total household earnings, if any. With respect to unemployment benefits, 10% of the households in the sample received some income from unemployment benefits, but they were the main source of income for only 2%. About 2% of the sample received welfare benefits. Our results are robust to dropping non-labor income from the model (see Table A in the Appendix to

[10] See, for example, Del Boca Daniela , Pasqua Silvia and Pronzato Chiara (2007) on the effects of earnings and policies on fertility choices.

[11] We do not use region dummies as there are not enough observations for each of them (20).

the paper).

Finally,we constructed household composition variables as well as a series of occupation dummies distinguishing individuals with no particular skill; low skills, corresponding to routine worker qualifications; medium skills, equal to specialized workers; and upper skills, representing managers, teachers, and university professors. These are used to instrument wages in the model.

3.1 Descriptive statistics

Sample descriptive statistics are provided in Table 1. Descriptive statistics of parents' time allocation are shown in Table 2 for the sample that answered the diary on a week day. In what follows we use the terms "husband" and "wife" for simplicity, though we include cohabiting couples in our sample.

About 80% of the couples in the sample were married and 26% had young children, aged less than three years (see Table 1). Roughly 20% lived in the region of Paris (Ile de France) but only 2% actually resided in inner Paris (see Table 1). Roughly 93% of the individuals in the sample were born in France. About 60% of the women and 90% of the men were employed in a job for pay. Average working hours were about 34 per week for men, and 19 for women. According to the diary, average hours of work were 32 for men and 17 for women, excluding weekend diaries. The average gross hourly wage rate was equal to ten Euros for men and eight Euros for women.

The percentage of husbands reporting zero paid work hours falls from over 25% to over 10% (second column of the second block in Table 2) when excluding couples that answered the diary on a weekend. About 50% of women and 75% of men did not spend any time with their children on the day the diary was filled in (restricting the sample to couples with young children, aged under three, these figures became 3% for women and 34% for men, but the sample size fell to 353 couples). Both partners performed on average more house work than child care: at the median, women spent 50 minutes on child care and 220 on house work, in the diary day; men spent 0 time on children and 30 minutes doing house work (see columns three and four of Table 2). In France, child care facilities, as well as maternal and elementary school, are open about ten hours a day, which certainly reduces the time parents

will spend with their children (see also OECD, 2000). It is also likely that the presence of children in the household considerably increases the amount of time that people spend on activities such as shopping, cooking, washing up dishes and cleaning the house, which are difficult to delegate to others. Because we only consider primary childcare we are likely to underestimate the time parents spend with children.

House work done by men increases considerably if a broader definition of house work is adopted, which includes also repairs, gardening and taking care of pets. The amount of house work carried out by women does not increase substantially, on average, using this broader definition of house work.[12]

Behaviour at the mean or median conceals considerable heterogeneity across individuals. Mothers in the first 5 per cent of the distribution of female household work carry out 30 minutes of domestic tasks a day (Table 2); while the corresponding figure for women in the top 95% is 460 minutes, for any day of the week. The men in the bottom 5 per cent of the distribution of male household work carry no domestic work on any day (Table 2); while men in the top 5 per cent of this distribution (at the 95% of the distribution) carry out 210 minutes(Table 2).[13]

4 Estimation Results

The empirical model specified in Section 3 was estimated for the full sample and for the sub-sample of couples answering the diary on a week day.[14] In what follows we use the terms "husband" and "wife" for simplicity, though we include cohabiting couples in our sample. As we said before (see Section 3.1), we do not claim to estimate causality relations although we use the standard terminology for ease of exposition. Although our estimates are robust to various checks, we do not have a 'truly exogenous' source of variation in wages at hand.

Table 3 shows the estimation results for the sample of couples that answered the diary

[12] Burda M., Hamermesh D.S. and Weil P. (2007) argue that men and women do the same total amount of paid and unpaid work.

[13] Notice, however, that Harley Frazis and Jay Stewart, 2012, argue that only the mean can be taken as representative of individual behaviour from cross-sectional diary data on a day time allocation.

[14] Although weekend work in France is becoming more and more common, it is still rare that both spouses may be employed in gainful employment on a weekend day, which makes the distinction between week and weekend days meaningful.

on a week day, excluding weekend days, and adopting a core definition of domestic work. We find that parents' own wage rates have a positive and significant effect on the own hours of market work (see Table 3). The corresponding elasticities[15] are shown in Table 5. We conclude that own market hours respond positively to increases in the own wage rate. In particular, the own wage elasticity is much larger for women than men: an increase of 1% in the wage rate of mothers would increase their market labor supply by 0.95%, against 0.3% for the own-wage response of market work of fathers. Parents' market hours are more sensitive to their own wage than to their spouse's wage. This is in line with the conclusions of most labour-supply studies that did not control for unpaid work of parents.

Parents' own wage rates affect significantly and negatively hours of own domestic chores and child care - although, the effect of the husband's wage rate on the own child care hours is only significant at the ten per cent level. The higher the wage rate of the mother, the more time the husband spends on house work and child care. Increasing her wage rate by 1% would lead to 0.5% more house work by men and a similar increase is found for child care. This may be explained by the fact that the wage rate captures negotiation power within the household. However, the increase in his domestic work does not compensate fully for the fall in hers - as at the household level, the total time allocated to domestic tasks falls (see Table 5). This is likely to be due to the fact that the couple hires maids as the female partner's participation into market work increases (see Leslie Stratton and Elena Stancanelli, 2013, for an analysis of the probability of hiring a maid). Alternatively, as the wife increases her market hours, some of the housework is left undone (see Liana Sayer, 2007 for a discussion of this scenario). For child care, the total effect of an increase in her wage is neutral -her child care falls by about as much as his childcare increases. However, remember that we do not control for "secondary" childcare -i.e. childcare that is performed simultaneously with other tasks such as cooking or watching television- and therefore we are likely to underestimate

[15] We have computed the response of hours to a 1% rise in wages. We simulated the model given by Equation 1 1000 times, using observed wages, whenever available, and simulated wages otherwise. To compute the elasticity of hours with respect to the husband (wife)'s wage, we increase all husbands (wives)' wages by 1% and simulate the model again. We thus record the change in time for each activity for both men and women and compute the elasticity. The procedure is repeated for non-labour income. The standard errors illustrate the variation in the elasticity which results from the use of parameter estimates. We also compute the impact of a change in wages on the total time allocated by spouses in each household on a given activity, by summing the husband's and wife's hours changes in each activity.

the amount of childcare done by parents.

