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Households' simultaneous consumption spending and home production responses to retirement

Do retirees substitute consumption spending?

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Households' simultaneous consumption spending and home production responses to retirement: Do retirees substitute consumption spending? *

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Abstract

We analyze the effect of spouses' retirement on simultaneous consumption spending and home production decisions. For causal identification, we exploit discontinuities in US Social Security benefits claiming using a Regression Discontinuity Design. Our results suggest that the consumption drop due to retirement is only partially compensated by an increase in home production of the retiring household member. Home production can make up for losses in spending categories that are well-substitutable by home production, although only 11% of total consumption spending, but there is no evidence that households fully replace these categories by home produced counterparts.

JEL codes: C33, D1, H55, J22, J26
Keywords: Regression Discontinuity, Retirement, Consumption, Home production, Couples, Panel data

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1 Introduction

In his seminal work, Becker (1965) argues that consumption is 'produced' by two inputs: market expenditures (*market consumption*) and time (*home production*). The relative price of time, the foregone wage, determines the share of market consumption in the consumption bundle. Hence, spending on market consumption is a bad proxy for actual consumption as 'time' can be used to increase consumption beyond market expenditures (Hurst, 2008). Moreover, the theory of home production of Becker (1965) suggests that people will substitute away from market consumption to home production as the opportunity cost of time drops.

This argument is often suggested to explain the substantial drops in consumption spending at retirement, known as the retirement-consumption puzzle, found by a large strand of literature (Mariger, 1987; Robb & Burbidge, 1989; Banks et al., 1998; Bernheim et al., 2001; Miniaci et al., 2010; Battistin et al., 2009; Hurd & Rohwedder, 2003, 2006; Smith, 2006; Haider & Stephens, 2007; Hurst, 2008; Aguila et al., 2011; Hurd & Rohwedder, 2013). Hurd & Rohwedder (2007) find evidence for increased home production at retirement. Part of this increased home production after retirement is because of substitution between market consumption and home production (Schwerdt, 2005). Aguiar & Hurst (2005) explicitly show that retired persons substitute market consumption by home production with evidence on food expenditures and time spent in shopping and preparing meals. However, aforementioned studies were unable to relate detailed consumption expenditures to detailed time use decisions. Other studies have also shown that substitution possibilities between market consumption and home production are found to be relatively small (Hicks, 2015), also among retirees (Been et al., 2017). Hence, the increases in home production may not be able to fully protect against the consumption drops at retirement.

Prior literature has also shown that spouses' retirement decisions decrease consumption spending (Lundberg et al., 2003; Moreau & Stancanelli, 2015) and increase time spent in home production (Stancanelli & Van Soest, 2012b; Bonsang & Van Soest, 2015). This suggests that the relative price of time of both spouses is considered in consumption spending and home production decisions of the household. For this reason, couples have the possibility to smooth drops in household consumption spending over both own and spousal home production decisions. The effects of spouses' retirement decisions on consumption spending and home production decisions have only been analyzed in isolation so far.

The current paper's contribution to the literature is threefold. First, it analyzes the effect of households' retirement on simultaneous consumption and home production decisions. An integral approach of consumption and home production is important as retirees are expected to shift away from market consumption to home production as their opportunity cost of time decreases (Becker, 1965). Although Stancanelli & Van Soest (2012b) and Bonsang & Van Soest (2015) point out that spouses' home production can compensate for the reduction in household income, they do not explicitly relate the increase in home production to the drop in consumption spending. Aguiar & Hurst (2005) only focus on spending and preparing of food. We, however, have detailed information on yearly consumption spending by households.

Second, causal identification comes from a Regression Discontinuity approach, like Stancanelli & Van Soest (2012b), and by exploiting the panel structure of the data, like Bonsang & Van Soest (2015). Whereas Stancanelli & Van Soest (2012b) use a discontinuity in pension benefits claiming at the age of 60 caused by the French pension system their analysis is based on a cross-section. In contrast, Bonsang & Van Soest (2015) control for fixed household specific effects to solve endogeneity issues regarding as they argue that there is no convincing discontinuity available in the German pension system. We use the HRS/CAMS data set which combines detailed information on consumption spending with detailed information on time use of both spouses in a household over time.[1] Our discontinuity approach is based on legislation regarding Social Security benefits claiming in the US. Basically, the Social Security system introduces discontinuous jumps in the probability to retire because of age (claiming from the age of 62) and birth year cohort (FRA differs between cohorts with accompanied actuarially fair reductions when claiming prior to reaching the FRA). A third source of discontinuity comes from the age of the partner (Stancanelli & Van Soest, 2012a). We use all three discontinuities in the paper.

Third, we contribute to the existing literature by analyzing the extent to which retiring households

[1] Most data sets with time-use information do not have information on consumption spending (for example, American Time Use Survey (ATUS)) or less detailed information on time-use categories (for example, German Socioeconomic Panel (GSOEP)), do not have information on both spouses within a household (for example, Panel Study on Income Dynamics (PSID)) or have a limited longitudinal dimension (for example, French, Italian and Spanish Time Use Survey). Compared to the Dutch Longitudinal Internet Studies for the Social Sciences (LISS), the HRS/CAMS has the advantage to span a wider time frame with information on consumption and time use.

replace consumption spending categories by home produced counterparts. The results of both Stancanelli & Van Soest (2012b) and Bonsang & Van Soest (2015) suggest that retirement increases home production of the retiree as well as the spouse suggesting that households can compensate for the reduction in household income. However, the extent to which this increase in home production allows households to consume the same consumption bundle remains unclear. Therefore, we condition home production estimates on consumption spending. Endogeneity issues between consumption spending and home production decisions are solved by using individuals' prior expectations on the adequacy of retirement income as an instrumental variable.

