Retirement and Time Use in Couples:

A Regression Discontinuity approach

Elena Stancanelli* and Arthur Van Soest**

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Abstract

Existing studies show that retirement from the labour market is typically associated with a dramatic change in the time allocation of individuals. In this paper we analyze the causal effect of retirement on the house work of both partners, allowing for endogeneity of the retirement decisions. Our identification strategy exploits the fact that for most French salaried workers, the earliest age at which a retirement pension can be drawn is age 60, which enables us to use a regression discontinuity approach to identify the effect of retirement on time allocation. We find that the retirement probability increases significantly for spouses aged 60 and above, which supports our identification strategy. We conclude that retirement increases significantly house work time. For men, it is specially semi-leisure chores -defined to include gardening, house repairs, taking care of pets, making jams, knitting and sewing- that increase significantly with retirement, while for women it is core house work – cleaning, washing up dishes, doing the laundry- and cooking and shopping. The time devoted to caring for children or adults increases significantly for both partners with own retirement. Finally, we conclude that controlling for both partners retirement is crucial to understanding the effect of retirement on home production.

Keywords: Time Use, Ageing, Retirement, Regression Discontinuity

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***CNRS, Université Cergy Pontoise and OFCE, Sciences-Po**

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1. Introduction

Retirement is one of the key transitions over the life-cycle. It immediately changes the available time for other activities than paid work and typically increases the time available for household production, resulting in additional goods and services that may substitute consumption in the market. In particular, earlier studies argue that the drop in consumption upon retirement, known as the retirement consumption puzzle, may be at least partly explained by increased home production. The earlier literature focuses on retirement of the male head of the household and its effects on consumption and individual home production. However, retirement of one (or both) of the partners may change the way in which both partners spend their time. Furthermore, retirement from the labour market of an individual in a couple may not be independent from retirement of the other partner.

In this paper we analyze the causal effect of retirement (and corresponding changes in paid work) of men and women in a couple on the time use decisions of both partners, allowing for endogeneity of both retirement decisions (or both amounts of time spent on paid work). Our identification strategy exploits the fact that for most French salaried workers, the earliest age at which a retirement pension can be drawn is age 60. This makes each partner's probability to be in retirement a discontinuous function of their age, with a substantial positive jump at age 60. We therefore can use a regression discontinuity approach to identify the effect of own and partner's retirement on the individual allocation of time. In particular, we study the effect of retirement on the time allocated to home production by partners. We also consider leisure activities, sleeping and eating, and caring for adults and children, whether from the same or from other households.

Existing studies show that retirement of an individual is typically associated with a dramatic change in the time allocation of that individual. For the United States, Mark Aguiar and Eric Hurst (2005) estimate the effect of retirement (instrumented with age) on individual food production activities in a remarkable pioneering study in this area. They conclude that retired people spend more time on home production and thus compensate for the fall in their private expenditure, which explains at least part of the retirement consumption puzzle. Hurd and Rohwedder (2008) using the Health and Retirement Survey argue that there is no retirement consumption puzzle since economic theory can provide explanations for the drop in consumption around retirement, such as health shocks, changes in the allocation of time or reduction in work-related expenditures. Matthew Brzozowski and Yuqian Lu (2006) find that

in Canadian households, retirement or unemployment leads to substitution of food eaten in restaurants by food prepared at home and of precooked meals by meals prepared from primary ingredients, explaining why retirement does not lead to a change in food intake, in spite of the reduction in food expenditure.

Contrasting evidence is given by Erich Battistin, Agar Brugiavini, Enrico Rettore and Guglielmo Weber (2009) who conclude that private consumption falls significantly at retirement, but most of the drop in consumption is explained by the reduction in work-related expenditures and children leaving home. In particular, when adjusting their consumption measure for family size, the effect of retirement on consumption becomes insignificant.

Other studies have focused more generally on the time allocation of older people (see, for example, Sayer, Liana, Suzanne Bianchi and John Robinson, 2001). Rachel Kratz-Krent and Jay Stewart (2007), using US data drawn from the American Time Use Survey (ATUS), find that the time allocation of older individuals varies considerably as a function of their hours of paid work rather than their age, confirming earlier findings by John Robinson and Geoffrey Godbey (1997).

The relation between life cycle consumption or home production and retirement has been the object of a vast literature (see for example, Hamermesh, 1984) that has however been conducted disjoint from that on partners' joint retirement. In the scant literature on partners' joint retirement decisions one of the explanations for joint retirement is externalities in leisure: joint retirement makes it possible to derive utility from joint leisure activities that exceeds the utility from leisure activities without the partner (see, for instance, Hurd, 1990). Recently, a major contribution in this area is the structural model of retirement of partners developed by Gustman and Steinmeier (2000 and 2009). Much less attention is paid to the effect of retirement of one partner in a couple on the time use of the other partner. Shelly Lundberg, Richard Startz and Steven Stillmann (2003) argue that retirement of the husband lowers the husbands' bargaining power. In particular, the authors explain the fact that retirement of the primary earner (usually the husband) reduces household consumption expenditures for couples but not for singles from an increase in the bargaining weight of the wife, who has a larger preference for future consumption rather than current consumption, because of longer life expectancy.

Our regression discontinuity approach is similar to that of Erich Battistin, Agar Brugiavini, Enrico Rettore and Guglielmo Weber (2009) who exploit an institutional feature

in the Italian retirement system, implying that retirement becomes possible at a specific minimum age (that depends on how long someone has paid contributions). Here we allow for both the husband's and the wife's retirement to affect home production. We specify a recursive model of retirement and time allocation of the two partners, endogenizing own and partner's retirement. The four equations in this model are estimated jointly (by simulated maximum likelihood). Similarly, we also estimate models in which the dichotomous retirement variables are replaced by the continuous measures of paid work from the diary data, so that we can directly analyze how the time that becomes available by reducing or quitting paid work is reallocated to various home production activities. These include shopping, cooking, gardening, and, more generally, doing household chores, and caring for adults and children.

The data for the analysis are drawn from the 1998-99 French time use survey, carried out by the National Statistical offices (INSEE). In our data, age is available in months. The sample includes a thousand of couples where each partner was aged 50 to 70. A time diary was collected for each partner on the same day, either on a week or a weekend day.

We find that the retirement probability increases significantly for spouses aged 60 and above; moreover, the time spent on paid work drops significantly at this age. This supports our identification strategy. Our findings indicate that for men in a couple, it is especially semi-leisure chores -defined to include gardening, house repairs, taking care of pets, making jams, knitting and sewing- that increase significantly with retirement, while for women it is core house work –including cleaning, washing up dishes, doing the laundry- and cooking and shopping. To complete the picture, the time devoted to caring for children or adults from other households increases significantly for both partners with own retirement.

The structure of this paper is the following. The next section presents the econometric approach; Section 3 provides details of the data and the sample selection. The exploratory analysis and the results of the estimations are presented in Sections 4 and 5. The last section concludes.

2. A regression discontinuity approach

To identify the causal effect of retirement on individual time allocation, we exploit the legislation on early retirement in France, which sets 60 as the earlier retirement age for most categories of workers. This creates a discontinuity in the probability of retirement as a

function of age that enables us to apply a regression discontinuity framework. Excellent literature reviews of regression discontinuity methods are provided by, for example, David Lee and Thomas Lemieux, 2010; Wilbert van der Klaauw, 2008; and Guido Imbens and Thomas Lemieux, 2007.

Identification of the retirement effect on the time uses is achieved thanks to the sudden and large increase in the treatment participation at the point of discontinuity (age 60) in the assignment variable (age). Since individuals cannot manipulate their age, this seems a valid assumption in our context. In our design the probability of t retirement is a function of age (and other variables) and this function is discontinuous at age sixty. If we were faced with a "sharp" regression discontinuity design, everyone would retire at age 60 by law. However, some people may retire earlier –due to special early retirement schemes or to specific employment sector rules that may differ from the general prescription of the early retirement age being sixty - and others later. In particular, the pension benefits payable reach a maximum when individuals have cumulated a given contribution record (40 years of contributions in the private sector, at the time of the survey).[1] Therefore, individuals that have full pension rights at the early retirement age have no incentive to retire later. On the contrary, those with lesser pension benefit entitlement have a disincentive to retire earlier. In particular, this may be the case for individuals that delayed entry into the labour market to study longer (the high educated) or for those that have interrupted labour market experience like mothers– notice, however, that in France unemployment or maternity and sick leave periods counts towards the contribution period.

It follows that we are confronted with a "fuzzy" regression discontinuity design and the probability of retirement at age 60 is greater than zero and less than one. If we did not control for partner's (joint) retirement, this would lead to specifying two stages least square regressions of time use instrumenting retirement with an indicator for being age 60 and above and interactions of such indicator with (left and right) age polynomials. This is the approach followed, for example, by David Card, Carlos Dobkin and Nicole Maestas (2004 and 2008); who studied the effect of individual age eligibility rules to health insurance (Medicaid, to which anyone is eligible upon reaching age 65 in the United States)) on individual health insurance coverage and health related outcomes.

[1] See, for example, Hairault, Langot and Sopraseuth (2010) for more details.

