Home Production and Retirement in Couples: A Panel Data Analysis

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Abstract

We analyze the effects of retirement of one partner on home production by both partners in a couple. Using longitudinal data from the German Socio-Economic Panel on couples in the age group 45-75, we control for fixed household specific effects to address the concern that retirement decisions are correlated with unobserved characteristics that also affect home production. For males as well as females, we find that own retirement significantly increases the amounts of home production. There are negative cross-effects of retirement on home production done by the partner. The income fall at retirement is compensated by an increase in own household production, in spite of the (smaller) negative effect on home production by the partner.

JEL codes: J22, J29, J14
Key words: time allocation, home production, retirement, couples

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1. Introduction

Retirement is one of the main economic and social changes in the lives of most individuals and their households. Most people retire abruptly from a full-time job to a situation where they no longer take part in paid work. This not only affects their personal and household income, but also their social network and the activities on which they spend their time. For individuals in couples, retirement of the partner may have an important impact through household income, but also through the changes in the time spent by the retired partner on, for example, household production or joint leisure activities. The effects of retirement on the other partner have been used in the retirement literature to explain, for example, the stylized fact that many couples retire at almost the same point in time, in spite of an age difference (Hurd, 1990; Gustman and Steinmeier, 2000, 2009).

The economics literature has emphasized the drop in household consumption expenditures upon retirement of the main earner, known as the retirement consumption puzzle (Hamermesh, 1984; Banks et al., 1998). Several explanations for the retirement consumption puzzle have been given (see, e.g., Hurst, 2008, or Battistin et al., 2009), such as a reduction in work related expenses, or, - the focus of this paper -, a fall in required consumption expenditures to achieve a given welfare level because of an increase in time spent on household production activities. For example, Aguiar and Hurst (2005, 2007) find that after retirement, individuals in the US spend more time on shopping and preparing food, leading to a lower effective price of food consumption. Hurd and Rohwedder (2008) find that after retirement, men and women in the US spend more time on house cleaning, and men also spend more time on home improvements and gardening or yard work, probably reducing the need for expenditures on outsourcing.

Stancanelli and van Soest (2012), unlike the studies mentioned above, also consider the effect of retirement of one spouse on the time spent on home production by the partner. Using cross-

section data on French couples around retirement age, they find that men respond to their wives' retirement by significantly reducing the time they allocate to home production, while there is no significant effect of men's retirement on their wives' hours of home production. Battistin et al. (2009) and Stancanelli and van Soest (2012) account for the potential endogeneity of retirement decisions exploiting a regression discontinuity approach, based upon the minimum age for receiving retirement benefits in Italy and France. Aguiar and Hurst (2005) also allow for endogeneity of retirement but make the stronger assumption that age can be used as an instrument for retirement. None of these studies uses panel data.

The current study uses longitudinal data on time use of German couples in the age group 45 - 75 that are followed over time from 1993 until 2009. The data set not only contains rich background information, but also has survey information on the time spent on various types of activities (housework, errands, household repairs/gardening, hobbies, education, child care), similar to the time use information in the HRS consumption and activities module (see Hurd and Rohwedder, 2008).

Previous research has shown that this type of retrospective survey information has certain drawbacks compared to the detailed diary information typically collected in specific time use surveys, but does lead to reliable results in multivariate analysis where the focus is not on the absolute amounts of time spent on certain activities but on the relations between time use and other variables (Bonke, 2005; Kitterød and Lyngstad, 2005). The potential drawbacks of the retrospective nature of the survey questions are in our view amply compensated by the unique longitudinal nature of the data, particularly since this allows considering within household changes at retirement and using household specific fixed effects in the empirical models. Incorporating these in the model makes it possible to identify the causal effect of retirement while controlling for time persistent confounding factors that simultaneously affect retirement and time allocation. This provides an alternative to the identification strategy of Battistin et al.

(2009) and Stancanelli and van Soest (2012) which is less convincing in the German institutional setting than in Italy or France because there are several standard retirement ages but not one unambiguous minimum eligibility age.

We analyze the effect of retirement of both partners on the time spent and the value of home production activities. We compare the results of fixed effects and random effects specifications imposing and not imposing independence between error terms and the retirement status variable. We argue that the fixed effects specification in which retirement is independent of the error terms is the preferred specification. A regression discontinuity approach where we instrument retirement of both spouses with age dummies for several institutional retirement ages in Germany gives findings of similar magnitude but much less precision.

Using the model estimates for both males and females, we find that own retirement significantly increases home production and that this increase largely compensates the income loss at retirement. We also find significantly negative cross-effects of retirement on home production done by the partner, which partly undo the effects of increases in own home production. This leads to the conclusion that retirement of one partner leads to important adjustment in home production of both partners, something that deserves more attention when trying to understand the impact of retirement on the economic and non-economic well-being of older couples.

2. Empirical approach

The aim of the empirical analysis is to analyse the impact of retirement of the husband and wife's[1] retirement (R_{it}^m and R_{it}^f, respectively) on home production (h_{it}^m and h_{it}^f). The equations to be estimated are the following:

$$h_{it}^m = \beta_1^m R_{it}^m + \beta_2^m R_{it}^f + X_{it}\beta^m + \alpha_i^m + \nu_{it}^m, \quad (1)$$

$$h_{it}^f = \beta_1^f R_{it}^f + \beta_2^f R_{it}^m + X_{it}\beta^f + \alpha_i^f + \nu_{it}^f, \quad (2)$$

Here X_{it} is a row vector of control variables describing personal and household characteristics of husband and wife, β_1^j, β_2^j, and β^j are parameters to be estimated, α_i^j represents the time-invariant unobserved heterogeneity terms and ν_{it}^j the time-varying error terms, for $j = m, f$. Assuming that ν_{it}^j is identically and independently distributed and independent of X_{it}, R_{it}^m, and R_{it}^f and that α_i^j is normally distributed and independent of X_{it}, R_{it}^m, and R_{it}^f, the model is a standard random effects (RE) model that can be estimated with the standard estimator for linear RE models. The latter assumption may not hold if retirement (R_{it}^m and/or R_{it}^f) is related to time-invariant unobserved heterogeneity (α_i^j). For instance, preferences for leisure or productivity in market or non-market activities are potential drivers of both retirement and the allocation of non-working time. As a result, RE estimates of the parameters of interest are likely to be biased. The assumption of independence of explanatory variables and time-invariant heterogeneity can be relaxed using a fixed effects (FE) model and the standard (within-group) estimator for this model.

[1] We also include cohabiting (heterosexual) couples but will refer to the two partners in these couples as husband and wife for ease of exposition.