We find that the amount of house work carried out by mothers is not responsive to their husband's wage. This result might be driven by specialization of women into household production. Indeed, 40% of the women in the sample are housewives.[16] Using a broader definition of domestic chores (see Table 6), which includes 'semi-leisure' activities, the cross-wage effect becomes insignificant for men, suggesting perhaps that men 'specialize' in doing household repairs, taking care of pets and gardening - there is little scope for negotiating over performing these tasks.

The results of estimation are also robust to using a different sample selection rule, including spouses that answered the time-diary on a weekend (see Table 7). The effect of parents' wages on own child care time becomes then less significant, possibly because wage incentives go in opposite directions for weekend or week days. Fathers perform significantly more child care tasks on weekend days and mothers significantly less. This suggests some substitution between his and her child care hours across weekdays and weekend days. The weekend dummy is statistically significant and negative for market work of parents, but positive for domestic chores.

Restricting the sample to couples without children younger than three years and estimating the model including both week and weekend days (to compensate for the smaller sample size), does not affect substantially the results of estimation (see Table 8), except for the effect of the own wage on parental child care hours, which becomes statistically insignificant for both parents (though remaining negative). This may be due to having included couples that answered the time diary on a weekend day. Selecting couples without children older than ten years, and estimating the model including both week and weekend days, does not affect the results either (results available from the authors), except for the effect of the own wage on parental child care hours, which again becomes statistically insignificant for both parents (though remaining negative). The effect of her wage on his non-market work stays positive and significant (it is significant at the ten per cent level for child care).

[16] Restricting the analysis to dual-earners, the wage of the husband shows a significant and negative effect on their wives' domestic work hours. However, the cross-wage effect stays insignificant for child care hours of women. Restricting the sample to dual-earners, the positive effect of women's wages on the hours of domestic work of their husband remains significant and increases substantially in size. The effect of her wage on his child care becomes insignificant, though it stays positive.

Therefore, our findings contrast with earlier literature that found a positive effect of parents' own wage rate on own childcare hours. However, we do find that higher educated mothers spend more time with their children. This suggests that it is education that drives the positive effect on childcare rather the wage rate in itself.

As an additional check, we re-estimated the model using a linear specification for market hours, house work and child care hours. This corresponds to interpreting the zeros in the activity records as due to infrequency -some individuals may perform domestic tasks like shopping or cleaning on a certain day and the diary may have been collected on a different day, which would explain the zeros- rather than choice, under the assumption that the random process of observing a zero time record is independent of the time demand process (see Section 3). The elasticities obtained using linear hours equations are shown in Table 11. The elasticities for paid work are almost identical to those in Table 9. This is not surprising, because we observe whether a zero amount of market work is associated with nonemployment or with employment (someone may be employed but not working on the day the time diary was collected), and our model includes an employment equation, that accounts precisely for this type of selection. We find somewhat larger differences for house work and child care (with the largest difference being for the effect of her wage on her child care time), although the estimates are always well within each other's confidence bounds.

We have not yet discussed the effect of other covariates on the time allocation of parents. Non-labor income has a significantly negative effect on the market labor supply of both partners (see Table 3), as predicted by standard labor supply theory. The size of the elasticity is small and estimated imprecisely for women, though. The estimated effect of non-labor income on non-market hours is positive, although not much significant.[17]

The number of children of different ages affects significantly the time allocation of mothers, while it has no effect for fathers. The hours allocated to market work fall with the number of children and this negative effect is larger the younger the child. Mothers' child care and domestic chores hours increase with the number of children. For men, the number of children of different ages has a significant and positive impact on child care hours

[17] However, since some of the non-components of non-labor income may depend on time allocation choices, we also experimented with dropping non-labor income from the model and our main conclusions were not affected (see Table A in the Appendix to the paper).

(decreasing with the age of the child), while it has no impact on market work or domestic chores.

Married women perform significantly more domestic work than unmarried women. However, marital status has no significant impact on parental child care. French fathers spend more hours on market work, but the country of birth does not affect other time uses. Geographical area of residence does not play much of a role either. Education affects parental child care. In particular, the effect is positive and increasing in education level for women. The impact of having a shorter University education is smaller than that of upper secondary education, which might possibly be driven by dropouts (as a shorter degree might be due to dropping out and thus possibly be associated with negative characteristics).

Moreover, the estimates of the wage equations show that wage rates are increasing in occupational qualifications, decreasing in the regional unemployment rate, and increasing in educational attainments. For fathers, wages are increasing in experience. For mothers, the effect of experience is positive only for more than five years of work experience suggesting that additional work experience pays little for women at the start of their work career[18] Residents of the region of Paris (Ile de France) have higher wage rates than individuals living in the rest of France.

Finally, most of the variables included in mothers' employment participation equation are statistically significant. The mother's employment rate increases with occupational qualifications and falls with the level of non-labor income and the number of children -this negative effect is stronger for children in the younger age group. Her level of education affects positively her employment rate. Women born in France enjoy higher employment rates. Geographical residence has little impact on her employment rate. None of the variables relating to the husband (experience, education or skills) are significant in her employment equation. Only few of the regressors of the fathers' employment equation are statistically significant, suggesting that selection into employment is not an issue for married men (around 90 per cent of the men in the sample are employed, irrespective of their characteristics, see Table 1). The regional unemployment rate and non-labour income have a significant negative impact on the employment of men.

[18] This is perhaps because employers expect young women to give birth and thus go on maternity leave.

Finally, let us discuss the estimates of the unrestricted correlations between the errors of the ten equations. Many of them are strongly significant (see Table 4). In particular, the correlation coefficients between the unobservables of, respectively, the wages (equal to 0.24), the employment status (equal to 0.23), the market work hours (equal to 0.16) and the child care hours (equal to 0.10) of the two partners are all positive and significant at the 5% level. This is suggestive of positive correlations in spousal preferences for market and non-market hours; and possibly of positive assortative mating. The correlations between the errors of own market hours and those of, respectively, own domestic work and own child care are negative and large in absolute value for both partners. However, the correlations between the errors of the own wage rate and own unpaid work are positive (though not significant for men). This may result from unobserved productivity effects: women who are more productive in the market and thus, have relatively higher wages may also be more productive in performing domestic work.

The correlation between the errors of the equations of own domestic time and own child care time is significantly positive for both partners -which may capture preferences or productivity effects. The correlations of the errors of the equations of own paid work and the partner's child care time are positive, implying that if one partner spends more time in market work, the other one will spend more time on childcare. These cross-effects are insignificant for domestic chores, suggesting no scope for substitution there.