Here we model the effect of retirement of both partners on their time allocation by specifying a system of simultaneous equations for time uses and retirement of each partner as follows. Let R be a dummy for retirement, equal to one if individuals have retired from market work and zero otherwise, and T be the time allocated to a given activity, say house work. The subscript m stands for male partner and w, for female partner, and we consider time use of type j:

a) $$T_{jm} = Z_m \beta^{tjm} + Z_f \beta^{tjf} + R_m \gamma^{tjm} + R_f \gamma^{tjf} + Agepol_m \psi^{tjm} + Agepol_f \psi^{tjf} + \nu^{tjm}$$

b) $$T_{jf} = Z_m \lambda^{tjm} + Z_{if} \lambda^{tjf} + R_m \delta^{tjm} + R_f \delta^{tjf} + Agepol_m \zeta^{tjm} + Agepol_f \zeta^{tjf} + \nu^{tjf}$$

c) $$R_{im}^{*} = Z_m \beta^{rm} + Z_f \beta^{rf} + D_m \gamma^{rm} + Age_m D_m \eta^{rm} + Age_m (1-D_m) \pi^{rm} + D_f \gamma^{rf} +$$

$$+Age_f D_f \eta^{rf} + Age_f (1-D_f) \pi^{rf} + \nu^{rm}; R_{im}=1 \text{ if } R_{im}^{*}>0 \text{ and } R_{im}=0 \text{ if } R_{im}^{*}\leq 0$$

d) $$R_{if}^{*} = Z_m \lambda^{rm} + Z_f \lambda^{rf} + D_m \delta^{rm} + Age_m D_m \tau^{rm} + Age_m (1-D_m) \mu^{rm} + D_f \delta^{rf} +$$

$$+Age_f D_f \tau^{rf} + Age_f (1-D_f) \mu^{rf} + \nu^{rf}; R_{if}=1 \text{ if } R_{if}^{*}>0 \text{ and } R_{if}=0 \text{ if } R_{if}^{*}\leq 0$$

Here $Age_m = [(Age_m -60), (Age_m -60)^2, \ldots . , (Age_m -60)^n]$

$Age_f = [(Age_f -60), (Age_f -60)^2 , \ldots., (Age_f -60)^n]$

$Agepol_m = [(Age_m), (Age_m)^2 , \ldots., (Age_m)^n]$

$Agepol_f = [(Age_f), (Age_f)^2 , \ldots, (Age_f)^n]$

The vectors Z_m and Z_f contain control variables (other than age functions); D_m and D_f are dummies for whether the two individuals have reached age 60; and Age is a polynomial of order n in age minus 60, which is fully interacted in the retirement equations with the dummies for being 60 or older; and Agepol is a polynomial of order n in age. The Greek letters denote (vectors of) coefficients. The v's are normally distributed errors, independent of Z_m and Z_f and the ages of both partners. The equations for retirement therefore are probit equations; the time use equations are linear equations.

The equations for retirement status of both partners, equations c) and d), explain retirement of each partner from the control variables of both partners, flexible continuous functions of each partner's age, and dummies D_m and D_f for whether the two individuals have reached age 60. The coefficients on the dummies determine the discontinuities at age 60 of the individual and the partner; we expect the former to be larger than the latter, but if there is

joint retirement (in the sense that the preference for retirement of one spouse increases if the other spouse is retired), the individual's retirement decision may also depend on whether the partner is age eligible for retirement the individual's retirement decision may also depend on whether the partner is age eligible for retirement. The control variables (denoted by Z_i) include individual and household characteristics, such as education level, presence of children, and local labour market variables like the regional unemployment rate.[2]

The time use equations, a) and b) can be seen as linear demand equations, defining the time inputs into optimal household production and utility functions of partners.[3] The time use equations include the same control variables as the retirement equations; a flexible age polynomial and retirement status dummies of both partners as additional regressors. Because the zeros time use participation may capture infrequencies rather than censoring we use a linear specification rather than a tobit one (see Stewart, 2009, for a thorough discussion).

The four equations will be estimated jointly with simulated maximum likelihood. The error terms in equations a) – d) are allowed to be correlated in an arbitrary way. This implies that in this model, own and partner's retirement are allowed to be endogenous to time use. The dummies D_m and D_f are included in the retirement equations but excluded from the time use equations: The probability to be retired changes discontinuously when reaching age 60 (and perhaps also when the spouse reaches age 60), but given retirement status, time use is assumed to be a continuous function of age. This makes our approach essentially a regression discontinuity approach.

Alternatively, we also analyze models in which retirement is replaced by paid work time, obtained from the diary information (for the same day as the other time use variables). This model uses the same explanatory variables and identification strategy, since reaching age 60 will, through retirement, lead to a discontinuous drop in average hours of paid work (given the control variables). This enables us to compare more precisely the size of the effects of reducing hours of paid work on time allocation of men and women in a couple: married women typically may work shorter hours than married men, affecting the amount of time that is freed up through retirement, and this may affect the time allocation changes at retirement.

[2] See Goux and Maurin (2000), for an analysis of changes in the demand for workers with low-skilled qualifications in France.

[3] Taking a more structural approach to model the time allocation of partners, like for example in Laurens Cherchye, Bram De Rock and Frederic Vermeulen (2010), would not only require additional information on prices and consumption not available in our data, but also imply selecting only couples with positive participation in the time uses considered.

We use similar models for the total time allocated by the two partners to a given activity, using a system of three instead of four equations: two retirement equations (one for each partner) and one time use equation at the household level. The advantage of this is that it makes it easier to interpret the effect of retirement of one or both partners on the total time allocated by the couple to say home production. If, for example, retirement of the husband increases the amount of household chores performed by the husband but equivalently reduces the amount of chores carried out by his wife, the total home production at the household level would not be affected.

In the framework sketched above, the causal effects we are trying to estimate may have several sources. First consider the effect of retirement on own time use. Retirement typically reduces hours of paid work and the time that becomes available must be spent on something else, so that almost automatically retirement will lead to an increase in the time spent on some activities of the same individual. Second, own retirement as well as retirement of the partner may directly affect the marginal utility of certain types of time use. Third, retirement may make it attractive to spend more time on home production, at the same time reducing expenditures on consumption goods and services bought in the market to compensate for lower income and usefully exploiting the extra time that becomes available. This is one of the potential explanations for the retirement consumption puzzle, the phenomenon that consumption expenditures tend to fall at retirement. Fourth, retirement of either partner may change each partner's bargaining power within the household, which may change the outcomes of the household decision process. Changes in bargaining power may also affect the share of home production that is produced by each partner (see Robert Pollak 2005 and 2010), as well as the optimal amount of total home work to be done within the household (if the partner with the larger bargaining power has stronger preferences for home production, the couple may produce relatively more of the home produced good than under the opposite scenario).

If the retirement decision is exogenous to the time allocation choices, it would not be necessary to rely on regression discontinuity for identification. To test the sensitivity of our results to allowing for endogenous retirement, we also estimate the same time allocation equations separately (that is, not jointly with retirement equations), taking retirement as an exogenous variable, and compare the estimated effects of retirement on time use under the two specifications.

3. Data

The data for the analysis are drawn from the 1998-99 French time use survey, carried out by the National Statistical Offices (INSEE). This survey is a representative sample of more than 8,000 French households with 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. The diary was collected for all individuals in the household, which is an advantage over many other surveys that only have information on one individual in each household. The diary was filled in for one day, which was chosen by the interviewer and could be either a week day or a weekend day. This was the same day for all household members.

3.1 Sample selection

Selecting couples, either married or unmarried but living together, gave a sample of 5,287 couples with and without children. We then applied the following criteria to select estimation samples of older men and women in a couple:

- Each respondent was aged 50 to 70.
- Each respondent had filled in the time diary.
- No respondent had filled in the time diary on an "exceptional day", defined as a special occasion such as a vacation day, a day of a wedding or another party, etc.
- The respondents were not unemployed or disabled.
- We dropped one man who reported to be a home-maker, but we kept housewives (who are neither retired nor working).

Applying these criteria led to a final sample of 1043 couples.

3.2 Diary activities and covariates

The diary was filled in by each household member on one specific day, either a week day or a weekend day, according to the following procedures:

a) The interviewer chose the day the diary should be filled in.
b) The diary covered a 24 hours time span, with activities recorded every ten minutes.

c) Main and secondary activities were coded, where the latter were defined as activities carried out simultaneously with another, primary, activity (for example, cooking and watching the children). The respondent decided which activity should be coded as primary and which as secondary (if any).
d) About 140 categories of main activities and 100 categories for secondary activities were distinguished in the design of the survey.

Here we only consider activities reported as main activity. Very few respondents filled in secondary activities. We distinguish the following activities:

1. Paid work (at home or at the workplace).
2. House work, and its subcomponents:
   2.1. Core household work, including cleaning, doing the laundry, ironing, cleaning the dishes, setting the table, and doing administrative paper work for the household.
   2.2. Shopping
   2.3. Cooking
   2.4 "Semi-leisure" household work, including time devoted to gardening, house repairs, knitting, sewing, making jam, and taking care of pets.
3. Caring for children and/or adults living in the same household or in another household.

Earlier studies show that one should be careful about aggregating the care tasks and the household chores listed under category two. In particular, the care activity includes a large number of diary reported activities like bathing the children, feeding them, helping them with homework, playing with them, taking them somewhere, giving medical treatment to adults, taking care for them, doing the cleaning, the shopping, the washing, the ironing, the garden, or taking care of pets for them.

In our data, age is available in months. The employment or retirement status is derived from the respondent's self-assessed occupational status. The indicator for retirement takes value one for respondents who reported to be retirees or early-retirees.

We constructed a dummy variable for time diaries filled in on a weekend day. This indicator was interacted with other variables where appropriate, for example with hours of paid work in the models using paid work instead of retirement to explain the time spent on other activities, and with age dummies for having reached age 60 in the equations explaining the time spent on paid work.