In order to assess the validity of our results, we also estimate the model using an identification strategy similar to Stancanelli and van Soest (2012), adjusted for the German institutional setting. Following Bonsang and Klein (2012), our instruments are indicators for reaching ages 60, 63 and 65 at which individuals can start collecting retirement benefits. Which of the three ages applies depends upon labour market history; see, for example, Börsch-Supan and Jürges (2009) for details. While reaching these specific ages has a direct effect on the probability of retirement, it is unlikely that the effect of age on home production is discontinuous at these (or other) ages, keeping retirement constant. In this case, we model retirement of both partners as probit models including the X vector and six dummies that are equal to one when the individual or the partner has reaches the ages 60, 63 and 65. The three equations (for home production, own, and partner's retirement) are then jointly estimated allowing for correlations between the three error terms using simulated maximum likelihood (See Roodman 2007, 2009).

3. Data

3.1 Sample

The empirical analysis uses GSOEP data from 1993 to 2009. The GSOEP is a longitudinal household survey that has started in West Germany in 1984 and in East Germany in 1990.[2] We use data as of 1993 because this is the first wave where the questions about time use not only on weekdays but also during a normal Saturday and a normal Sunday are available.[3]

[2] The GSOEP is described in Wagner *et al.* (1993). It is sponsored by the Deutsche Forschungsgemeinschaft and administered by the German Institute for Economic Research (Berlin) and the Center for Demography and Economics of Aging (Syracuse University).

[3] We think it is important to take into account the change in time use during the week-end because some preliminary analysis revealed that individuals tend to substitute home production during the week-end to home

These questions are only asked once every two years and we only use these waves.[4] Our sample is restricted to individuals living in a heterosexual couple (cohabiting or married) who are between 45 and 75 years old and do not belong to the foreigners subsamples or to the high-income subsample.[5] As the focus of this study is about couples' transitions into retirement, we select couples where both partners are working at the first wave they are observed. We drop observations where individuals report not working but are observed going back to work in later waves since we focus on retirement in the sense of a definitive withdrawal from the labour market. Finally, we drop all observations with missing or unreliable values[6] for the variables used in the analysis. Our final sample includes 6,172 observations about 1,571 couples.

3.2 The measure of home production

GSOEP has survey questions on the number of hours respondents spend on several activities on a normal weekday, on a normal Saturday, and on a normal Sunday (Figure 1 presents the questions on time use). These activities include: job, apprenticeship, and/or second job (including travel time to and from work); errands (shopping, trips to government agencies, etc); housework (washing, cooking, cleaning); child care; care and support for persons in need of care; education and further training (also school, university); repairs on and around the house, including car repairs or garden work; and hobbies and other free-time activities.

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production during the week when they retire (Results are available upon request). Using information on time use during the weekday only would overestimate the effect of retirement on home production.

[4] Besides, the question regarding time use was slightly different before 1991. Before 1991, the question about time use did not make the difference between time devoted to housework (such as washing, cooking, or cleaning) and time devoted to errands (such as shopping, trips to government agencies…).

[5] "Foreigners subsamples cover persons in private households with a Turkish, Greek, Yugoslavian, Spanish or Italian household head. A subsample of high-income households has been added in 2002.

[6] In particular, we drop observations where the sum of all time-use categories exceeds 18 hours per day.

[Figure 1 about here]

Following Schwerdt (2005) and Frazis and Stewart (2011), our measure of home production includes errands, housework, and repairs on and around the house, including car repairs or garden work. We exclude care and support in need of care because it is mainly related to care provided to non-household members and thus should not be taken into account as an input in the home production of the household. We also exclude child care as it is mostly related to time spent with grandchildren and is thus plausibly not an input in the home production function. Anyway, the inclusion or not of those time use categories should not matter much as they only represent a small fraction of the total time for the respondents in our selected sample. One may also question the inclusion of repairs on and around the house (including gardening), as it may be considered as a leisure activity rather than a productive activity. We will assess the robustness of our results by using a more conservative measure of home production excluding this latter activity from home production.

In order to construct a measure of home production done per week, we add the reported home production on a normal Saturday and a normal Sunday to the reported home production on a normal weekday multiplied by five. Figure 2 presents the distribution of the time spent on home production per week for men and women in our estimation sample. We observe that women spend more time on home production than men do and that there are barely any women reporting zero hours of home production. It is a bit more common among men to spend zero hours on home production, but still marginal (about 2 percent). Given the low proportion of individuals reporting zero hours of home production, the use of a censored regression (tobit) model instead of linear model should not significantly affect the results.

[Figure 2 about here]

3.3 Retirement

There are many definitions of retirement. For the purpose of our analysis, we follow Lazear (1986) and define an individual as retired if he/she is definitively out of the labour force with the intention of staying out permanently. Akin to Bonsang, Adam and Perelman (2012), Bonsang and Klein (2012), Coe and Zamarro (2011), Mazzonna and Peracchi (2012), and Rohwedder and Willis (2010), an individual is defined as "Working" if he/she claims to be currently working for pay and "Retired" if he/she reports not working. One issue with this definition is that we may classify some individuals as retired although they are actually unemployed. However, given that we drop observations for individuals who are not working but observed going back to work in later waves, we only keep non-working individuals who never go back to work, those unemployed individuals who did not succeed in finding a new job can then be classified as retired, or more precisely as *involuntary retired* following the definition adopted by Bonsang and Klein (2012).[7]

[Figure 3 about here]

3.4. Control variables

We use household characteristics and health indicators as additional explanatory variables to control for time varying factors that are likely to be related to both home production and retirement. We control for age by including a third-order polynomial in age of the individual and the age of the partner (age of the partner is not included in fixed effects model due to collinearity with age of the respondent). Household characteristics consist of the number of adults and children in the household. We also include a measure of self-assessed general

[7] The distinction between "involuntarily retired" and "unemployed" individuals therefore depends on how long we can follow them after they stop working. We do not expect this to be a severe problem because we observe most individuals for at least some years after they stop working.

health for each partner in the models, based on the question "How satisfied are you with your health?" where respondents are invited to answer on a Likert scale from 0 (not satisfied at all) to 10 (very satisfied). Table 1 presents the mean of the control variables for men and women by retirement status of both partners.

[Table 1 about here]

4. Descriptive statistics

Table 2 shows the average number of hours of home production by gender and retirement status of both partners. In dual earner couples, men on average spend about 16 hours per week on home production compared to 29 hours for women. An average retired man spends 30 hours on home production if his partner is working and 27 hours if she is retired. For retired women, there is no significant difference in average hours of home production depending on the labour force status of her partner. Working women on the other hand spend less time on home production when their partner is retired (29 versus 26.5 hours).

[Table 2 about here]

The longitudinal dimension of the survey allows us to observe the evolution of home production around the age of retirement of each partner. Figures 4 and 5 present average hours of home production per week in the five years before and the five years after own retirement (Figure 4) and retirement of their partner (Figure 5). We observe a significant increase in home production in the year of retirement for both men and women, but there does not seem to be any specific trend before or after retirement, suggesting that dynamics do not play an important role. The increase is similar in magnitude for men and women (although the levels are higher for women).