5 Discussion

We thus find that when domestic activities are closer to what most people consider as 'household chores' mothers' wage rates have a significant and positive effect on fathers' non-market time but the effect of fathers' wages on mothers' non market hours is close to zero. It can be expected that the wage rate captures negotiation power within the household and individuals with higher wages prefer to perform less house work and child care. In light of the Grossbard-Shechtman (1984) model mentioned above these findings suggest that there are few substitutes to parental time when it comes to house work and that French women at the time of the survey were close to having reached a ceiling as far as supplying WIH is

concerned, but this was not the case for men. Therefore, we find that couples with high-wage women displayed more house work by men but in couples with high-wage men the option of satisfying a higher demand for WIH with more women's WIH was not available perhaps due to the women having reached their ceiling. Relative to women, men seem to have more potential for increasing their house work when partner's incomes increase. This situation corresponds to the illustration in Figure 1. However, notice that these conclusions only hold true using a standard definition of house work. If semi-leisure activities are included in the definition of house work then the effect of her wage on his non-market work becomes insignificant, which is perhaps explained by the smaller scope for intra-household substitution in house work activities that are less compulsory.

These findings carry policy implications. Due to increasing education rates and increasing participation rates of women, women's wages are also expected to catch up in the future with those of men. Therefore, in the future this could lead to an increase in housework by men and a reduction in housework by women. Indeed, there is more potential for expansion of household production by men than by women since according to our results women are already close to the ceiling of housework they can provide. The possibilities of substituting parental house work and child care with that of maids is limited because only part of house work can be delegated (it is rare to be able to delegate putting small children to bed, for example, or setting and unsetting the table, except to other family members). However, Stratton and Stancanelli (2013) also find that a higher wage of the wife results in an increase both in the husband's house work and in the probability that the couple hires a maid.

We also find that when it comes to the effect of the wage on market hours, there is a negative effect of his wage on her market hours (significant at the ten per cent level) and an insignificant effect of his wage on her non-market time (positive and close to zero). Therefore, women's participation in market work is likely to increase further in the future as the within household gap between the husband's wage and the wife's wage gets smaller, possibly due to increasing education levels of women.

Moreover, our estimates indicate that parents' market and non-market hours respond significantly to changes in the own wage rate: positively, for market work, and, negatively, for domestic work and child care. Charlene Kalenkoski, David Ribar and Leslie Stratton

(2008)) found a positive effect of parents own wage (and especially mothers' wage rates) on child care hours for the United States and Britain. Here, we find a positive effect of mother's education on parental time as perhaps we disentangled the effect of education from that of the wage rate.

We conclude that husband's and wife's hours of child care are likely to be substitutes on weekends, when fathers perform more child care and mothers less so. Both spouses do less market work and more house work on weekends. Women's house work hours increase significantly with formal marriage.

Finally, looking at total paid work hours, house work and childcare hours produced by the couple on a representative day, we conclude that an increase in her wage, increases total market hours and reduces total house work hours. This is explained by perhaps hiring a maid or possibly leaving housework undone. In contrast, total child care hours are unaffected -as the increase in his childcare hours fully compensates for the fall in hers.

6 Conclusions

The aim of this paper was to estimate the effect of partners' wage rates on their hours of market work, house work and child care. Earlier literature in this area either considered partners one at a time, thus ignoring the simultaneity of partners' decisions, or ignored the endogeneity of partners' wages. Here we specify and estimate a ten simultaneous equations model of market hours, child care, and house work hours of partners, endogenizing wage rates and controlling for selection into employment. We use current and past broad job characteristics as well as potential experience to identify wages. Employment and hours are identified using non-labor income. We use a rich French dataset that collected time diaries for both partners on the same day, chosen by the interviewer, to estimate the model. Although our results are robust to many specification checks, we do not claim to estimate the causal effect of wages on hours but rather statistical correlations between parents' wages and the time they devote to market work, house work and child care. Our discussion is to be interpreted in this light.

We find that parents' market and non-market hours respond significantly to changes in

the own wage rate: positively, for market work, and, negatively, for domestic work and child care. Moreover, we conclude that mothers' wage rate has a significant and positive effect on fathers' non-market time; while the effect on his market hours is close to zero. The reverse is true for the effect of his wage on her hours: we find a negative effect of his wage on her market hours (significant at the ten per cent level) and an insignificant effect of his wage on her non-market time (positive and close to zero).

Generally, the estimates of the own and cross effects of partners' wages on partners' hours are robust to various sensitivity checks. However, restricting the sample to dual-earners, the own wage effects become smaller and less precise (as the extensive margin is excluded), which may also explain why earlier studies that focused on dual-earners found less significant wage effects on partners' time allocation than we do. Using a broader definition of house work, the effect of her wage on his domestic chores becomes statistically insignificant, though it stays positive. Finally, many of the correlations across the errors of the equations of the system are strongly significant, which further supports our specification strategy. In particular, the correlations between the errors of the wages and the hours equations of the two partners within each household are significant and positive, possibly due to positive correlations in partners' preferences.

We thus find that when domestic activities are closer to what most people consider as 'household chores' mothers' wage rate has a significant and positive effect on fathers' non-market time; while the effect of fathers' wage on mothers' non market hours is close to zero. It can be expected that the wage rate captures negotiation power within the household and individuals with higher wages prefer to perform less house work and child care. In light of the Grossbard-Shechtman (1984) model these findings suggest that there are few substitutes to parental time when it comes to house work and that French women at the time of the survey were close to having reached a ceiling as far as WIH is concerned, but this was not the case for men.Therefore, if the secular increase in women's education and participation rates translates into better wages for women, this might result in men doing more house work, which could in the long term close not only the gender wage gap but also the housework gap between men and women.

References

Apps, P and Rees, R. (2002), "Household production, full consumption and the costs of children", Labour Economics, Vol. 8, pp.621-648.

Apps, P. F. and Rees, R. (1997), "Collective Labor Supply and Household Production", Journal of Political Economy, 105, 178-190.

Becker Gary (1973), "A Theory of Marriage: Part I ", Journal of Political Economy, Vol. 81, pp. 813-846.

Blundell, R, A. Duncan, and C. Meghir (1988), "Estimating Labor Supply Responses using Tax Reforms", Econometrica, Vol. 66, nr. 4, pp. 827-862.

Bonke J., Datta Gupta N. and Smith N. (2003), "Timing and Flexibility of Housework and Men and Women's Wages", IZA DP No. 860

Bonke J., Deding M., Lausten M. and Stratton L. (2007), "Intrahousehold Specialization in Housework in the United States and Denmark", IZA DP No. 2777

Blanchflower and Oswald (1994), "Estimating a wage curve for Britain: 1973-90", Economic Journal, Vol. 104, nr. 426, pp. 1025-1043.