The number of children in the household includes dependent children up to 18 years of age. Three education levels are distinguished: low (less than twelve years of schooling), intermediate (twelve years of schooling), and high (over twelve years of schooling). The unemployment rate is the regional unemployment rate at the time of the survey. Paris is an indicator for whether individuals reside in the city of Paris. Cohabiting individuals are those living together but not formally married. Bad health is an indicator which is equal to one if an individual reports to have bad or very bad health status -health is self-assessed on a five point scale: very good, good, medium, bad, or very bad.

3.3 Descriptive statistics

Descriptive statistics for the samples are given in Table 1. We have selected a sample with both partners aged between 50 and 70 years (see Section 3.1). Women are on average two years younger than their husbands. About 57 per cent of the men and 43 per cent of the women in our sample are aged 60 or above. About 64 per cent of the men and 33 per cent of the women in the sample report to have retired from market work. Note that the sample also includes a substantial number of housewives (see Section 3.1) – about 35 per cent of the women in our sample. The percentage employed is similar for both partners 36 per cent for men and 32 per cent for women.

Only a small minority of individuals were not born in France: 4 per cent of the men and 3 per cent of the women. The majority of the respondents have less than twelve years of schooling (the benchmark level of education). Men tend to be slightly more educated than women: 12 per cent of husbands have completed intermediary education (12 years of schooling) and 15 per cent of men have a higher education level (over twelve years of schooling), compared to 10 and 11 per cent for women, respectively. Only 4 per cent of the couples are cohabiting; the others are formally married. These findings are due to a combination of having selected older generations and only those in a couple, as younger generations in France tend to be more educated and more often cohabiting. About 15 per cent of this sample of older households still has children living in the parental home. Very few couples (2 per cent) were living in the city of Paris. The mean level of local unemployment at the time of the survey was pretty high, over eleven per cent. Only three per cent of the men and five per cent of the women in our sample reported to have a bad general health status. This percentage is probably lower than in the complete population since disabled workers were dropped from the sample. About 23 per cent of the observations filled in the time diary in a weekend.

Descriptive statistics of participation, mean and median diary day duration, in minutes, for various time uses (see Section 3.2 for the definition of the diary activities considered) are provided in Table 2. Of course, all these statistics relate to our sample of couples in the age range 50 to 70; the picture may be quite different for singles or younger people. In line with the low employment rates, only 30 per cent of the men and 22 per cent of the women report any paid work activity on the day the diary was collected (with 23 per cent of these in a weekend). Average paid work including the zeros is slightly over two hours a day for men and slightly less than an hour and a half for women.

Using a standard definition of housework, including chores and semi-leisure activities, like gardening, doing house repairs, and knitting, 87 per cent of the husbands and 99 per cent of the wives report doing some house work on the diary day. On average, husbands spend three hours on it and wives more than five hours. Excluding semi-leisure chores leads to a dramatic fall in the amount of housework for men (which then includes 'core' housework: cleaning, cooking, shopping, washing clothes, ironing, doing the dishes, and doing administrative paper work), to about hour and a quarter, on average. For women, the average remains more than four hours. The median man indeed spends an hour on semi-leisure chores, compared to no time at all for the median woman. On the other hand, the other activities not included in core housework are more common among women. The participation rate in cooking is 93 per cent for women and 30 per cent for men while 41 per cent of the men and 52 per cent of the women do some shopping on the diary day.

The time spent on caring includes care provided to children and to adults living at home or belonging to other households. It also includes performing house work for adults in another household at no charge (see Section 3.2). The participation rate and average time spent on this activity are larger for women than for men but rather modest for both genders (18 minutes per day on average for men, 24 minutes for women).

3.4 Exploratory graphical analysis

In this subsection we carry out some exploratory graphical analysis of the discontinuities in the probability of retirement and the time spent on paid work and other activities upon reaching age 60 for each partner, in line with the regression discontinuity literature (see Section 2). We split the sample into equally sized age bins of twelve months.[4] The graphs also

[4] Using smaller or larger bins does not affect the jump at age 60 for either men or women.

show separate regression lines (regressing on an intercept and age only) for those younger and older than 60. In Chart 1, individual retirement status and the time devoted to paid work are plotted against, for men and women separately, against their own age. There are obvious discontinuities at age 60 for both men and women, with jumps in the expected direction.

Total housework (see Sections 3.2 for details) and total care time are plotted against age in Chart 2. There is a sharp increase in housework carried out by men around age 60, which could be a result of the retirement peak at age 60. The pattern is less clear for adult and child care or personal care. For women, there are no discontinuities at age 60 in these activities. Core housework and semi-leisure house chores (two subcomponents of housework) are plotted against age in Chart 3. The increase in semi-leisure chores of men at age 60 is rather sharp, while the same cannot be said for women's semi-leisure chores. As far as core housework is concerned, no clear discontinuities at age 60 are found for either men or women. Chart 4 plots the time allocated to cooking or shopping against age. There is an increase at age 60 in both of these time uses for men, but less so for women. In particular, the time allocated to shopping by women seems to fall with age, perhaps because their (retiring) husbands take over the shopping duties.

To sum up, for some of the unpaid activities considered, the plots suggest that there is a substantial jump at age 60. In our regression discontinuity framework, these discontinuities are due to the discontinuity of the retirement probability (or the drop in paid work) at age 60 in Chart 1 combined with a substantial effect of retirement (or time spent on paid work) on the time spent on the activity. The identifying assumption is that there is no discontinuous jump at age 60 in each of these types of time use when retirement or paid work is kept constant - the direct effects of age on time use are assumed to be continuous. Essentially this is also the identification strategy of the econometric models discussed in the previous section and estimated below, where we allow for more flexible continuous age patterns to the left and right of age 60, and where we control for a number of individual characteristics other than age and hours of paid work or retirement status.

4. Estimation results

We have estimated simultaneous models of retirement (or paid work) and each of the time uses discussed above of both partners. All models are estimated by simulated maximum

likelihood, using 100 random draws.[5] The explanatory variables of the retirement equations include dummies for age 60 and older and cubic polynomials in age of the two partners interacted with the age 60 dummies (see Section 2). The equation for time spent on paid work also contains the interactions of the age 60 dummies with the weekend diary dummy. The coefficients on the age 60 dummies determine the discontinuities at age 60 of the individual and the partner. The other regressors included in the retirement and paid work equations are: an indicator for whether the couple resides in Paris; a cohabiting dummy; the regional unemployment rate; the number of children; and indicators for whether each partner holds an intermediate or higher educational degree. The time use equations include the same control variables and a flexible cubic polynomial in age, and add the retirement status dummies of both partners as additional regressors. They also control for a weekend dummy and its interactions with the retirement dummies. The error terms of the equations of the system are assumed to be jointly normally distributed and we also estimate their unrestricted correlations.

Table 3 presents the estimates of the model for retirement and house work in a broad sense, including core house work -cleaning, ironing, doing the laundry, doing the dishes, setting the table, cooking, shopping- and semi-leisure chores -gardening, doing house repairs, taking out dogs, doing jams, or knitting. Marginal effects for the same model are presented in Table 4. The estimates of a similar model for paid work and broadly defined house work are given in Table 5. We show all the estimates except the many coefficients on the age polynomials and their interactions with the age 60 dummies.

Table 3 shows that the retirement probability increases significantly when individuals reach age 60, as expected from Chart 1. The estimated size of the jump is substantial: 0.23 for men and 0.13 for women. The fact that partner reaches age sixty has no significant effect on an individual's retirement status. Similarly, Table 5 shows that reaching age 60 leads to a significant downward jump in own hours of paid work on week days by more than 170 minutes for men and 130 minutes for women. The effect is much smaller on weekend days, and for men even changes sign (-173+225 = +52 minutes). These results confirm that the age60 dummies are correlated with the endogenous regressors (retirement status or paid work time), which is needed for our identification strategy.

Not many other variables are significant in the equations for retirement. Respondents living in Paris are less often retired and higher education is also associated with later

[5]We used Roodman' Stata code; see Roodman (2007, 2009) for details.

retirement. Somewhat surprisingly, there seems to be a positive effect of the partner's education level and being retired, particularly for men. In the equation for time spent on paid work (Table 5), the only significant effect of education is that women with higher education work more. Men and women living in Paris work more hours, but the difference is significant for men only. As expected since most people do not work in weekends, the time spent on paid work reported in a weekend day diary is much smaller than for weekdays.

For both husbands and wives, we find that own retirement significantly increases the time spent on broadly defined house (see Table 3). For both partners the effect is much stronger on week days (188 minutes for men; 159 for women) than on weekend days (59 and 28 minutes). Retirement of the wife considerably reduces the amount of house work carried out by men during week days (by 107 minutes) or weekend days (by 100 minutes). On the other hand, the husband's retirement has no significant effect on the amount of house work carried out by women (and the point estimates are positive instead of the negative effect expected in case of substitution).

Table 5 shows that the amount of time spent on paid work has a negative effect on the time devoted to household chores by partners on week days. The effect is significant at the 5 per cent level for men but only at the ten per cent level for women. For men, every additional hour of paid work reduces house work by 26 minutes. Moreover, the husband's time spent on house work weekends increases significantly in response to paid work in weekends by the wife: if she works an additional hour on a weekend day, he does 27 minutes ((0.253+0.209)*60) more housework.

The estimated correlation structure of the error terms in Tables 3a and 5a show positive correlations between unobservables driving the retirement status of the two partners, between unobservables affecting hours of paid work of the two partners, and between unobservables driving both partners' house work. This could mean that preferences of the two partners are correlated, or it could point at complementarities in the time spent in retirement (e.g., joint leisure activities). On the other hand, we find no significant correlation between the error terms in the retirement or paid work equations on the one hand, and the house work equations on the other hand. This suggests that controlling for endogeneity of retirement status or time spent on paid work might not be necessary – if all these correlations are indeed zero, then retirement and paid work time are exogenous to house work.