[Figures 4 and 5 about here]

Turning now to the evolution of home production around the retirement age of the partner, we do not observe any significant change in home production for both men and women. This may suggest that there is no cross-effect of retirement on home production of the partner but we have to keep in mind that these figures are only descriptive, not controlling for other determinants of home production (such as own labour force status). The empirical analysis below will overcome this limitation.

5. Results

Table 3 presents the results of the effect of own retirement and spouse's retirement on time devoted to home production for men and women. We present the results of the random-effects model, the fixed effects model, and the model allowing for correlation between the error term of the home production equation and the retirement equation of each partner. The results are qualitatively quite similar across all models estimated. Still, for both men and women, the Hausman test rejects the hypothesis that individual unobserved effects and the explanatory variables are uncorrelated. In other words, the fixed effects model is preferred to the random effects specification. The estimated effect of retirement on home production is slightly lower in the fixed effects model than for the random effects model. For men, retirement increases the number of hours devoted to home production by approximately 11 hours per week. For women, we observe a lower effect of retirement than for men (about 8 hours per week). Table 3 also highlights significantly negative cross-effects of retirement on home production of the partner. The partner's retirement decreases the time devoted to home production by about 1 hour per week for men and by about 2 hours for women.

[Table 3 about here]

Furthermore, while exhibiting larger standard errors, the point estimates of the instrumental variable models are very close to those from the fixed effects model, suggesting that

endogeneity due to reverse causality or time-variant unobserved confounding factors are not driving our main results.[8] We thus conclude that the fixed effects model is the preferred specification.

Our estimated effects of retirement on home production are remarkably similar in magnitude to those obtained by Van Soest and Stancanelli (2012) who found that, at retirement, own home production increases by about 11.3 hours per week for men and 8.8 hours for women in France. However, our estimated effects of partner's retirement on own home production differ from those of Van Soest and Stancanelli (2012). They identified a large effect of partner's retirement on home production of men (home production of French men decreases by 8.6 hours per week when their partner retires) but no effect for women. While we found significant cross-effects for men as well as women, their magnitudes are modest compared to the direct effect of retirement on own home production of each partner. As a result, total home production of couples still increases when both partners retire even when taking the cross-effects into account, contrary to France where home production only increases for men but the cross-effect annihilates the positive direct effect of retirement on home production for women. Those results clearly show that ignoring the effect of retirement on partner's home production will result in biased estimates of the effect of retirement of couples on home production. First of all, the direct effect of retirement on home production in a model where partner's retirement is omitted will result in an under-estimation of the direct effect of retirement on home production (as long as own retirement and partner's retirement are positively correlated and partner's retirement is negatively correlated with own home production). Note however that this bias is negligible in our case: if we omit partner's retirement status from the fixed

[8] The full results of the Instrumental Variables are presented in Table A1 and A2 in the Appendix. The first-stage equations show that our instrument are relevant for predicting retirement decision: the age-specific dummies (the instruments) are all significant in the retirement model for men and the dummies for reaching 60 year-old only is highly significant for women.

effects model, the estimated direct effect of retirement is 10.560 (Standard error: 0.457) for men and 8.106 (Standard error: 0.465) for women. Second and more importantly, the estimated effect of retirement of both partners on total home production would be over-estimated by about 20 percent by ignoring the cross-effects.

Some other results regarding the other explanatory variables are worth noting. Health of both partners has important effects on the time allocated to home production. For men, better own health is associated with a higher level of home production, but partner's health has the opposite sign. Surprisingly, contrary to men, own health is not related to home production for women. However, like for men, a spouse in better health devotes less time to home production. There are also noticeable differences between men and women in the way their home production changes with household composition. While the numbers of adults and children in the household are unrelated to home production of men (in the fixed effects model), they are positively related to home production of women.

Table 4 presents the results of the fixed effects model for each component of home production separately (housework, errands, and repairs/gardening).[9] Men increase time devoted to housework by about 4.02 hours per week, compared to 4.59 hours for women. Time devoted to errands increases by 2.59 hours per week for men and 1.93 hours for women. The increase in repairs/gardening is bigger for men than for women (4.12 versus 1.82). More importantly, the results show that the main source of the negative cross-effect of retirement on total home production comes from the negative effect on housework. For both men and women, about 40% of the increase in housework due to own retirement is annihilated once the partner retires.

[Table 4 about here]

[9] The results of the IV models are similar. See Table A5 in appendix.

6. Does home production compensate for the income loss due to retirement?

The fundamental question in relation to the retirement-consumption puzzle is whether home production is able to compensate the income loss due to retirement. Figure 6 presents the evolution of monthly net household income around retirement of men and women. As expected, we observe a drop in income once the individual retires from the labor force. For male retirement the drop is substantial: from about 3,250 Euros per month two years before retirement to about 2,500 Euros after retirement. We observe a similar pattern for retirement of women but the drop is smaller.

[Figure 6 about here]

One challenge associated with this research question is to estimate the value of home production. There exist different ways to estimate it and each method has its advantages and drawbacks. Following Frazis and Steward (2011) and Frick et al. (2012), we decided to use the replacement cost approach to value home production (instead of following the opportunity cost approach), which defines the value of the time spent on home production as the cost of purchasing home production services in the market. This method uses either the generalist or the specialist wage approach. For this paper, we decided to use a simple and transparent method to impute a value of home production and to choose a uniform imputed wage for home production. Following Frick et al. (2012), we impute a net hourly wage of 4 Euros to approximate the wage of informal employment in the private sector, or a wage of 8.50 Euros of 2014 that approximates the minimum wage that has just been approved by the German Parliament. As our data cover a relatively long period, we adjust those amounts for inflation by adjusting the amounts to 2009 prices. We then compute the total resources of the household as its net monthly household income plus the amount of home production of the couples per month multiplied by the imputed wage rate (either 4 or 8.5 Euros/hour).

Table 5 presents the results of a fixed effects model, in the same way as the previous model of home production, with the logged total resources of the household as dependent variable, depending on three assumptions: no value for home production, home production valued at 4 Euros/hour, and the home production valued at 8.5 Euros/hour. The results help us to quantify to which extent home production is able to cover for the income loss due to retirement.

[Table 5 about here]

Taking into account home production has a remarkably important effect on the loss of resources due to retirement of the couple. While household income drops by 14 percent when the man retires and 10 percent when the woman retires (See the first column), the drop in total resources of the household only accounts for 5 percent for men's retirement and 3 percent for women's retirement when we impute the most conservative value to home production (valued at 4 Euros per hour of home production). If we use the minimum wage of 8.5 Euros per hour to value home production, the drop completely disappears for both partners' retirement. The valorization of home production has a bigger tempering effect on the drop of resources due to the retirement of men than for women because, as seen in Table 3, home production of men increases more at retirement than for women and also because the negative spillover effect is bigger for women than for men.

Using the narrower definition of home production by excluding repair/gardening provides similar results. The drop in total resources of the household accounts for 8 percent for men's retirement and 5 percent for women's retirement when we impute the most conservative value to home production. If we use the minimum wage of 8.5 Euros per hour to value home production, the drop in resources remains significant for both partners' retirement but small: resources fall by 4% when the man retires and by 1.5% when it is the woman.[10]

[10] See Table 3bis in Appendix.