Bloemen, H., Pasqua S. and E. Stancanelli (2010), "An empirical analysis of the Time Allocation of Italian Couples: are they irresponsive", Review of the Economics of the Household, Volume 8 (3), pp. 345-369.

Börsch-Supan, A. and V. Hajivassiliou (1993), "Smooth unbiased multivariate probability simulators for maximum likelihood estimation of limited dependent variable models", Journal of Econometrics, Vol. 58, nr. 3, pp.347-368.

Bryan, Mark L. and Almudena Sevilla-Sanz, 2011. "Does housework lower wages? Evidence for Britain," Oxford Economic Papers, Oxford University Press, vol. 63(1), pages 187-210

Burda M., Hamermesh D.S. and Weil P. (2007), "Total Work, Gender and Social Norms?," NBER WP 13000. dd

Chiappori, P. -A. (1997),"Introducing Household Production in Collective Models of Labour Supply", Journal of Political Economy, Vol. 105, No. 1, pp. 191-209.

Connelly, R. and Kimmel, J. (2009), "Spousal influences on parents' non-market time choices", Review of Economics of the Household, 7(4), pp. 361-394.

Cragg, J.G. (1971), "Some Statistical Models for Limited Dependent Variables with Application to the Demand for Durable Goods", Econometrica, Vol. 39, nr. 5, pp. 829-844.

Del Boca D. , Pasqua S. and Pronzato C. (2007), "An Empirical Analysis of the Effects of Social Policies on Fertility, Labour Market Participation and Earnings of European Women", in: Social Policies, Labour Markets and Motherhood: a Comparative Analysis of European Countries, D. Del Boca and C. Wetzels (eds.), Cambridge University Press

Flinn, C., and J. Heckman (1982), "New methods for analyzing structural models of labor force dynamics", Journal of Econometrics, Vol. 18, pp. 115-1168.

Grossbard-Shechtman, Amyra (1984), "A Theory of Allocation of Time in Markets for Labour and Marriage", The Economic Journal, Vol. 94, pp. 863-882.

Grossbard-Shechtman, S. (2003), "A Consumer Theory with Competitive Markets for Work in Marriage", Journal of Socio-Economics, 31(6): 609-645.

Harley Frazis and Jay Stewart (2012), "How to Think About Time-Use Data: What Inferences Can We Make About Long- and Short-Run Time Use from Time Diaries? ", Annales d'Economie et Statistique, Vol. 105-106, pp. 231-246.

Hallberg, D. and Klevmarken, A. (2003), "Time for Children: A Study of Parent's Time Allocation", Journal of Population Economics, Vol. 16(2), pp. 205-226.

Hersch, J. and Stratton, L. S.(1994), "Housework, Wages, and the Division of Housework Time for Employed Spouses", American Economic Review, Vol. 84, 2, pp. 120-125.

Hersch, J. and Stratton, L. S. (1997). "Housework, Fixed Effects, and Wages of Married Workers." Journal of Human Resources, Vol. 32, No. 2 (Spring), pp. 285-307.

Kalenkoski, S., Ribar, D. S., and Stratton, L. S.(2009), "The influence of wages on parents' allocation of time to child care and market work in the United Kingdom", Journal of Population Economics, Vol 22 (2), pp. 399-419.

Kalenkoski, S., Ribar, D. S., and Stratton, L. S.(2005), "Parental Child-Care in Single-Parent, Cohabiting and Married Couple Families: Time-Diary Evidence from the United Kingdom", American Economic Review, vol. 95 (2), pp. 194-198.

Kimmel, J. and Connelly, R. (2007), "Mothers' Time Choices: caregiving, leisure, home production and paid work", Journal of Human Resources, Vol. XLII (3), pp. 643-681.

Lundberg, Shelly and Robert A. Pollak (2008), "Family Decision-Making", The New Palgrave, Dictionary of Economics, 2nd Edition, Larry Blume and Steven Durlauf, eds. Palgrave Macmillan,

Mincer, J.A. (1974), "Schooling, experience and earnings", NBER, Columbia Press, New York.

OECD, Employment Outlook (2000), Combining Work and Family Chapter.

Pischke, J. (2011), "Money and happiness: evidence from the industry wage structure", NBER Working Paper Series, nr. 17056.

Pollak, Robert A. (2003), "Gary Becker's Contributions to Family and Household Economics", Review of Economics of the Household, 1 (1-2), pp.111-141.

Pollak, R. A. (2005), "Bargaining Power in Marriage: Earnings, Wage Rates and Household Production", NBER Working Paper No. 11239, March.

Pollak, Robert A. (2012), "Allocating Time: Individuals' Technologies and Household Technology", Annales d'Economie et Statistique, Vol. 105-106, pp. 75-98.

Rapoport, B., Sofer, C. et Solaz, A. (2011), "Household Production in a Collective Model: Some New Results", Journal of Population Economics 24 pp23-45.

Sayer, Liana, (2007), "More work for mothers? Trends and gender differences in multitasking", in T. van der Lippe and P. Peters (eds.) "Competing claims in work and family life", Cheltenham: Edward Elgar.

Stancanelli, Elena and Stratton, Leslie (2013), "Her Time, His Time, or the Maid's Time: An Analysis of the Demand for Domestic Work", Economica, forthcoming.

Stewart, Jay. (2009). "Tobit or Not Tobit?" IZA Discussion Paper 4588.

Table 1: Sample descriptive statistics

Variable	Week diaries N =1080		Weekend diaries N =393	
	Mean	Std Dev	Mean	Std Dev
W Age	37.84	7.53	37.70	7.29
H Age	40.27	7.86	40.23	7.40
W Compulsory education	0.11	0.31	0.11	0.32
W Lower Secondary	0.28	0.45	0.29	0.45
W Upper Secondary	0.15	0.36	0.14	0.35
W University short degree	0.12	0.32	0.13	0.34
W University degree and higher	0.10	0.29	0.07	0.26
H Compulsory education	0.07	0.26	0.08	0.27
H Lower Secondary	0.38	0.48	0.37	0.48
H Upper Secondary	0.08	0.28	0.12	0.33
H University short degree	0.11	0.31	0.09	0.29
H University degree and higher	0.12	0.33	0.12	0.32
W High-skilled occupation	0.08	0.28	0.06	0.24
W Intermediary occupation	0.18	0.38	0.19	0.40
W Low-Skill occupation	0.54	0.50	0.57	0.50
W Unskilled occupation	0.09	0.29	0.08	0.28
W occupational skill n. a.	0.10	0.31	0.09	0.29
H High-skilled occupation	0.20	0.40	0.17	0.37
H Intermediary occupation	0.23	0.42	0.27	0.45
H Low-Skill occupation	0.45	0.50	0.48	0.50
H Unskilled occupation	0.12	0.32	0.08	0.28
Married	0.83	0.37	0.81	0.39
# children	1.91	0.98	1.98	1.05
# children age < 3	0.26	0.47	0.25	0.47
# children age $3 - 10$	0.75	0.83	0.76	0.87
# children age $11 - 18$	0.90	0.98	0.96	1.03
Ile de France	0.20	0.40	0.17	0.38
Paris	0.02	0.15	0.01	0.09
Rural	0.17	0.38	0.17	0.38
W France born	0.93	0.25	0.91	0.28
H France born	0.93	0.26	0.91	0.29