To investigate this further, we re-estimated the house work time equations imposing exogeneity of retirement status or time spent on paid work. The results are presented in Table 6, both for retirement (columns two and three) and paid work (columns four and five). Remarkably, the estimated effect of retirement on house work is almost unaffected. The estimates are very close to those in Table 3, especially the significant ones. Differences are also small though more sizeable for the paid work model. These findings would suggest that individuals do not retire earlier because they want to spend more time on house work (reverse causality). Of course, this could be different for some of the other activities that we consider. Thus we opt for continuing to work with the models with endogenous retirement and time spent on paid work, as in Tables 3 and 5.

In Tables 7 to 12, we present selected estimates of the effect of retirement on several types of house work –total housework and its components: core house work, semi-leisure chores, cooking and shopping, and care time. For each time activity, we estimate two sets of models. In the first (left hand panels), the left hand side variables include each partner's time, leading to four simultaneous equations: two for retirement of each partner and two for the time use of each partner. In the top panel we do not distinguish between week and weekend day diaries; in the bottom panel we include interactions with the weekend dummy. In the other specification (right hand panels), the dependent variable is the total time devoted to the activity by both partners, adding up the time allocated by each of them. This gives a system of three equations: two for retirement of each partner and one for the total time devoted to the activity. Similar models are estimated using paid-work as a right hand side variable (instead of retirement), with results summarized in Tables 13 to 18.

Table 7 indicates that the total house work per day (broadly defined, as in Tables 3-6) increases by more than four hours after retirement of the husband, while the retirement status of the wife does not have a significant effect, since it negatively affects the housework done by the husband and positively that carried out by the wife –and these two effects are very close in absolute value. Most of the increase in house work occurs on weekdays while changes for weekend days are typically insignificant.

Similarly, Table 13 shows that a one hour reduction in paid work by the husband leads to an increase of about 30 minutes in total house work. On the other hand, a reduction in the wife's paid work has hardly any effect on total house work, since the induced increase in her house work is offset by a fall in his house work.

Looking at core housework defined as more "compulsory" tasks such as cleaning, ironing, doing the laundry and the dishes (Table 8) leads to quite different results: The wife's retirement increases the total time devoted to these activities, while the husband's retirement has no significant effect (although it significantly reduces the amount of time he spends on this in weekends). Interestingly, her retirement increases his and her time spent on core housework by almost the same amount. Table 14, however, shows that none of these effects are significant in terms of the responses to the drop in partners' paid work, which is perhaps due to the fact that many of the women in the sample are housewives and the paid work variable does not make a distinction between retired women and housewives.

Tables 9 and 15 present the results for semi-leisure chores, that include gardening, doing house repairs, taking care of pets, making jams, knitting and sewing. Table 9 shows that more than half of the increase in total housework in Table 7 induced by the husband's retirement can be attributed to the additional time that husbands allocate to semi-leisure activities. Particularly on week days, the effect of retirement is quite large - almost three hours – but even on weekend days retirement still leads to an increase of more than one and a half hours in men's semi-leisure. If the wife retires, men respond in the opposite way and devote much less time to semi-leisure activities, possibly because they then spend more time together with their wives. In contrast, the wife's time spent on semi-leisure activities is hardly affected by her own or her husband's retirement. Table 15 shows a negative effect of the husband's paid work on the time spent on semi-leisure activities for husbands. A fall of one hour in the husband's paid work time leads to an increase of 16 minutes in his time spent on semi-leisure activities and to an increase of about 23 minutes for total semi-leisure time of the couple. On the other hand, a fall in the wife's paid work has no significant effects.

Remarkably, the time devoted to cooking (Table 10) and shopping (Table 11) at the household level increases significantly if the wife retires, by over one hour for cooking and almost 50 minutes for shopping. On the other hand, the husband's retirement has no significant effect - it reduces the time he spends cooking, but this is partly offset by a small increase in the wife's cooking time. The wife's shopping time is almost unaffected by her or his retirement, except for a small increase on weekdays if she retires which is significant at the ten per cent level only. Like for core housework, we find no significant relation between the drop in paid-work and the time allocated to shopping (Table 16) or cooking (Table 17) by the couple. Although her paid work significantly increases his cooking time, the size of the impact is small. Moreover, her paid work, especially on weekdays, reduces significantly her

cooking time. The time the husband devotes to shopping also falls significantly with his paid-work but again the size of the impact is small.

Table 12 shows that own retirement significantly increases the time each partner allocates to caring for others, especially so for men. Table 18 shows that a reduction of paid work of the husband by one hour leads to an increase of 16 minutes in the time he spends on caring tasks and an increase of almost 23 minutes for the couple, on average. The effects on weekend days are larger than on week days. On the other hand, the wife's time spent on paid work has no significant effects on caring time.

To sum up, our findings indicate that for French men in 1998, especially semi-leisure chores increase significantly with retirement, while for women it is core house work, cooking and shopping. Men spend significantly more time on core chores and shopping if their wife retires while his semi-leisure chores drop substantially if she retires. The sum of all these house work components at the household level increases significantly with his retirement but is not responsive to hers. This finding is mainly due to the negative effect of her retirement on his semi-leisure chores and it suggests that considering only the aggregated house work effects at the household level does not give the complete picture.

6. Conclusions

There is a scant literature suggesting that the time allocation of individuals changes dramatically at the time of retirement. Because for most French salaried workers, the earliest age at which a retirement pension can be drawn is age 60, we use a regression discontinuity approach to study the effect of retirement on time uses of older French people.

We evaluate the effect of retirement on household work–and various subcomponents, core chores, cooking, shopping, and semi-leisure activities. We estimate a recursive model of retirement and time allocation of the two partners, endogenizing own and partner's retirement. Similarly, we also estimate models in which the dichotomous retirement variables are replaced by the continuous measures of paid work from the diary data, so that we can directly analyze how the time that becomes available by reducing or quitting paid work is reallocated to various activities. The data for the analysis are drawn from the 1998-99 French time use survey, carried out by the National Statistical offices (INSEE). In our data, age is available in months. The sample includes a thousand of couples where each partner was aged 50 to 70. A time diary was collected for each partner on the same day, either on a week or a weekend day.

We find statistically significant jumps in retirement at age 60 and above for both men and women in a couple. In accordance with this, paid work hours also drop significantly around age 60. This supports our identification strategy.

Our findings indicate that for men in a couple, it is especially semi-leisure chores that increase significantly with retirement, while for women it is core house work, cooking and shopping. In particular, married men spend significantly more time on core chores and shopping if their wife retires while the opposite holds true for his semi-leisure chores that drop dramatically if she retires. The time devoted to caring for others increases significantly for both partners with own retirement. Looking at the sum of all these house work components at the household level, we conclude that this increases significantly with his retirement but is not responsive to hers. This finding is mainly due to the negative effect of her retirement on his semi-leisure chores and it suggests that considering only the aggregated house work effects at the household level may lead to the misleading conclusions. In conclusion, we have gathered evidence that controlling for both partners retirement is crucial to understanding the effect of retirement on home production.

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Table 1. Descriptive statistics

	Male partner		*Female partner*	
	Mean	***Standard deviation***	***Mean***	***Standard deviation***
Age	60.72	5.50	58.60	5.61
Age 60 or older	0.57	0.49	0.43	0.47
Retired	0.64	0.48	0.33	0.47
Employed	0.36	0.48	0.32	0.47
Born in France	0.96	0.18	0.97	0.16
Intermediate ed. (12 years schooling)	0.12	0.32	0.10	0.30
Higher education (over 12 years of schooling)	0.15	0.36	0.11	0.31
Bad health	0.03	0.18	0.05	0.23
	Household level variables			
	Mean	***Standard deviation***		
Number of children living at home	0.15	0.51		
Cohabiting	0.04	0.19		
Resides in Paris	0.02	0.15		
Regional Unemployment rate	11.45	2.46		
Weekend diary	0.23	0.42		

Notes: 1043 observations. Age in years (accurate up to one month); Diary activities in minutes per day.

Table 2. Participation rates and mean and median durations of diary day activities

	Male partner			***Female partner***		
	Particip. rate %	***Mean duration (standard. dev.)***	***Median duration***	***Particip. rate (%)***	***Mean duration (standard. dev.)***	***Median duration***
Paid work	*29.82*	137.83 (235.46)	0	*21.67*	86.04 (182.88)	0
House work	*86.77*	183.70 (152.56)	160	*99.04*	310.60 (147.40)	310
House work , excluding semi-leisure	*70.18*	77.19 (88.64)	40	*98.85*	264.85 (123.81)	260
Core Housework (excludes a, b, c)	*50.81*	36.38 (59.05)	10	*96.07*	145.04 (90.28)	140
Cooking, a	*29.63*	11.40 (24.09)	0	*93.38*	81.67 (49.15)	80
Shopping, b	*40.84*	29.42 (47.97)	0	*52.06*	38.14 (49.96)	10
Semi-leisure, chores, c	*61.74*	106.51 (128.64)	60	*43.72*	45.75 (75.36)	0
Caring for children or adults	*14.67*	17.66 (66.12)	0	*21.76*	24.31 (65.13)	0

Note: 1043 observations. Activities in minutes on the diary day. The sample includes week day diaries (77 per cent) and weekend diaries (23 per cent).