7. Concluding remarks

In this paper we analyze the effect of retirement of couples on home production of both partners. For that purpose we use longitudinal German data from 1993 to 2009 and models taking into account the endogeneity of retirement in a model of home production. We show that fixed effects models provide results that are similar to the results using instrumental variable models in the spirit of Van Soest and Stancancelli (2012). Our results show that own retirement substantially increases time devoted to home production for both men and women. Furthermore, we identify significant spillover effects of retirement of the partner: Both men and women decrease the time spent on home production when their partner retires from the labor force: Not taking into account those spillover effects results in an over-estimation of the effect of retirement of the couple on home production by about 20 percent.

Imputing the value of each hour of home production in several ways, we show that, when we take the cross-effects into account, home production of the couples largely compensates for the loss of financial resources of the household when its members retire from the labor force.

This paper adds some more insight about the retirement-consumption puzzle, lending support to the fact that taking home production of couples into account makes the retirement-consumption puzzle much less of a puzzle, even when accounting for the opposite effects on the two partners in a couple.

Our study is not without limitations. First, our measure of home production is based on time-use survey based on recall questions. This kind of measure has often been criticized by the time-use literature. We however argue that this drawback is largely compensated by the availability of a long panel which is crucially missing in time use survey using the diary. A large effort in collecting longitudinal data based on diary data would be needed in order to investigate whether diary data would really make a difference, not only for the estimated

levels of home production but also for the estimated changes in home production due to retirement.

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Figure 1. Questions on time use in GSOEP.

2. What is a typical day like for you?
How many hours do you spend on the following acitivities on a typical weekday, Saturday, and Sunday?

☞ *Please give only whole hours.*
Use zero if the activity does not apply!

	Typical **weekday** Number of hours	Typical **Saturday** Number of hours	Typical **Sunday** Number of hours
Job, apprenticeship, second job (including travel time to and from work)			
Errands (shopping, trips to government agencies, etc.)			
Housework (washing, cooking, cleaning)			
Child care			
Care and support for persons in need of care			
Education or further training (also school, university)			
Repairs on and around the house, car repairs, garden work			
Hobbies and other free-time activities			

Figure 2. Distribution of the number of hours of home production by week.

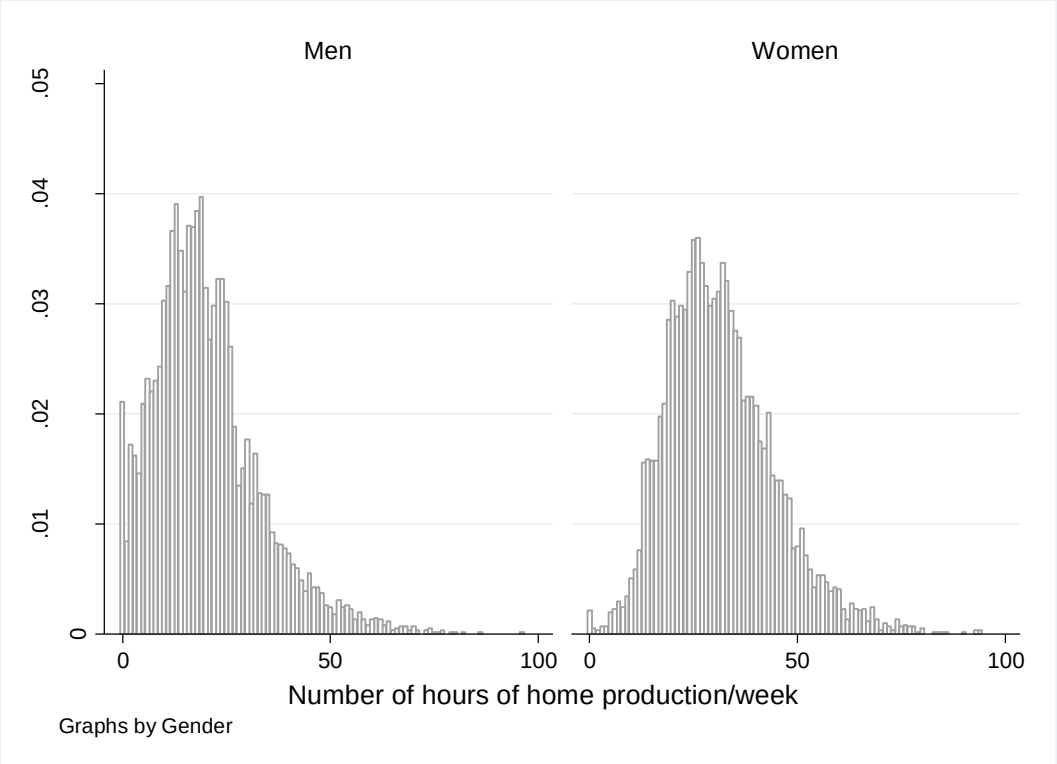


Figure 3. Proportion of individuals being retired by age.