Table 1: Sample descriptive statistics (continued)

Variable	Week diaries N =1080		Weekend diaries N =393	
	Mean	Std Dev	Mean	Std Dev
W Employed	0.62	0.48	0.63	0.48
H Employed	0.90	0.29	0.92	0.27
W Hours of work per week	18.45	17.42	19.68	17.77
H Hours of work per week	33.59	13.24	33.86	13.11
W Hours of work per week, diary	16.77	19.03	3.10	9.60
H Hours of work per week, diary	32.76	18.81	4.99	12.84
W Household work, minutes, diary	227.99	134.51	248.96	123.45
H Household work, minutes, diary	50.18	73.07	90.48	91.29
W Household work broad, diary	246.13	146.88	272.70	131.64
H Household work broad, diary	104.12	134.95	174.89	146.60
W Child care, primary activity, diary	89.43	98.96	67.66	83.02
H Child care, primary activity, diary	26.32	46.96	35.73	67.49
W hourly wage, Euros	8.53	5.61	8.20	4.75
H hourly wage, Euros	10.01	5.55	9.96	6.10
Household non-labor income, monthly	496.39	721.24	447.80	623.00
Regional unemployment rate	11.35	2.41		

These are unweighted sample statistics.
The diary paid work activity is actually recorded in minutes per day, but we have transformed it here in hours per week, to compare it to the standard usual hours from the individual questionnaire.
In the econometric analysis, hours per day were entered as the dependent variable.
Wage rates are averaged over positive values only.
Wages and non-labor income are in Euros.

Table 2: Distribution of spouses' time allocation

Percentiles	Excluding weekend diaries N =1078			
Percentiles	Paid work	Child care	Housework	Housework broad
Wives 1%	0	0	0	0
5%	0	0	30	30
10%	0	0	60	60
25%	0	0	130	130
50%	0	60	220	230
75%	460	140	330	350
90%	510	230	410	450
95%	540	290	460	510
99%	640	400	550	610
Husbands 1%	0	0	0	0
5%	0	0	0	0
10%	0	0	0	0
25%	270	0	0	10
50%	480	0	20	60
75%	540	30	70	140
90%	600	90	150	310
95%	660	130	210	400
99%	750	200	340	610

These are unweighted sample statistics.

Table 3: Results of estimation: the sample includes only weekdays diaries, $N = 1080$
Estimates of the time-use equations

	Husbands			Wives		
Variable	Paid	House	Child	Paid	House	Child
Log wage rate	2.17**	-0.85**	-0.64**	-1.29**	0.34	0.10
husband	(0.91)	(0.42)	(0.38)	(0.66)	(0.27)	(0.22)
Log wage rate	-0.26	0.82**	0.59**	5.51**	-3.63**	-1.18**
wife	(0.60)	(0.25)	(0.24)	(1.80)	(0.76)	(0.49)
Intercept	-92.80**	-2.36	-19.90	-124.74**	51.44**	-24.49*
	(33.97)	(17.57)	(17.63)	(38.38)	(18.57)	(13.02)
Log age	51.49**	1.50	11.11	67.32**	-23.87**	17.33**
	(18.88)	(9.71)	(9.80)	(21.12)	(10.25)	(7.40)
Log age squared	-7.23**	-0.18	-1.62	-9.81**	3.81**	-2.66**
	(2.59)	(1.33)	(1.34)	(2.98)	(1.44)	(1.05)
Compulsory ed.	-0.96	0.49**	0.61**	-0.15	0.14	0.05
	(0.64)	(0.27)	(0.26)	(0.70)	(0.30)	(0.25)
Low secondary	-0.29	0.17	0.39**	-0.65	0.26	0.49**
	(0.42)	(0.18)	(0.17)	(0.66)	(0.29)	(0.20)
Upper secondary	-1.01	0.21	0.53**	-1.44*	0.36	1.06**
	(0.64)	(0.31)	(0.25)	(0.87)	(0.41)	(0.25)
Univers. short	-0.61	0.12	0.48	-0.81	0.87	0.84**
	(0.82)	(0.38)	(0.31)	(1.36)	(0.58)	(0.39)
Univers. and higher	-0.79	0.42	0.98**	-2.39	1.69**	1.42**
	(0.98)	(0.45)	(0.37)	(1.90)	(0.81)	(0.51)
Married	0.41	-0.17	-0.13	-0.65	0.49**	-0.06
	(0.36)	(0.17)	(0.17)	(0.46)	(0.22)	(0.16)
French-born	0.69	-0.11	0.31	1.37	-0.40	0.00
	(0.65)	(0.27)	(0.26)	(1.02)	(0.30)	(0.27)
Ile de France	-0.18	-0.02	0.13	-0.40	-0.01	0.20
	(0.45)	(0.19)	(0.16)	(0.53)	(0.24)	(0.17)
Rural	-0.08	0.16	0.01	-0.17	0.22	-0.01
	(0.40)	(0.16)	(0.15)	(0.50)	(0.21)	(0.16)
# children age < 3	0.36	-0.06	0.63**	-2.15**	0.26	1.81**
	(0.44)	(0.19)	(0.14)	(0.56)	(0.22)	(0.15)
# children age $3 - 10$	0.05	-0.03	0.33**	-1.11**	0.41**	0.89**
	(0.21)	(0.09)	(0.08)	(0.30)	(0.11)	(0.08)
# children age $11 - 18$	0.11	0.01	-0.14*	-0.55**	0.35**	0.20**
	(0.20)	(0.08)	(0.08)	(0.25)	(0.09)	(0.08)
Non-labor income	-0.10**	0.03**	0.02*	-0.07	0.01	0.03*
	(0.04)	(0.01)	(0.01)	(0.04)	(0.02)	(0.01)

Non-labor income is measured in French Francs and divided by 1000.