Chart 1. Retirement and Paid Work: discontinuities at age 60

Chart 2. House work and care time: discontinuities at age 60

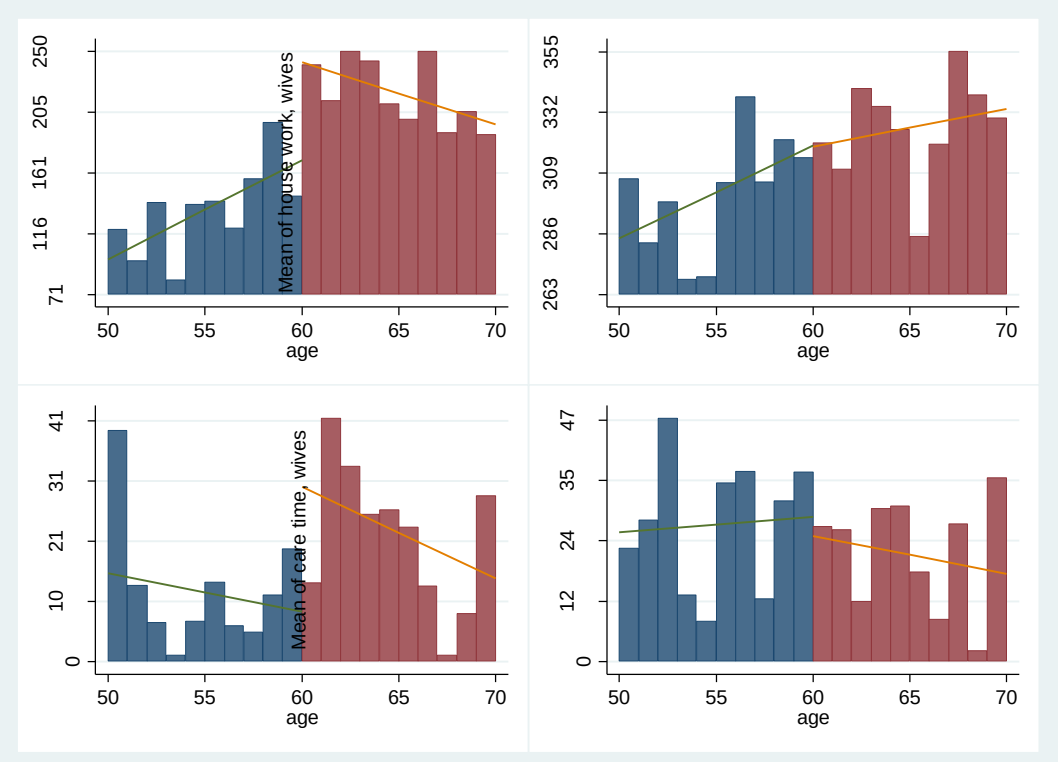
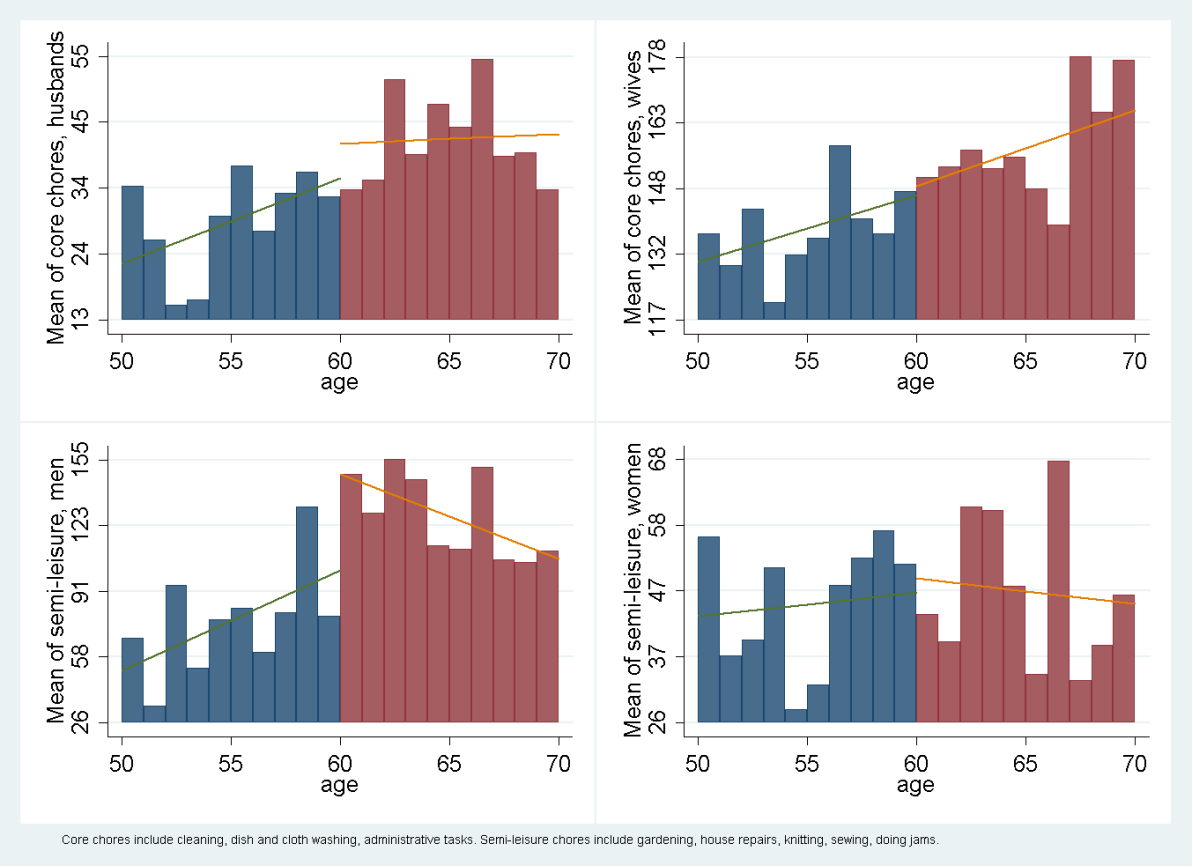


Chart 3. Core chores and semi-leisure chores: discontinuities at age 60



Core chores include cleaning, dish and cloth washing, administrative tasks. Semi-leisure chores include gardening, house repairs, knitting, sewing, doing jams.