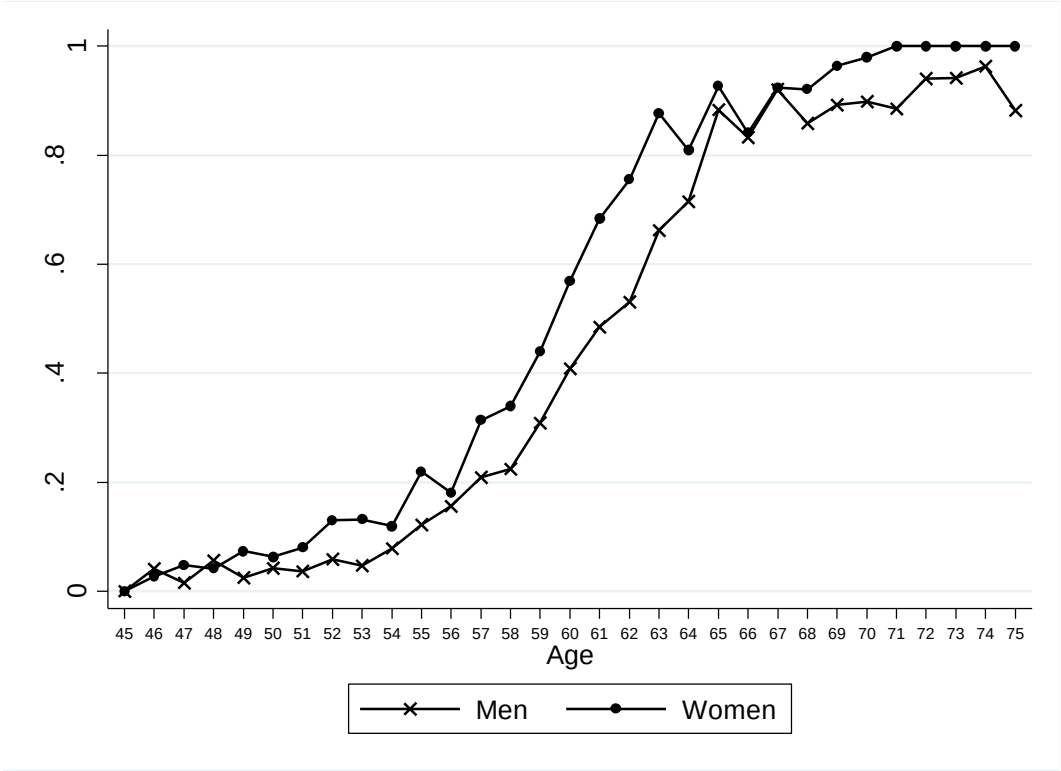
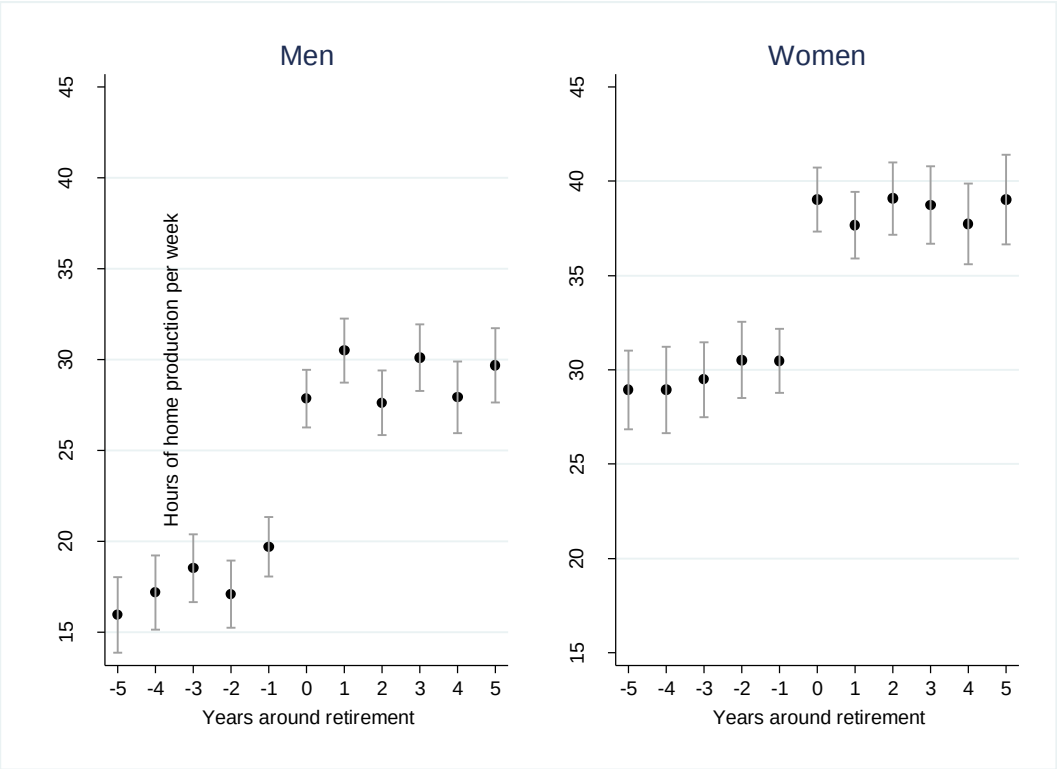
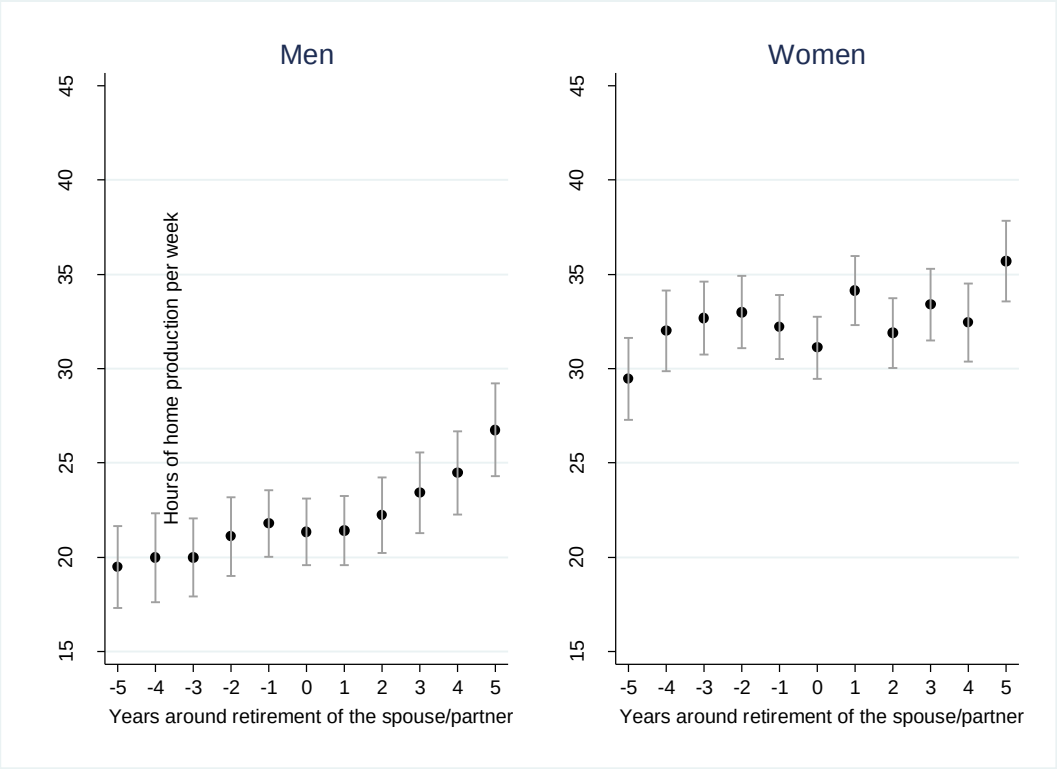


Figure 4. Average number of hours of home production by week around own retirement