Table 3, continued: Results of estimation:
the sample includes only weekdays diaries, $N = 1080$
Estimates of the employment and wage equations

	Employment equations		Wage equations	
Variable	Husbands	Wives	Husbands	Wives
Intercept	-3.38	-2.91	2.34**	3.47**
	(4.03)	(2.10)	(0.29)	(0.31)
Log experience husband	2.65	1.05	0.56**	
	(2.52)	(1.37)	(0.20)	
Log exp. squared husband	-0.50	-0.26	-0.04	
	(0.41)	(0.24)	(0.03)	
Compulsory ed. husband	0.28	-0.14	0.15**	
	(0.42)	(0.26)	(0.03)	
Low secondary husband	0.10	-0.22	0.14**	
	(0.24)	(0.14)	(0.02)	
Upper secondary husband	0.47	-0.43*	0.19**	
	(0.50)	(0.24)	(0.03)	
Univers. short husband	-0.12	-0.60**	0.38**	
	(0.48)	(0.29)	(0.03)	
Univers. and higher husband	0.09	-0.66**	0.52**	
	(0.48)	(0.32)	(0.04)	
Log experience wife	1.19	1.47		-0.38*
	(1.24)	(1.03)		(0.21)
Log exp. squared wife	-0.19	-0.18		0.12**
	(0.24)	(0.19)		(0.04)
Compulsory ed. wife	0.13	0.61**		0.17**
	(0.39)	(0.19)		(0.03)
Low secondary wife	0.25	0.43**		0.24**
	(0.26)	(0.17)		(0.03)
Upper secondary wife	0.21	0.58**		0.39**
	(0.42)	(0.23)		(0.04)
Univers. short wife	1.37**	0.93**		0.61**
	(0.54)	(0.33)		(0.04)
Univers. and higher wife	-0.27	1.11**		0.76**
	(0.72)	(0.42)		(0.05)

Table 3: (continued) Results of estimation:
the sample includes only weekdays diaries, $N = 1080$
Estimates of the employment and wage equations

	Employment equations		Wage equations	
Variable	Husbands	Wives	Husbands	Wives
Ile de France	-0.16	0.10	0.12**	0.14**
	(0.28)	(0.15)	(0.02)	(0.02)
Rural	-0.22	-0.25**	0.00	0.03
	(0.23)	(0.13)	(0.02)	(0.03)
Unemployment rate	-0.09**	-0.06**	-0.01**	-0.01*
	(0.04)	(0.02)	(0.00)	(0.00)
Married	0.25	0.14		
	(0.24)	(0.15)		
France born	0.31	0.51**		
	(0.27)	(0.23)		
# children age < 3	-0.03	-0.82**		
	(0.24)	(0.17)		
# children age $3 - 10$	0.06	-0.54**		
	(0.12)	(0.08)		
# children age $11 - 18$	0.17*	-0.24**		
	(0.09)	(0.07)		
Non-labor income	-0.14**	-0.04**		
	(0.02)	(0.01)		
Low-skill husband	0.36	-0.03	0.12**	
	(0.26)	(0.15)	(0.02)	
Intermed.-skill husband	0.48	-0.22	0.37**	
	(0.33)	(0.19)	(0.03)	
High-skill husband	0.81	-0.40	0.73**	
	(0.56)	(0.25)	(0.03)	
Low-skill wife	0.15	0.95**		0.07*
	(0.21)	(0.13)		(0.04)
Intermed.-skill wife	0.47	1.28**		0.29**
	(0.41)	(0.20)		(0.05)
High-skill wife	1.03	1.61**		0.61**
	(0.65)	(0.33)		(0.06)

Table 4. Results of estimation: the sample includes only weekdays diaries, $N = 1080$
Estimates of the covariance matrix: standard deviations and correlation coefficients

	Paid work husb.	House work husb.	Child time husb.	Paid work wife	House work wife	Child time wife	Empl. men	Empl. wom.	Wage rate husb.	Wage rate wife
Paid wk husb.	3.84**									
House wk husb.	-0.52**	1.65**								
Child tm husb.	-0.20**	0.21**	1.36**							
Paid wk wife	0.16**	-0.04	0.16**	4.36**						
House wk wife	-0.04	-0.01	-0.10**	-0.73**	2.18**					
Child tm wife.	0.09**	-0.04	0.10**	-0.37**	0.20**	1.57**				
Empl. husb.	0.24	-0.25**	-0.20**	0.05	-0.12	0.07	1.00			
Empl. wife	0.01	0.12**	0.12**	0.26**	-0.52**	-0.27**	0.23*	1.00		
Wage rt husb.	-0.14**	0.13*	0.09	-0.01	0.07	0.03	-0.03	-0.08*	0.23**	
Wage rt wife	-0.02	-0.05	-0.10	-0.27**	0.37**	0.16**	-0.01	0.02	0.24**	0.23**

Table 5: Elasticities, week diaries only;
standard definition of housework

Elasticity of:	Wage husband	Wage wife	Non-labor income
Paid work:			
Paid work husband	0.30**	-0.04	-0.04**
	(0.12)	(0.08)	(0.02)
Paid work wife	-0.22*	0.95**	-0.03
	(0.12)	(0.31)	(0.02)
Total paid work time, for both spouses	0.13	0.29**	-0.04**
	(0.10)	(0.12)	(0.02)
Housework time:			
Housework husband	-0.57**	0.54**	0.08**
	(0.28)	(0.17)	(0.03)
Housework wife	0.08	-0.90**	0.01
	(0.07)	(0.19)	(0.02)
Total housework time, for both spouses	-0.04	-0.62**	0.02*
	(0.08)	(0.15)	(0.01)
Child care time:			
Child care time husband	-0.58*	0.54**	0.08
	(0.36)	(0.21)	(0.07)
Child care time wife	0.05	-0.54**	0.04
	(0.10)	(0.22)	(0.02)
Total child care time, for both spouses	-0.10	-0.29	0.05*
	(0.12)	(0.18)	(0.03)