Chart 4. Cooking and shopping: discontinuities at age 60

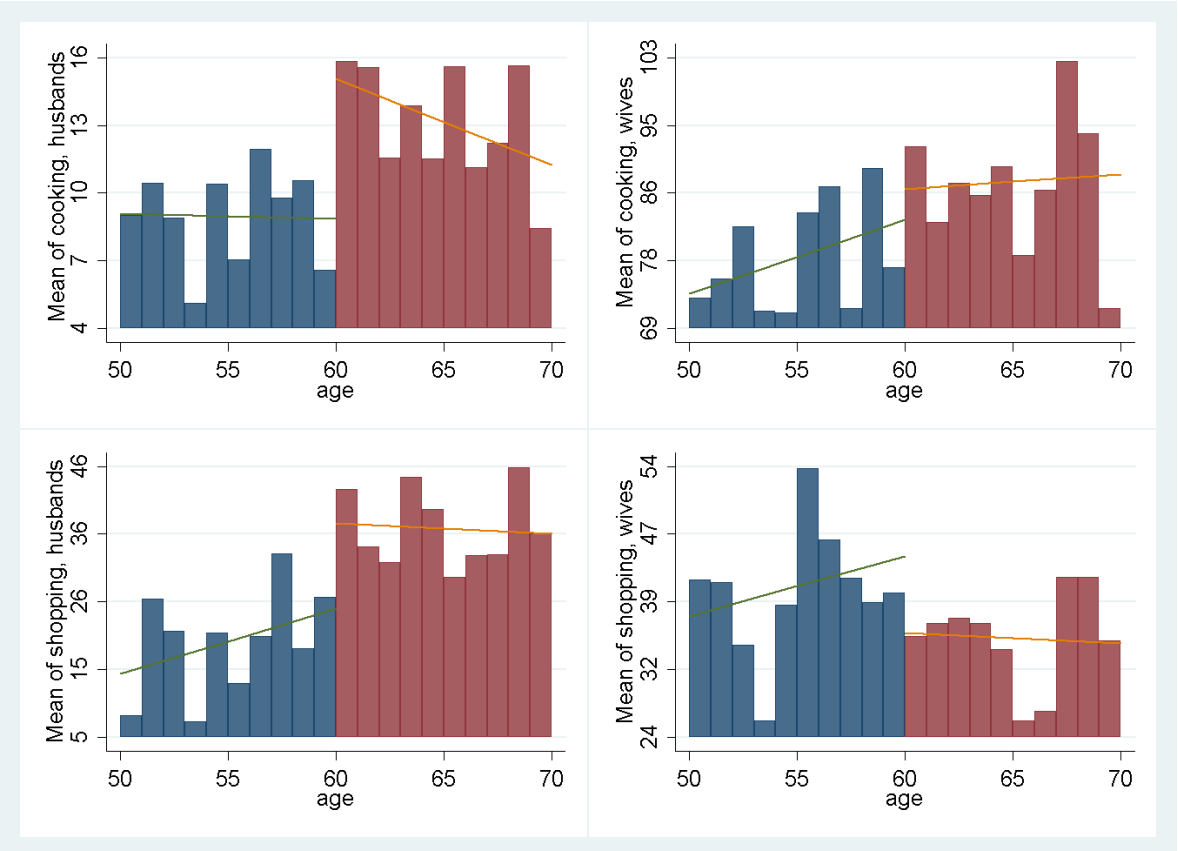


Table 3. Results of estimation of retirement and house work of partners

	He retired	She retired	His Housework	Her Housework
paris	-1.716***	-0.830**	-79.57**	-13.42
	(0.384)	(0.326)	(33.26)	(30.96)
urate	-0.0125	0.0240	-0.192	-2.032
	(0.0265)	(0.0198)	(1.817)	(1.735)
He intermediate education	-0.270	0.246	0.930	-8.850
	(0.202)	(0.155)	(14.57)	(13.88)
He high education	-0.522**	0.293*	-5.911	-27.25*
	(0.229)	(0.163)	(16.78)	(15.70)
She intermediate education	0.468**	-0.133	22.77	-38.92**
	(0.233)	(0.165)	(16.38)	(15.53)
She high education	-0.0421	-0.743***	-16.11	-36.94*
	(0.267)	(0.182)	(19.85)	(18.95)
Children number	-0.0420	0.139*	9.100	19.92**
	(0.130)	(0.0841)	(9.433)	(9.008)
Cohabitant	0.0625	0.286	-23.04	-55.50**
	(0.290)	(0.269)	(23.23)	(22.20)
He age 60 or over	**1.060*** **	**-0.311**		
	(0.396)	**(0.341)**		
She age 60 or over	**-0.493**	**1.001*** **		
	(0.453)	**(0.369)**		
He retired			**188.1*** **	**47.38**
			(61.17)	**(45.63)**
She retired			**-107.0** **	**159.4*** **
			(49.10)	**(46.60)**
Weekend Diary			59.81***	89.57***
			(18.37)	(18.00)
He retired*weekend diary			**-129.0*** **	**-10.41**
			(23.49)	**(22.96)**
She retired*weekend diary			**7.309**	**-131.9*** **
			(23.93)	**(23.41)**

Note: The four equations are estimated simultaneously by simulated maximum likelihood, with 100 draws. The explanatory variables of the retirement equations also include left and right cubic polynomials in age of the two partners interacted with the dummy for being 60 or older (see Section 2). The time use equations include cubic polynomials in age of each partner. Correlations across the errors of the four equations are shown in Table 3 a.
Retirement equations are specified as probit, the time uses as linear equations.
Time uses are measured in minutes.
Her retirement is defined as non-employment. House Work includes core house work and semi-leisure activities (see Section 3).
Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table3a. Correlations of the error terms

	She is retired	His housework	Her housework
He is retired	0.256***	-0.025	-0.318
	(0.0918)	(0.025)	(0.206)
She is retired		0.386*	-0.093
		(0.218)	(0.218)
His housework			0.239***
			(0.0442)

Table 4. Results of estimation of retirement and house work of partners: Marginal Effects

	He retired	She retired	His Housework	Her Housework
Paris	-0.377***	-0.106**	-79.57**	-13.42
	(0.384)	(0.326)	(33.26)	(30.96)
Urate	-0.003	0.003	-0.192	-2.032
	(0.0265)	(0.0198)	(1.817)	(1.735)
He intermediate education	-0.059	0.031	0.930	-8.850
	(0.202)	(0.155)	(14.57)	(13.88)
He high education	-0.115**	-0.037*	-5.911	-27.25*
	(0.229)	(0.163)	(16.78)	(15.70)
She intermediate education	0.103**	-0.016	22.77	-38.92**
	(0.233)	(0.165)	(16.38)	(15.53)
She high education	-0.009	-0.095***	-16.11	-36.94*
	(0.267)	(0.182)	(19.85)	(18.95)
Children number	-0.009	0.018*	9.100	19.92**
	(0.130)	(0.0841)	(9.433)	(9.008)
Cohabitant	0.014	0.036	-23.04	-55.50**
	(0.290)	(0.269)	(23.23)	(22.20)
He age 60 or over	**0.233*** **	**-0.040**		
	(0.396)	**(0.341)**		
She age 60 or over	**-0.108**	**0.128*** **		
	(0.453)	**(0.369)**		
He retired			**188.1*** **	**47.38**
			(61.17)	**(45.63)**
She retired			**-107.0** **	**159.4*** **
			(49.10)	**(46.60)**
Weekend Diary			59.81***	89.57***
			(18.37)	(18.00)
He retired*weekend diary			**-129.0*** **	**-10.41**
			(23.49)	**(22.96)**
She retired*weekend diary			**7.309**	**-131.9*** **
			(23.93)	**(23.41)**

Note: The four equations are estimated simultaneously by simulated maximum likelihood, with 100 draws. The explanatory variables of the retirement equations also include left and right cubic polynomials in age of the two partners interacted with the dummy for being 60 or older (see Section 2). The time use equations include cubic polynomials in age of each partner. Correlations across the errors of the four equations are shown in Table 3 a.
Retirement equations are specified as probit, the time uses as linear equations. Marginal effects for the retirement equations are calculated at the mean value of the continuous explanatory variables and, for dichotomous ones, assuming lower than intermediate education for both partners, no residence in Paris, formal marital status (setting cohabiting to zero) and that both are aged 60 years or more.
Time uses are measured in minutes.
Her retirement is defined as non-employment. House Work includes core house work and semi-leisure activities (see Section 3).
Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 5. Results of estimation of paid work and house work of partners

	His paid work	Her paid work	His House Work	Her House Work
Paris	135.8***	52.50	-50.99*	-26.58
	(35.31)	(33.79)	(29.77)	(27.85)
Urate	1.376	-3.770*	0.503	-1.622
	(2.124)	(2.032)	(1.849)	(1.722)
He intermediate education	-10.01	-1.244	-7.598	-1.913
	(17.09)	(16.35)	(13.67)	(12.80)
He high education	22.36	-24.30	-11.14	-25.55*
	(18.61)	(17.80)	(15.71)	(14.66)
She intermediate education	-0.634	40.25**	18.45	-28.43*
	(19.02)	(18.19)	(16.88)	(15.70)
She high education	28.53	76.44***	-3.045	-41.81**
	(20.87)	(19.96)	(19.60)	(18.19)
Children number	-11.08	-13.93	5.130	19.17**
	(10.83)	(10.36)	(8.828)	(8.259)
Cohabitant	11.29	-13.55	-17.46	-47.02**
	(27.52)	(26.34)	(21.92)	(20.52)
He age 60 or over	**-173.0*** **	**18.00**		
	(41.90)	**(39.39)**		
She age 60 or over	**41.04**	**-129.9*** **		
	(40.10)	**(38.98)**		
Weekend Diary	-263.7***	-147.6***	-60.31***	-50.99***
	(18.03)	(17.21)	(14.92)	(13.87)
He age 60*weekend diary	**224.7*** **	**59.67*** **		
	(32.75)	**(31.14)**		
She age 60*weekend diary	**25.45**	**76.71** **		
	(33.46)	**(32.21)**		
			-0.437* **	**-0.0901**
His paid work			**(0.1000)**	**(0.0915)**
			0.253	**-0.313** **
Her paid work			**(0.180)**	**(0.163)**
			0.118	**0.0927**
His paid work* weekend			**(0.0740)**	**(0.0689)**
			0.209 **	**0.117**
Her paid work* weekend			**(0.0873)**	**(0.0813)**

Notes: See Table 3 for specifications of right hand sides of the equations
Paid work and the other time uses are linear equations. They are measured in minutes. House Work includes core house work and semi-leisure activities (see Section 3). Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 5a. Correlations of the error terms

	Her paid work	His housework	Her housework
His paid work	0.342***	-0.0573	0.262
	(0.0310)	(0.219)	(0.212)
Her paid work		-0.276	-0.114
		(0.289)	(0.266)
His housework			0.341***
			(0.0987)

Table 6: Results of estimation under the assumption that retirement (paid work) is exogenous: without auxiliary retirement equations.

	Retirement Model		Paid Work Model	
VARIABLES	His Housework	Her Housework	His Housework	Her Housework
Paris	-62.27**	-31.30	-47.95*	-34.51
	(29.15)	(28.38)	(27.53)	(25.64)
U rate	-0.743	-2.030	-0.281	-2.460
	(1.736)	(1.690)	(1.644)	(1.531)
He intermediate education	-2.076	-10.07	-6.411	0.345
	(13.94)	(13.58)	(13.20)	(12.30)
He high education	-11.32	-31.65**	-16.12	-32.35**
	(15.18)	(14.78)	(14.36)	(13.38)
She intermediate education	26.10*	-36.25**	26.46*	-20.36
	(15.49)	(15.09)	(14.69)	(13.68)
She high education	0.850	-41.70**	8.545	-33.45**
	(17.09)	(16.65)	(16.16)	(15.05)
Children number	4.971	20.87**	3.135	18.25**
	(8.894)	(8.661)	(8.404)	(7.827)
Cohabitant	-29.08	-52.96**	-19.76	-50.72**
	(22.34)	(21.75)	(21.16)	(19.71)
His age	-2.708	-1.665	0.154	-2.977
	(2.797)	(2.723)	(2.304)	(2.145)
(His age)2	-0.233	0.178	-0.263	0.0812
	(0.180)	(0.175)	(0.168)	(0.157)
(His age)3	-0.00846	0.00506	-0.0293	0.0354
	(0.0325)	(0.0317)	(0.0298)	(0.0278)
Her age	-1.117	-2.012	-2.159	-3.322*
	(2.244)	(2.185)	(2.114)	(1.969)
(Her age)2	0.141	-0.110	0.257	-0.0251
	(0.181)	(0.176)	(0.171)	(0.159)
(Her age)3	0.0376	0.0307	0.0442	0.0335
	(0.0299)	(0.0291)	(0.0283)	(0.0264)
He retired/ His paid work	**180.6*** **	**-16.79**	**-0.379*** **	**0.0417***
	(16.88)	**(16.44)**	**(0.0245)**	**(0.0228)**
She retired/ Her paid work	**-20.99*** **	**143.7*** **	**0.0587** **	**-0.486*** **
	(12.16)	**(11.84)**	**(0.0267)**	**(0.0249)**
Weekend diary	60.60***	90.57***	-68.26***	-48.82***
	(18.52)	(18.03)	(10.93)	(10.18)
Weekend*He retired (His paid work)	**-128.4*** **	**-12.68**	**0.102**	**0.107***
	(23.71)	**(23.08)**	**(0.0694)**	**(0.0646)**
Weekend*She retired (Her paid work)	**6.578**	**-130.6*** **	**0.206** **	**0.117**
	(24.23)	**(23.60)**	**(0.0873)**	**(0.0813)**