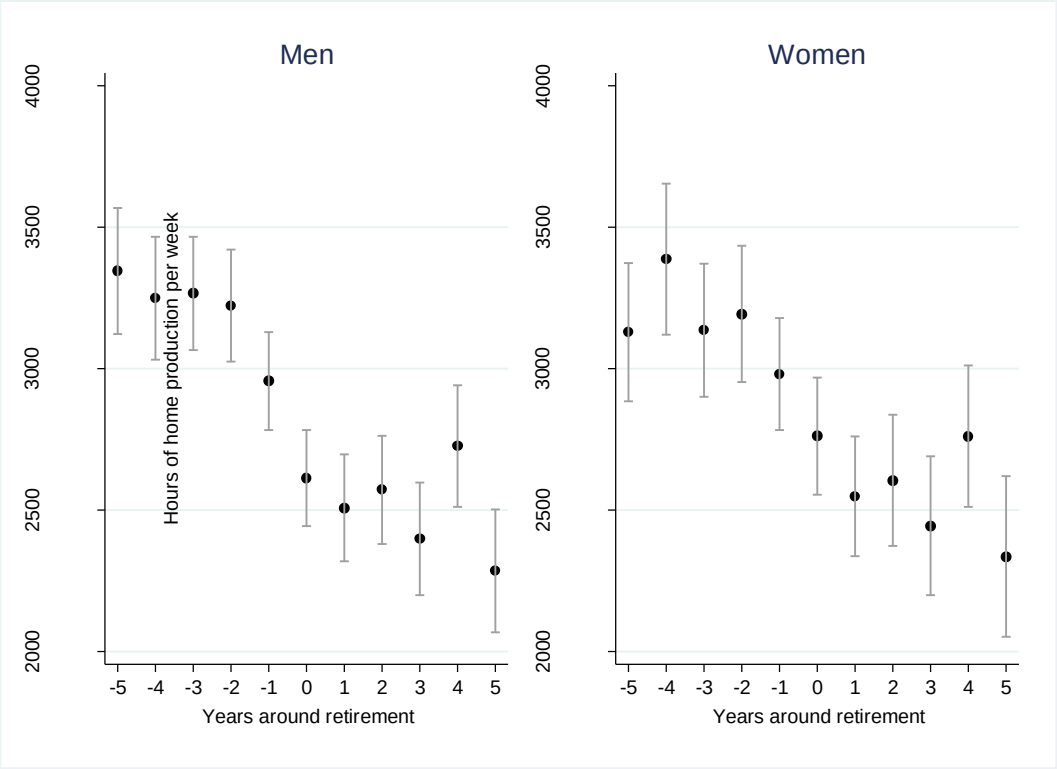
Note: The dots represent the average number of hours of home production per week and the vertical lines represent the 95% confidence interval.

Figure 5. Average number of hours of home production by week around retirement of the spouse.



Note: The dots represent the average number of hours of home production per week and the vertical lines represent the 95% confidence interval.

Figure 6. Average monthly net household income around retirement.



Note: The dots represent the average monthly net household income and the vertical lines represent the 95% confidence interval.

Table 1. Means of the control variables.

	Men				Women			
Individual:	Working	Working	Retired	Retired	Working	Working	Retired	Retired
Partner:	Working	Retired	Working	Retired	Working	Retired	Working	Retired
Age	53.6	58.1	60.7	65.3	51.1	55.6	57.1	63.2
Health satisfaction	6.5	6.2	5.7	5.7	6.7	6.5	5.8	5.8
Spouse health satisfaction	6.7	5.8	6.5	5.8	6.5	5.7	6.2	5.7
Number of adults in the household	2.7	2.4	2.3	2.2	2.7	2.3	2.4	2.2
Number of children in the household	0.2	0.1	0.1	0.0	0.2	0.1	0.1	0.0
N	3,575	603	764	1,230	3,575	764	603	1,230

Table 2. Average number of hours of home production per week.

	Men				Women			
Individual:	Working	Working	Retired	Retired	Working	Working	Retired	Retired
Partner:	Working	Retired	Working	Retired	Working	Retired	Working	Retired
Home production	16.4	15.9	30.7	26.9	29.0	26.5	39.3	37.8
	(9.4)	(10.9)	(15.3)	(13.9)	(10.8)	(11.5)	(15.0)	(14.0)
N	3,575	603	764	1,230	3,575	764	603	1,230

Note: Standard errors in parentheses.

Table 3. Retirement and home production of couples: Linear models

	Men			Women		
	RE model	FE model	IV-MLE	RE model	FE model	IV-MLE
Retired	11.884***	10.731***	12.260***	9.176***	8.404***	10.383***
	(0.409)	(0.461)	(0.850)	(0.424)	(0.468)	(0.957)
Spouse retired	-1.383***	-1.316***	-1.318	-2.079***	-2.211***	-1.859*
	(0.411)	(0.450)	(1.042)	(0.422)	(0.461)	(1.058)
Health satisfaction	0.335***	0.406***	0.342***	0.117	0.162*	0.084
	(0.073)	(0.086)	(0.102)	(0.076)	(0.087)	(0.117)
Spouse health satisfaction	-0.305***	-0.230***	-0.412***	-0.372***	-0.228***	-0.555***
	(0.074)	(0.085)	(0.105)	(0.075)	(0.088)	(0.106)
Number of adults in the household	-0.266	-0.233	-0.177	1.940***	0.888***	2.892***
	(0.229)	(0.303)	(0.305)	(0.237)	(0.312)	(0.312)
Number of children in the household	-0.770**	-0.559	-0.963**	2.463***	2.172***	2.311***
	(0.393)	(0.514)	(0.390)	(0.406)	(0.535)	(0.446)
Age	-3.344	-3.860	-4.038	-6.236	-4.332	-9.041*
	(3.767)	(3.463)	(5.023)	(3.977)	(3.574)	(5.014)
$Age^2/100$	7.034	7.917	7.679	12.020*	8.006	17.193*
	(6.456)	(5.892)	(8.678)	(6.995)	(6.273)	(8.874)
$Age^3/1000$	-0.465	-0.520	-0.471	-0.732*	-0.492	-1.042**
	(0.366)	(0.331)	(0.495)	(0.407)	(0.363)	(0.518)
Spouse's age	0.721		-1.381	1.852		2.663
	(3.859)		(4.839)	(3.884)		(5.017)
Spouse's $age^2/100$	-1.626		2.313	-2.984		-4.105
	(6.788)		(8.584)	(6.656)		(8.680)
Spouse's $age^3/1000$	0.104		-0.141	0.139		0.192
	(0.395)		(0.502)	(0.377)		(0.495)
Hausman test	$\chi^2(9) = 31.00$			$\chi^2(9) = 35.94$		
N	6,172	6,172	6,172	6,172	6,172	6,172

Note: IV-MLE is the estimation by simulated maximum likelihood and where retirement equations are specified as a probit model. The standard error of the IV-MLE are clustered at the individual level. *** p<0.01, ** p<0.05, * p<0.1. Standard errors in parentheses.