Table 6: Elasticities, week diaries;
Broader definition of housework

Elasticity of:	Wage husband	Wage wife	Non-labor income
Paid work:			
Paid work husband	0.31**	-0.03	-0.04**
	(0.13)	(0.09)	(0.02)
Paid work wife	-0.15	0.90**	-0.03
	(0.12)	(0.29)	(0.02)
Total paid work time, for both spouses	0.16*	0.28**	-0.04**
	(0.09)	(0.14)	(0.02)
Housework time:			
Housework husband	-0.64**	0.20	0.08**
	(0.21)	(0.16)	(0.03)
Housework wife	0.01	-0.85**	0.02
	(0.07)	(0.17)	(0.01)
Total housework time, for both spouses	-0.19**	-0.52**	0.04**
	(0.08)	(0.13)	(0.02)
Child care time:			
Child care time husband	-0.54*	0.54**	0.08
	(0.33)	(0.21)	(0.06)
Child care time wife	0.00	-0.50**	0.04
	(0.10)	(0.22)	(0.02)
Total child care time, for both spouses	-0.13	-0.26	0.05**
	(0.11)	(0.18)	(0.02)

Table 7: Elasticities, week and weekend diaries
standard definition of housework

Elasticity of:	Wage husband	Wage wife	Non-labor income
Paid work:			
Paid work husband	0.21	0.07	-0.03*
	(0.13)	(0.08)	(0.02)
Paid work wife	-0.16	0.76**	-0.03
	(0.11)	(0.27)	(0.02)
Total paid work time, for both spouses	0.07	0.30**	-0.03**
	(0.09)	(0.11)	(0.01)
Housework time:			
Housework husband	-0.42**	0.45**	0.07**
	(0.20)	(0.13)	(0.03)
Housework wife	-0.02	-0.65**	0.01
	(0.05)	(0.13)	(0.01)
Total housework time, for both spouses	-0.10*	-0.42**	0.02*
	(0.06)	(0.10)	(0.01)
Child care time:			
Child care time husband	-0.28	0.54**	0.06
	(0.29)	(0.18)	(0.04)
Child care time wife	0.04	-0.31*	0.03
	(0.09)	(0.18)	(0.02)
Total child care time, for both spouses	-0.04	-0.09	0.04**
	(0.10)	(0.14)	(0.02)

Table 8: Elasticities, week- and weekend diaries
no households with children younger than 3 in the sample
standard definition of housework
$N = 819$

Elasticity of:	Wage husband	Wage wife	Non-labor income
Paid work:			
Paid work husband	0.46**	0.06	-0.03
	(0.22)	(0.12)	(0.03)
Paid work wife	-0.14	0.55	-0.01
	(0.17)	(0.35)	(0.03)
Total paid work time, for both spouses	0.25	0.23	-0.03
	(0.17)	(0.16)	(0.02)
Housework time:			
Housework husband	-0.81**	0.52**	0.08**
	(0.30)	(0.17)	(0.04)
Housework wife	0.03	-0.39**	0.01
	(0.08)	(0.18)	(0.02)
Total housework time, for both spouses	-0.15	-0.19	0.02
	(0.09)	(0.14)	(0.02)
Child care time:			
Child care time husband	-0.48	0.71**	0.09
	(0.56)	(0.29)	(0.08)
Child care time wife	-0.02	-0.32	0.03
	(0.16)	(0.34)	(0.04)
Total child care time, for both spouses	-0.13	-0.06	0.04
	(0.19)	(0.27)	(0.04)

Table 9: Elasticities, week diaries only;
standard definition of housework
Linear equations

Elasticity of:	Wage husband	Wage wife	Non-labor income
Paid work:			
Paid work husband	0.28**	-0.04	-0.03*
	(0.11)	(0.07)	(0.02)
Paid work wife	-0.23**	0.95**	-0.04*
	(0.11)	(0.28)	(0.02)
Total paid work time, for both spouses	0.11	0.32	-0.03**
	(0.08)	(0.11)	(0.01)
Housework time:			
Housework husband	-0.71**	0.52**	0.10**
	(0.40)	(0.22)	(0.03)
Housework wife	0.08	-0.97**	0.01
	(0.07)	(0.20)	(0.02)
Total housework time, for both spouses	-0.06	-0.70**	0.03**
	(0.09)	(0.17)	(0.01)
Child care time:			
Child care time husband	-0.67	0.49*	0.09*
	(0.44)	(0.28)	(0.05)
Child care time wife	0.07	-0.83**	0.04*
	(0.11)	(0.26)	(0.02)
Total child care time, for both spouses	-0.10	-0.53**	0.06**
	(0.13)	(0.21)	(0.02)

A Likelihood contributions

To deal with the multidimensional integration of the likelihood contributions, we estimate the model by simulated maximum likelihood, using the GHK algorithm (see, for instance, Börsch-Supan and Hajivassiliou, 1993), proceeding as follows.

We write the variance-covariance matrix Σ of the errors of the time-use, employment and wage equations as:

$$\Sigma = \begin{pmatrix} A & C' \\ C & \Omega \end{pmatrix} \tag{6}$$

with

$$\Omega = Eu_i u_i', u_i = \begin{pmatrix} u_{im} \\ u_{if} \end{pmatrix}, C = Eu_i \begin{pmatrix} \epsilon_{im} \\ \epsilon_{if} \\ \nu_{im} \\ \nu_{if} \end{pmatrix}', A = E \begin{pmatrix} \epsilon_{im} \\ \epsilon_{if} \\ \nu_{im} \\ \nu_{if} \end{pmatrix} \begin{pmatrix} \epsilon_{im} \\ \epsilon_{if} \\ \nu_{im} \\ \nu_{if} \end{pmatrix}' \tag{7}$$

The joint density of the errors of the time-use equations (Equation 1) and the employment equations (Equation 3), conditional on the errors of the wage equations (Equation 2), is normal with mean B_i and variance-covariance matrix Z, with:

$$B_i = C'\Omega^{-1}u_i, Z = A - C'\Omega^{-1}C \tag{8}$$

Let L be the lower-triangular matrix implicitly defined by:

$$LL' = Z \tag{9}$$

with typical element $l_{js}, j = 1, ...8, s = 1, ..., j$. For each household, we draw R independent random numbers $u^*_{isr}, i = 1, ..., N, s = 1, ..., 7, r = 1, ..., R$ from the uniform distribution over the range $(0, 1)$. These random numbers are used to recursively simulate the likelihood contributions for the time-use equations of the husband, the time-use equations of the wife, and the employment equations of husband and wife. We initially assume that wages w_{im} and w_{if} are observed. Let l_{itmjr} denote the simulated likelihood contribution for the j-th time use ($j = 1, 2, 3$) of the husband in household i, and replication r. If the husband reports no

time spent on time use j ($j = 1, 2, 3$), but is employed, we set[19]

$$l_{itmjr} = \Phi\left(-\frac{\alpha_{jm}^{m} \ln w_{im} + \alpha_{jm}^{f} \ln w_{if} + x'_{im}\beta_{jm} + \sum_{s=1}^{j-1} l_{js}\nu_{isr}}{l_{jj}}\right) \tag{10}$$

and

$$\nu_{ijr} = \Phi^{-1}(l_{itmjr} u^{*}_{ijr}) \tag{11}$$

where $\Phi(.)$ represents the standard normal distribution function. If the husband is not employed, there is no information about the latent amount of paid work, because we do not know whether this state is due to choice or restriction, and the likelihood contribution is the probability (10) plus its complement, which leads to $l_{itm1r} = 1$ for paid work.