For each model, the two house work equations of partners are estimated simultaneously by simulated maximum likelihood with 100 draws. Retirement is assumed exogenous and thus no retirement (paid work) equation is estimated.
Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table7 Models of retirement and Home Production: estimated effects of retirement

	His housework[1]	Her housework[1]	His + Her Housework[2]
He is retired	211.8**	61.46	287.0***
	(89.57)	(39.62)	(78.43)
She is retired	-118.0***	115.6***	71.13
	(45.56)	(42.93)	(117.7)
He is retired weekdays	188.1***	47.38	276.4***
	(61.17)	(45.63)	(94.22)
She retired weekdays	-107.0**	159.4***	116.2
	(49.10)	(46.60)	(115.2)
He is retired weekends	59.09	36.97	139.7
	(64.97)	(49.52)	(101.1)
She retired weekends	-99.71*	27.47	-9.725
	(52.66)	(40.50)	(117.2)

(1) The four equations of each partners' retirement and house work are estimated simultaneously by simulated maximum likelihood.

(2) The three equations of each partners' retirement and total house work at the household level (his plus her house work) are estimated simultaneously by simulated maximum likelihood.

For either model, the explanatory variables of the retirement equations include dummies for age 60 and older, and left and right cubic polynomials in age of the two partners interacted with the age 60 dummies (see Section 2). The house work equations include cubic polynomials in age of each partner. Other regressors included in all of the four equations are: an indicator for whether the couple resides in Paris; a cohabiting dummy; the regional unemployment rate; the number of children; and indicators for whether each partner holds a university or higher degree.

House work includes semi-leisure chores, core chores, cooking and shopping.

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table8. Models of retirement and House core chores : estimated effects of retirement

	His core chores[1]	Her core chores [1]	His + Her Core chores[2]
He is retired	-15.09	7.463	-36.53
	(12.34)	(28.04)	(31.31)
She is retired	51.00***	53.08**	91.69**
	(10.67)	(21.42)	(37.38)
He is retired weekdays	-13.20	17.41	-31.94
	(11.94)	(25.96)	(30.96)
She is retired weekdays	51.21***	59.34***	105.9***
	(10.25)	(20.94)	(36.00)
He is retired weekends	-34.97**	17.03	-55.73
	(14.60)	(29.61)	(34.55)
She is retired weekends	60.97***	-5.021	49.97
	(13.06)	(24.03)	(37.54)

(1) The four equations of each partners' retirement and house core chores are estimated simultaneously by simulated maximum likelihood.

(2) The three equations of each partners' retirement and total core chores time at the household level (his plus her core chores time) are estimated simultaneously by simulated maximum likelihood.

For either model, the explanatory variables of the retirement equations include dummies for age 60 and older, and left and right cubic polynomials in age of the two partners interacted with the age 60 dummies (see Section 2). The core chores equations include cubic polynomials in age of each partner. Other regressors included in all of the four equations are: an indicator for whether the couple resides in Paris; a cohabiting dummy; the regional unemployment rate; the number of children; and indicators for whether each partner holds a university or higher degree.

Core chores include cleaning, washing up dishes, doing the laundry and the ironing.

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 9. Models of retirement and semi-leisure chores : estimated effects of retirement

	His semi-leisure [1]	Her semi-leisure [1]	His + Her semi-leisure chores[2]
He is retired	162.7***	19.69	196.4***
	(33.60)	(26.89)	(48.98)
She is retired	-131.6***	22.53	-102.2*
	(23.70)	(16.26)	(54.26)
He is retired weekdays	170.9***	18.99	199.0***
	(34.32)	(26.40)	(50.02)
She retired weekdays	-117.9***	30.33*	-78.21
	(15.87)	(9.97)	(58.67)
He is retired weekends	106.0***	11.63	125.8**
	(38.83)	(28.91)	(56.31)
She retired weekends	-138.2***	9.158	-118.8*
	(29.67)	(19.35)	(62.28)

(1) The four equations of each partners' retirement and semi-leisure chores are estimated simultaneously by simulated maximum likelihood.
(2) The three equations of each partners' retirement and total semi-leisure chores time at the household level (his plus her semi-leisure time) are estimated simultaneously by simulated maximum likelihood.

For either model, the explanatory variables of the retirement equations include dummies for age 60 and older, and left and right cubic polynomials in age of the two partners interacted with the age 60 dummies (see Section 2). The semi-leisure chores equations include cubic polynomials in age of each partner. Other regressors included in all of the four equations are: an indicator for whether the couple resides in Paris; a cohabiting dummy; the regional unemployment rate; the number of children; and indicators for whether each partner holds a university or higher degree.
Semi-leisure chores include gardening, house repairs, knitting, sewing, doing jams, care of pets.
Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 10. Models of retirement and cooking time: estimated effects of retirement

	His cooking time [1]	Her cooking time [1]	His + Her cooking time[2]
He is retired	-18.36***	5.624	3.965
	(3.550)	(9.084)	(16.37)
She is retired	0.0558	66.85***	63.38***
	(10.90)	(11.63)	(11.95)
He is retired weekdays	-16.28***	6.583	5.059
	(3.509)	(8.676)	(16.35)
She retired weekdays	2.548	67.69***	64.64***
	(8.563)	(11.54)	(11.86)
He is retired weekends	-31.70***	8.851	-7.151
	(4.661)	(10.55)	(17.59)
She retired weekends	17.74*	41.98***	53.84***
	(9.172)	(13.34)	(13.59)

(1) The four equations of each partners' retirement and cooking time are estimated simultaneously by simulated maximum likelihood.
(2) The three equations of each partners' retirement and total cooking time at the household level (his plus her cooking time) are estimated simultaneously by simulated maximum likelihood.

For either model, the explanatory variables of the retirement equations include dummies for age 60 and older, and left and right cubic polynomials in age of the two partners interacted with the age 60 dummies (see Section 2). The time to cook equations include cubic polynomials in age of each partner. Other regressors included in all of the four equations are: an indicator for whether the couple resides in Paris; a cohabiting dummy; the regional unemployment rate; the number of children; and indicators for whether each partner holds a university or higher degree.

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 11. Models of retirement and shopping time: estimated effects of retirement

	His shopping time [1]	Her shopping time [1]	His + Her shopping time[2]
He is retired	-33.70***	-10.55	23.96
	(8.866)	(10.64)	(30.04)
She is retired	27.07**	25.65	48.72**
	(11.02)	(17.02)	(22.08)
He is retired weekdays	-30.14***	-12.06	28.37
	(8.223)	(10.40)	(32.02)
She retired weekdays	27.62**	29.62*	52.56**
	(10.80)	(17.24)	(22.42)
He is retired weekends	-58.45***	-13.98	1.145
	(10.22)	(12.20)	(33.99)
She retired weekends	32.23***	7.466	34.18
	(12.09)	(18.09)	(24.26)

(1) The four equations of each partners' retirement and shopping time are estimated simultaneously by simulated maximum likelihood.
(2) The three equations of each partners' retirement and total shopping time at the household level (his plus her cooking time) are estimated simultaneously by simulated maximum likelihood.

For either model, the explanatory variables of the retirement equations include dummies for age 60 and older, and left and right cubic polynomials in age of the two partners interacted with the age 60 dummies (see Section 2). The time to shop equations include cubic polynomials in age of each partner. Other regressors included in all of the four equations are: an indicator for whether the couple resides in Paris; a cohabiting dummy; the regional unemployment rate; the number of children; and indicators for whether each partner holds a university or higher degree.

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table12. Models of retirement and Care Time: estimated effects of retirement

	His care time[1]	Her care time[1]	His + Her Care time[2]
He is retired	34.30***	13.97	51.20**
	(11.47)	(15.89)	(20.04)
She is retired	13.63	30.49**	39.43*
	(15.50)	(12.60)	(23.94)
He is retired weekdays	37.79***	15.23	55.45***
	(11.82)	(16.26)	(20.53)
She retired weekdays	13.08	31.75**	40.12*
	(15.34)	(12.92)	(24.25)
He is retired weekends	18.22	9.986	30.64
	(14.47)	(18.56)	(24.61)
She retired weekends	20.09	26.12*	41.44
	(17.40)	(15.32)	(27.47)

(1) The four equations of each partners' retirement and care time are estimated simultaneously by simulated maximum likelihood.

(2) The three equations of each partners' retirement and total care time at the household level (his plus her care time) are estimated simultaneously by simulated maximum likelihood.

For either model, the explanatory variables of the retirement equations include dummies for age 60 and older, and left and right cubic polynomials in age of the two partners interacted with the age 60 dummies (see Section 2). The care equations include cubic polynomials in age of each partner. Other regressors included in all of the four equations are: an indicator for whether the couple resides in Paris; a cohabiting dummy; the regional unemployment rate; the number of children; and indicators for whether each partner holds a university or higher degree.