Table 4. Retirement and components of home production of couples: Fixed effects linear models

	Men			Women		
	FE model			FE model		
	Housework	Errand	Repair/Garden	Housework	Errand	Repair/Garden
Retired	4.017***	2.595***	4.119***	4.586***	1.928***	1.891***
	(0.236)	(0.177)	(0.302)	(0.311)	(0.174)	(0.219)
Spouse retired	-1.573***	-0.144	0.402	-1.717***	-0.406**	-0.087
	(0.230)	(0.173)	(0.294)	(0.306)	(0.172)	(0.216)
Health satisfaction	0.124***	0.097***	0.185***	0.051	0.016	0.095**
	(0.044)	(0.033)	(0.056)	(0.058)	(0.033)	(0.041)
Spouse health satisfaction	-0.121***	-0.050	-0.059	-0.059	-0.056*	-0.112***
	(0.044)	(0.033)	(0.056)	(0.058)	(0.033)	(0.041)
Number of adults in the household	-0.091	0.071	-0.213	0.867***	0.162	-0.142
	(0.155)	(0.116)	(0.198)	(0.207)	(0.116)	(0.146)
Number of children in the household	-0.358	0.077	-0.278	2.010***	0.267	-0.105
	(0.263)	(0.198)	(0.336)	(0.355)	(0.199)	(0.250)
Age	-2.016	-1.072	-0.772	-2.291	-0.618	-1.422
	(1.772)	(1.332)	(2.264)	(2.371)	(1.330)	(1.670)
$Age^2/100$	3.952	2.114	1.851	4.263	1.209	2.534
	(3.014)	(2.267)	(3.852)	(4.161)	(2.334)	(2.931)
$Age^3/1000$	-0.247	-0.134	-0.139	-0.267	-0.080	-0.146
	(0.169)	(0.127)	(0.216)	(0.241)	(0.135)	(0.170)
N	6,172	6,172	6,172	6,172	6,172	6,172

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

Table 5. Retirement and (logged) household resources of the household. Fixed effects models

	Fixed effects model		
	No home production	Home production valued at 4/hour	Home production valued at 8.50/hour
He retired	-0.139***	-0.054***	-0.008
	(0.012)	(0.009)	(0.009)
She retired	-0.101***	-0.031***	0.007
	(0.012)	(0.009)	(0.009)
His health satisfaction	0.003	0.003*	0.003*
	(0.002)	(0.002)	(0.002)
Her health satisfaction	0.006***	0.005***	0.004**
	(0.002)	(0.002)	(0.002)
Number of adults in the household	0.146***	0.110***	0.090***
	(0.008)	(0.006)	(0.006)
Number of children in the household	0.096***	0.072***	0.060***
	(0.013)	(0.011)	(0.010)
His age	0.122	0.117*	0.089
	(0.088)	(0.071)	(0.069)
His age^2/100	-0.192	-0.180	-0.132
	(0.150)	(0.120)	(0.117)
His age^3/1000	0.010	0.009	0.006
	(0.008)	(0.007)	(0.007)
N	5,660	5,660	5,660

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

APPENDIX

Table A1. Retirement and home production of couples: Full results of the LINEAR IV-MLE model. Men

	Retired	Spouse retired	Home production
Retired			12.260***
			(0.850)
Spouse retired			-1.318
			(1.042)
1[Age>=60]	0.189**	0.025	
	(0.082)	(0.088)	
1[Age>=63]	0.214***	0.118	
	(0.080)	(0.081)	
1[Age>=65]	0.300***	-0.083	
	(0.099)	(0.098)	
1[Spouse's Age>=60]	0.033	0.413***	
	(0.088)	(0.083)	
1[Spouse's Age>=63]	0.078	0.173*	
	(0.106)	(0.100)	
1[Spouse's Age>=65]	-0.197	-0.123	
	(0.126)	(0.127)	
Health satisfaction	-0.107***	-0.001	0.342***
	(0.015)	(0.013)	(0.102)
Spouse health satisfaction	-0.007	-0.100***	-0.412***
	(0.014)	(0.015)	(0.105)
Number of adults in the household	-0.151***	0.019	-0.177
	(0.049)	(0.048)	(0.305)
Number of children in the household	-0.022	0.064	-0.963**
	(0.106)	(0.081)	(0.390)
Age	-3.756***	-1.312	-4.038
	(0.934)	(0.964)	(5.023)
$Age^2/100$	6.658***	2.293	7.679
	(1.596)	(1.638)	(8.678)
$Age^3/1000$	-0.379***	-0.133	-0.471
	(0.090)	(0.092)	(0.495)
Spouse's age	2.029**	1.127	-1.381
	(0.992)	(0.966)	(4.839)
Spouse's $age^2/100$	-3.545**	-1.950	2.313
	(1.751)	(1.709)	(8.584)
Spouse's $age^3/1000$	0.207**	0.126	-0.141
	(0.102)	(0.100)	(0.502)
N	6,172	6,172	6,172

Note: IV-MLE is the estimation by maximum likelihood and where the home production equation is specified as a linear model and retirement equations are specified as a probit model. The standard error are clustered at the individual level.

*** p<0.01, ** p<0.05, * p<0.1

Standard errors in parentheses.

Correlations of the errors in the model. Men.

	Spouse retired	Home production
Retired	0.306	0.063
	(0.041)	(0.027)
Spouse retired		-0.006
		(0.039)

Note: The standard error in parentheses

Table A2. Retirement and home production of couples: Full results of the LINEAR IV-MLE model. Women.

	Retired	Spouse retired	Home production
Retired			10.383***
			(0.957)
Spouse retired			-1.859*
			(1.058)
1[Age>=60]	0.413***	0.034	
	(0.084)	(0.088)	
1[Age>=63]	0.172*	0.082	
	(0.101)	(0.106)	
1[Age>=65]	-0.122	-0.184	
	(0.127)	(0.125)	
1[Spouse's Age>=60]	0.024	0.192**	
	(0.087)	(0.082)	
1[Spouse's Age>=63]	0.118	0.209***	
	(0.081)	(0.079)	
1[Spouse's Age>=65]	-0.083	0.300***	
	(0.098)	(0.098)	
Health satisfaction	-0.100***	-0.007	0.084
	(0.015)	(0.014)	(0.117)
Spouse health satisfaction	-0.001	-0.107***	-0.555***
	(0.013)	(0.015)	(0.106)
Number of adults in the household	0.019	-0.149***	2.892***
	(0.048)	(0.049)	(0.312)
Number of children in the household	0.063	-0.021	2.311***
	(0.082)	(0.106)	(0.446)
Age	1.121	2.034**	-9.041*
	(0.966)	(0.991)	(5.014)
$Age^2/100$	-1.940	-3.547**	17.193*
	(1.709)	(1.751)	(8.874)
$Age^3/1000$	0.125	0.207**	-1.042**
	(0.100)	(0.102)	(0.518)
Spouse's age	-1.319	-3.745***	2.663
	(0.964)	(0.935)	(5.017)
Spouse's $age^2/100$	2.305	6.638***	-4.105
	(1.639)	(1.598)	(8.680)
Spouse's $age^3/1000$	-0.133	-0.378***	0.192
	(0.092)	(0.090)	(0.495)
N	6,172	6,172	6,172

Note: IV-MLE is the estimation by maximum likelihood and where the home production equation is specified as a linear model and retirement equations are specified as a probit model. The standard error are clustered at the individual level.
*** p<0.01, ** p<0.05, * p<0.1
Standard errors in parentheses.

Correlations of the errors in the model. Women.