If the husband reports a positive amount of time spent on activity j, we set $l_{itmjr} =$

$$\frac{1}{l_{jj}}\phi\left(\frac{t_{ijm} - [\alpha_{jm}^{m} \ln w_{im} + \alpha_{jm}^{f} \ln w_{if} + x'_{im}\beta_{jm} + \sum_{s=1}^{j-1} l_{js}\nu_{isr}]}{l_{jj}}\right) \tag{12}$$

where $\phi(.)$ is the standard normal density function, and

$$\nu_{ijr} = \frac{t_{ijm} - [\alpha_{jm}^{m} \ln w_{im} + \alpha_{jm}^{f} \ln w_{if} + x'_{im}\beta_{jm} + \sum_{s=1}^{j-1} l_{js}\nu_{isr}]}{l_{jj}} \tag{13}$$

We take a similar approach for the time uses of the wife. If the wife reports no time spent on activity j, but she reports to be employed, we determine:

$$l_{itfjr} = \Phi\left(-\frac{\alpha_{jf}^{m} \ln w_{im} + \alpha_{jf}^{f} \ln w_{if} + x'_{if}\beta_{jf} + \sum_{s=1}^{j+3-1} l_{js}\nu_{isr}}{l_{j+3,j+3}}\right) \tag{14}$$

and

$$\nu_{i,j+3,r} = \Phi^{-1}(l_{itfjr} u^{*}_{i,j+3,r}) \tag{15}$$

If she is not employed, we have $l_{itf1r} = 1$ for her paid work.

[19] We define the summation $\sum_{s=1}^{0} \equiv 0$.

If the wife reports a positive amount of time spent on activity j, we have $l_{itfjr} =$

$$\frac{1}{l_{j+3,j+3}}\phi\left(\frac{t_{ijf} - [\alpha_{jf}^{m}\ln w_{im} + \alpha_{jf}^{f}\ln w_{if} + x_{if}'\beta_{jf} + \sum_{s=1}^{j+3-1} l_{js}\nu_{isr}]}{l_{j+3,j+3}}\right) \tag{16}$$

and

$$\nu_{i,j+3,r} = \frac{t_{ijf} - [\alpha_{jf}^{m}\ln w_{im} + \alpha_{jf}^{f}\ln w_{if} + x_{if}'\beta_{jf} + \sum_{s=1}^{j+3-1} l_{js}\nu_{isr}]}{l_{j+3,j+3}} \tag{17}$$

The likelihood contribution for the employment status of the husband, denoted by l_{iemr}, is equal to, for a non-employed husband:

$$l_{iemr} = \Phi\left(-\frac{q_{im}'\gamma_m + \sum_{s=1}^{6} l_{7s}\nu_{isr}}{l_{77}}\right) \tag{18}$$

and

$$\nu_{i7r} = \Phi^{-1}(l_{iemr}u_{i7r}^{*}) \tag{19}$$

For an employed husband, it is equal to:

$$l_{iemr} = 1 - \Phi\left(-\frac{q_{im}'\gamma_m + \sum_{s=1}^{6} l_{7s}\nu_{isr}}{l_{77}}\right) \tag{20}$$

$$\nu_{i7r} = \Phi^{-1}((1 - l_{iemr}) + l_{iemr}u_{i7r}^{*}) \tag{21}$$

For the employment of the wife, we set the likelihood contribution l_{iefr} if she is nonemployed equal to:

$$l_{iefr} = \Phi\left(-\frac{q_{if}'\gamma_f + \sum_{s=1}^{7} l_{8s}\nu_{isr}}{l_{88}}\right) \tag{22}$$

If she is employed, we set this equal to:

$$l_{iefr} = 1 - \Phi\left(-\frac{q_{if}'\gamma_f + \sum_{s=1}^{7} l_{8s}\nu_{isr}}{l_{88}}\right) \tag{23}$$

Next, we set the simulated likelihood contribution of household i, for replication r of the time-use equations and employment status equal to l_{ir}, where

$$l_{ir} = \prod_{j=1}^{3} l_{itmjr}l_{itfjr}l_{iemr}l_{iefr} \tag{24}$$

This is then averaged over replications to yield:

$$l_i = \frac{1}{R} \sum_{r=1}^{R} l_{ir} \tag{25}$$

In the empirical application we set $R = 60$.

Were neither the wage rates of the husband or the wife to be observed, before computing the above likelihood contributions we simulated their wages w_{imr} and w_{ifr}, by drawing them from their joint distribution, (defined by Equation(2) and $u_i \sim N(0, \Omega)$), and then plugged them into the simulated likelihood contributions listed above. If the wage rate of the husband is observed, but that of his wife is not, we draw the wife's wage rate, w_{ifr}, from the distribution of w_{if}, conditional on w_{im}, and plug it into the simulated likelihood contribution, as above. The likelihood contribution was completed by multiplying Equation 25 by the marginal density of the husband's wage rate. For households, where, on the contrary, the wife's wage rate was observed but the husband's was not, we proceed similarly. If both wage rates are observed, we multiply the simulated likelihood contribution Equation 25 by the joint density function of the wife's and husband's wage rates.

Appendix Table A: Elasticities, week diaries
standard definition of housework
dropping non-labor income from the model
$N = 1080$

Elasticity of:	Wage husband	Wage wife
Paid work:		
Paid work husband	0.32**	-0.04
	(0.12)	(0.08)
Paid work wife	-0.14	0.96**
	(0.11)	(0.27)
Total paid work time, for both spouses	0.16*	0.30**
	(0.09)	(0.12)
Housework time:		
Housework husband	-0.55**	0.55**
	(0.27)	(0.17)
Housework wife	0.00	-0.90**
	(0.07)	(0.18)
Total housework time, for both spouses	-0.11	-0.62**
	(0.07)	(0.14)
Child care time:		
Child care time husband	-0.55	0.55**
	(0.36)	(0.21)
Child care time wife	-0.01	-0.56**
	(0.10)	(0.22)
Total child care time, for both spouses	-0.13	-0.30*
	(0.12)	(0.18)

Figure 1: Impact of wage changes on Work-in-Household (WIH)