Care time includes child and adult care, to individuals from the same or from other households.

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 13 Models of Paid Work and Home Production: estimated effects

	His total housework[1]	Her total housework[1]	His + Her Total Housework[2]
His paid work time	-0.361**	-0.150	-0.528**
	(0.157)	(0.141)	(0.251)
Her paid work time	0.323	-0.295	0.0140
	(0.238)	(0.207)	(0.377)
His paid work weekdays	-0.437***	-0.0901	-0.529***
	(0.1000)	(0.0915)	(0.158)
Her paid work weekdays	0.253	-0.313*	-0.0589
	(0.180)	(0.163)	(0.286)
His paid work weekends	-0.319**	0.00258	-0.319
	(0.129)	(0.118)	(0.203)
Her paid work weekends	0.463**	-0.195	0.268
	(0.199)	(0.180)	(0.314)

(1) The four equations of each partner's paid work and house work are estimated simultaneously by simulated maximum likelihood.

(2) The three equations of each partner's paid work and total house work at the household level (his plus her house work) are estimated simultaneously by simulated maximum likelihood.

For either model, the explanatory variables of the paid work equations include dummies for age 60 and older, and left and right cubic polynomials in age of the two partners interacted with the age 60 dummies a weekend day dummy also interacted with the age 60 dummies (see Section 2). The house work equations include cubic polynomials in age of each partner. Other regressors included in all of the four equations are: an indicator for whether the couple resides in Paris; a cohabiting dummy; the regional unemployment rate; the number of children; and indicators for whether each partner holds a university or higher degree.

House work includes semi-leisure chores, core chores, cooking and shopping.

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 14. Models of Paid Work and core chores : estimated effects

	His core chores [1]	Her core chores [1]	His + Her core chores [2]
His paid work time	0.0444	-0.0517	0.0114
	(0.0637)	(0.103)	(0.124)
Her paid work time	0.00338	0.0165	-0.00549
	(0.0913)	(0.160)	(0.187)
His paid work weekdays	0.0104	-0.0549	-0.0350
	(0.0418)	(0.0654)	(0.0790)
Her paid work weekdays	-0.0234	-0.0311	-0.0746
	(0.0735)	(0.120)	(0.143)
His paid work weekends	0.0127	0.0258	0.0471
	(0.0550)	(0.0826)	(0.103)
Her paid work weekends	0.103	0.000222	0.0833
	(0.0819)	(0.130)	(0.158)

(1) The four equations of each partner's paid work and core chores time are estimated simultaneously by simulated maximum likelihood.

(2) The three equations of each partner's paid work and total core chores time at the household level (his plus her core house work) are estimated simultaneously by simulated maximum likelihood.

For either model, the explanatory variables of the paid work equations include dummies for age 60 and older, and left and right cubic polynomials in age of the two partners interacted with the age 60 dummies and a weeken dummy interacted with age 60 of the two partners (see Section 2). The core house work time equations include cubic polynomials in age of each partner. Other regressors included in all of the four (three) equations are: an indicator for whether the couple resides in Paris; a cohabiting dummy; the regional unemployment rate; the number of children; and indicators for whether each partner holds a university or higher degree.

Core chores include cleaning, washing up dishes, doing the laundry and the ironing.

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 15. Models of Paid Work and semi-leisure house work: estimated effects

	His semi-leisure [1]	Her semi-leisure [1]	His + Her semi-leisure house work[2]
His paid work time	-0.265*	-0.0985	-0.387**
	(0.158)	(0.0822)	(0.180)
Her paid work time	0.392	-0.116	0.185
	(0.254)	(0.124)	(0.261)
His paid work weekdays	-0.346***	-0.0362	-0.375***
	(0.0960)	(0.0539)	(0.118)
Her paid work weekdays	0.252	-0.0482	0.186
	(0.176)	(0.0960)	(0.209)
His paid work weekends	-0.271**	-0.0314	-0.296*
	(0.121)	(0.0709)	(0.153)
Her paid work weekends	0.370*	-0.0153	0.337
	(0.191)	(0.107)	(0.232)

(1) The four equations of each partner's paid work and semi-leisure house work are estimated simultaneously by simulated maximum likelihood.

(2) The three equations of each partner's paid work and total semi-leisure house work at the household level (his plus her semi-leisure house work) are estimated simultaneously by simulated maximum likelihood.

For either model, the explanatory variables of the paid work equations include dummies for age 60 and older, and left and right cubic polynomials in age of the two partners interacted with the age 60 dummies a weekend day dummy also interacted with the age 60 dummies (see Section 2). The semi-leisure house work equations include cubic polynomials in age of each partner. Other regressors included in all of the four equations are: an indicator for whether the couple resides in Paris; a cohabiting dummy; the regional unemployment rate; the number of children; and indicators for whether each partner holds a university or higher degree.

Semi-leisure house work includes house repairs, gardening, knitting, sewing,making jams, care of pets.

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 16.. Models of Paid Work and cooking time: estimated effects

	His cooking time [1]	Her cooking time [1]	His + Her cooking time[2]
His paid work time	-0.0406	-0.0109	-0.0516
	(0.0267)	(0.0504)	(0.0565)
Her paid work time	0.0851**	-0.0858	-0.0151
	(0.0391)	(0.0750)	(0.0878)
His paid work weekdays	-0.0390**	0.0206	-0.0147
	(0.0174)	(0.0348)	(0.0382)
Her paid work weekdays	0.0793***	-0.147**	-0.0776
	(0.0308)	(0.0635)	(0.0726)
His paid work weekends	-0.0107	0.0243	0.0166
	(0.0226)	(0.0448)	(0.0482)
Her paid work weekends	0.0425	-0.131*	-0.0990
	(0.0341)	(0.0702)	(0.0792)

(1) The four equations of each partner's paid work and cooking time are estimated simultaneously by simulated maximum likelihood.

(2) The three equations of each partner's paid work and total cooking time at the household level (his plus her semi-leisure house work) are estimated simultaneously by simulated maximum likelihood.

For either model, the explanatory variables of the paid work equations include dummies for age 60 and older, and left and right cubic polynomials in age of the two partners interacted with the age 60 dummies (see Section 2). The time to cook equations include cubic polynomials in age of each partner. Other regressors included in all of the four equations are: an indicator for whether the couple resides in Paris; a cohabiting dummy; the regional unemployment rate; the number of children; and indicators for whether each partner holds a university or higher degree.

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table17. Models of Paid Work and shopping time: estimated effects

	His shopping time [1]	Her shopping time [1]	His + Her shopping time[2]
His paid work time	-0.0767 (0.0513)	-0.00521 (0.0558)	-0.0819 (0.0882)
Her paid work time	-0.0527 (0.0729)	-0.106 (0.0821)	-0.164 (0.128)
His paid work weekdays	-0.0716** (0.0333)	-0.0217 (0.0364)	-0.0911 (0.0567)
Her paid work weekdays	-0.0331 (0.0581)	-0.0813 (0.0653)	-0.119 (0.100)
His paid work weekends	-0.0594 (0.0442)	-0.0175 (0.0475)	-0.0749 (0.0744)
Her paid work weekends	-0.0299 (0.0654)	-0.0443 (0.0727)	-0.0790 (0.112)

(1) The four equations of each partner's paid work and shopping time are estimated simultaneously by simulated maximum likelihood.

(2) The three equations of each partner's paid work and total shopping time at the household level (his plus her semi-leisure house work) are estimated simultaneously by simulated maximum likelihood.

For either model, the explanatory variables of the paid work equations include dummies for age 60 and older, and left and right cubic polynomials in age of the two partners interacted with the age 60 dummies (see Section 2). The time to shop equations include cubic polynomials in age of each partner. Other regressors included in all of the four (three) equations are: an indicator for whether the couple resides in Paris; a cohabiting dummy; the regional unemployment rate; the number of children; and indicators for whether each partner holds a university or higher degree.

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 18 Models of Paid Work and Care Time: estimated effects

	His care time[1]	Her care time[1]	His + Her Total Care Time[2]
His paid work time	-0.264***	-0.134*	-0.384***
	(0.101)	(0.0767)	(0.141)
Her paid work time	-0.114	-0.00809	-0.0318
	(0.170)	(0.109)	(0.208)
His paid work weekdays	-0.0920	-0.0857*	-0.209**
	(0.0583)	(0.0499)	(0.0852)
Her paid work weekdays	-0.0740	0.0655	0.0796
	(0.113)	(0.0888)	(0.158)
His paid work weekends	-0.151**	-0.152**	-0.329***
	(0.0713)	(0.0641)	(0.105)
Her paid work weekends	-0.0694	0.137	0.155
	(0.123)	(0.0992)	(0.172)

(1) The four equations of each partner's paid work and care time are estimated simultaneously by simulated maximum likelihood.

(2) The three equations of each partner's paid work and total house work at the household level (his plus her house work) are estimated simultaneously by simulated maximum likelihood.

For either model, the explanatory variables of the paid work equations include dummies for age 60 and older, and left and right cubic polynomials in age of the two partners interacted with the age 60 dummies a weekend day dummy also interacted with the age 60 dummies (see Section 2). The house work equations include cubic polynomials in age of each partner. Other regressors included in all of the four equations are: an indicator for whether the couple resides in Paris; a cohabiting dummy; the regional unemployment rate; the number of children; and indicators for whether each partner holds a university or higher degree.

House work includes semi-leisure chores, core chores, cooking and shopping.

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1