	Spouse retired	Home production
Retired	0.306	-0.008
	(0.041)	(0.035)
Spouse retired		-0.001
		(0.043)

Note: The standard error in parentheses

Table A3. Retirement and home production of couples: Full results of the LINEAR IV-MLE model. Simultaneous estimation for men and women.

	He Retired	She retired	His home production	Her home production
He Retired			12.288***	-1.876*
			(0.865)	(1.109)
She retired			-1.336	10.361***
			(1.063)	(0.964)
1[His Age>=60]	0.189**	0.024		
	(0.083)	(0.088)		
1[His Age>=63]	0.214***	0.118		
	(0.080)	(0.081)		
1[His Age>=65]	0.301***	-0.083		
	(0.099)	(0.098)		
1[Her Age>=60]	0.032	0.413***		
	(0.088)	(0.083)		
1[Her Age>=63]	0.075	0.172*		
	(0.107)	(0.101)		
1[Her Age>=65]	-0.195	-0.122		
	(0.126)	(0.127)		
His health satisfaction	-0.107***	-0.001	0.343***	-0.555***
	(0.015)	(0.014)	(0.102)	(0.106)
Her health satisfaction	-0.007	-0.100***	-0.412***	0.083
	(0.014)	(0.015)	(0.105)	(0.117)
Number of adults in the household	-0.151***	0.019	-0.176	2.891***
	(0.049)	(0.048)	(0.305)	(0.312)
Number of children in the household	-0.022	0.064	-0.963**	2.311***
	(0.106)	(0.081)	(0.390)	(0.446)
His age	-3.761***	-1.315	-3.992	2.627
	(0.934)	(0.965)	(5.027)	(5.041)
His age^2\100	6.668***	2.297	7.601	-4.042
	(1.597)	(1.640)	(8.684)	(8.719)
His age^3\1000	-0.380***	-0.133	-0.466	0.188
	(0.090)	(0.092)	(0.495)	(0.497)
Her age	2.022**	1.124	-1.404	-9.081*
	(0.993)	(0.966)	(4.854)	(5.021)
Her age^2\100	-3.533**	-1.945	2.353	17.262*
	(1.753)	(1.708)	(8.610)	(8.886)
Her age^3\1000	0.206**	0.126	-0.143	-1.046**
	(0.103)	(0.100)	(0.503)	(0.518)
N	6,172	6,172	6,172	6,172

Note: IV-MLE is the estimation by maximum likelihood and where the home production equation is specified as a linear model and retirement equations are specified as a probit model. The standard error are clustered at the individual level.
*** p<0.01, ** p<0.05, * p<0.1
Standard errors in parentheses.

Correlations of the errors in the model.

	She retired	His Home production	Her home production
He Retired	0.307	0.062	-0.0001
	(0.041)	(0.028)	(0.045)
She retired		-0.006	-0.007
		(0.041)	(0.036)
His home production			0.204
			(0.019)

Note: The standard error in parentheses

Table A4. Retirement and total home production of couples

	RE model	FE model	IV-MLE
He retired	9.722***	8.589***	9.932***
	(0.629)	(0.702)	(1.501)
She retired	7.757***	7.152***	9.070***
	(0.633)	(0.684)	(1.472)
His health satisfaction	-0.027	0.182	-0.223
	(0.113)	(0.130)	(0.159)
Her health satisfaction	-0.181	-0.070	-0.329**
	(0.114)	(0.130)	(0.163)
Number of adults in the household	1.631***	0.631	2.703***
	(0.356)	(0.460)	(0.476)
Number of children in the household	1.701***	1.637**	1.347**
	(0.610)	(0.781)	(0.649)
His age	-1.583	-5.457	-2.224
	(5.784)	(5.268)	(7.678)
His age^2/100	4.223	11.048	5.018
	(9.911)	(8.963)	(13.300)
His age^3/1000	-0.337	-0.725	-0.358
	(0.561)	(0.504)	(0.760)
Her age	-5.436		-10.508
	(5.916)		(7.574)
Her age^2/100	10.227		19.657
	(10.407)		(13.485)
Her age^3/1000	-0.617		-1.191
	(0.605)		(0.792)
N	6,172	6,172	6,172

Note: IV-MLE is the estimation by simulated maximum likelihood and where retirement equations are specified as a probit model. The standard error of the IV-MLE are clustered at the individual level.
*** p<0.01, ** p<0.05, * p<0.1
Standard errors in parentheses.

Table A5. Retirement and components of home production of couples: IV-MLE linear models

	Men			Women		
	IV-MLE			IV-MLE		
	Housework	Errand	Repair/Garden	Housework	Errand	Repair/Garden
Retired	4.435***	2.866***	4.993***	5.762***	2.239***	2.452***
	(0.376)	(0.314)	(0.563)	(0.655)	(0.307)	(0.448)
Spouse retired	-3.173***	0.355	1.406*	-1.995***	0.017	0.048
	(0.579)	(0.426)	(0.751)	(0.737)	(0.331)	(0.456)
Health satisfaction	0.167***	0.068**	0.107	-0.116	0.023	0.178***
	(0.046)	(0.033)	(0.069)	(0.081)	(0.035)	(0.051)
Spouse health satisfaction	-0.193***	-0.119***	-0.102	-0.239***	-0.069**	-0.248***
	(0.052)	(0.036)	(0.071)	(0.069)	(0.033)	(0.052)
Number of adults in the household	-0.407***	-0.272***	0.504**	2.152***	0.308***	0.429***
	(0.121)	(0.102)	(0.209)	(0.235)	(0.112)	(0.146)
Number of children in the household	0.053	-0.300**	-0.715***	2.093***	0.395***	-0.178
	(0.208)	(0.141)	(0.275)	(0.322)	(0.141)	(0.187)
Age	-0.695	-1.777	-1.529	-5.680*	-0.086	-3.176
	(2.443)	(1.734)	(3.492)	(3.337)	(1.744)	(2.406)
$Age^2/100$	1.292	3.344	2.980	10.485*	0.613	5.925
	(4.236)	(2.983)	(6.083)	(5.866)	(3.109)	(4.289)
$Age^3/1000$	-0.074	-0.206	-0.188	-0.619*	-0.061	-0.353
	(0.242)	(0.169)	(0.350)	(0.340)	(0.183)	(0.253)
Spouse's age	-0.470	1.407	-2.462	0.472	1.403	0.679
	(2.484)	(1.781)	(3.526)	(3.532)	(1.679)	(2.366)
Spouse's $age^2/100$	0.820	-2.594	4.337	-0.237	-2.416	-1.268
	(4.409)	(3.145)	(6.322)	(6.091)	(2.911)	(4.096)
Spouse's $age^3/1000$	-0.049	0.153	-0.258	-0.021	0.133	0.070
	(0.258)	(0.183)	(0.374)	(0.346)	(0.166)	(0.234)
N	6,172	6,172	6,172	6,172	6,172	6,172

Note: *** p<0.01, ** p<0.05, * p<0.1. Standard errors (clustered at the individual level) in parentheses