To analyze the effects of couples' retirement decisions on consumption spending and home production simultaneously, we estimate a simultaneous equation model (SEM) like Stancanelli & Van Soest (2012b). To correct for time-invariant unobserved heterogeneity we condition the unobserved heterogeneity on the individual mean of time-varying regressors similar to Mundlak (1978). The empirical specification takes into account both jumps and kinks as discontinuities in the probability to retire (Dong, 2016).

Our estimation results suggest that retirement induces a drop in consumption spending while simultaneously increasing the time spent in home production of the retiring household member. However, our evidence suggests that households are only marginally able to smooth the consumption drop by increasing home production. Home production can replace components of consumption that are well-substitutable by home production, but 1) the scope for smoothing consumption by home production is small as these components are only about 11% of pre-retirement consumption spending, and 2) there is no evidence of substitution between these spending categories and home produced counterparts. Retiring households are therefore likely to choose a different consumption bundle instead of replacing consumption from the market by home production. The increases in households' home production can only partially explain the drops in consumption spending observed at retirement. This conclusion is in contrast to papers that do not integrate spending and time use categories.

The paper continues with explaining the data and showing the descriptive statistics of households' consumption spending and home production decisions in Section 2. Next, the Regression Discontinuity using Social Security benefits claiming is explained in Section 3. The theoretical framework and empirical model are explained in Section 4. Section 5 shows the estimation results as well as the robustness of the results to different specifications. Section 8 concludes the paper.

2 Data

2.1 HRS/CAMS

The data for our empirical analyses come from the Health and Retirement Study (HRS), a longitudinal survey that is representative of the U.S. population over the age of 50 and their spouses. The HRS conducts core interviews of about 20,000 persons every two years. In addition the HRS conducts supplementary studies to cover specific topics beyond those covered in the core surveys. The time-use data we use in this paper were collected as part of such a supplementary study, the Consumption and Activities Mail Survey (CAMS).

Health and Retirement Study Core interviews

The first wave of the HRS was fielded in 1992. It interviewed people born between 1931 and 1941 and their spouses, irrespective of age. The HRS re-interviews respondents every second year. Additional cohorts have been added so that beginning with the 1998-wave the HRS is representative of the entire population over the age of 50. The HRS collects detailed information on the health, labor force participation, economic circumstances, and social well-being of respondents. The survey dedicates considerable time to elicit income and wealth information, providing a complete inventory of the financial situation of households. In this study we use demographic and asset and income data from the HRS core waves spanning the years 2002 through 2010.

Consumption and Activities Mail Survey

The CAMS survey aims to obtain detailed measures of time-use and total annual household spending on a subset of HRS respondents. These measures are merged to the data collected on the same households in the HRS core interviews. The CAMS surveys are conducted in the HRS off-years, that is, in odd-numbered years.

The first wave of CAMS was collected in 2001 and it has been collected every two years since. Questionnaires are sent out in late September or early October. Most questionnaires are returned in October and November. CAMS thus obtains a snap-shot of time-use observed in the fall of the CAMS survey year. In the first wave, 5,000 households were chosen at random from the entire pool of households who participated in the HRS 2000 core interview. Only one person per household was chosen. About 3,800 HRS households responded, so CAMS 2001 was a survey of the time-use of 3,800 respondents and the total household spending of the 3,800 households in which these respondents live. Starting in the third wave of CAMS, both respondents in a couple household were asked to complete the time-use section, so that the number of respondent-level observations on time-use in each wave was larger for the waves from 2005 and onwards.

In this study we will therefore use CAMS data from 2005, 2007, 2009 and 2011. The CAMS data can be linked to the rich background information that respondents provide in the HRS core interviews. Rates of item nonresponse are very low (mostly single-digit), and CAMS spending totals aggregate closely to those in the CEX (Hurd & Rohwedder, 2009). The time use data aggregate closely to categories of time use in the American Time Use Study (Hurd & Rohwedder, 2007).

Respondents were asked about a total of 31 time-use categories in wave 1; wave 2 added two more categories; wave 4 added 4 additional categories. Thus, since CAMS 2007 the questionnaire elicits 37 time-use categories. For most activities respondents are asked how many hours they spent on this activity ”last week.” For less frequent categories they were asked how many hours they spent on these activities ”last month.” Hurd & Rohwedder (2008) provide a detailed overview of the time-use section of CAMS, its design features and structure, and descriptive statistics. A detailed comparison of time-use as recorded in CAMS with that recorded in the American Time Use Survey (ATUS) shows summary statistics that are fairly close across the two surveys, despite a number of differences in design and methodology (Hurd & Rohwedder, 2007).

Of particular interest for this study are the CAMS time-use categories related to home production following the definition of Aguiar et al. (2013):

- House cleaning
- Washing, ironing or mending clothes

- Yard work or gardening
- Shopping or running errands
- Preparing meals and cleaning up afterwards
- Taking care of finances or investments, such as banking, paying bills, balancing the checkbook, doing taxes, etc.
- Doing home improvements, including painting, redecorating, or making home repairs
- Working on, maintaining, or cleaning car(s) and vehicle(s)

Respondents were also asked about a total of 39 spending categories in the CAMS waves. For durable goods, the respondent is asked to indicate whether the household purchased the item in the ”past 12 months,” and, to the best of their ability, provide the purchase price. For nondurable goods and services, the respondent is asked how much was spent in each category and is sometimes given the option, depending on the survey wave and category, of reporting the amount spent weekly, monthly, or yearly. For frequent spending categories, such as gasoline and food, respondents are given the option of reporting all three periodicities, while less frequent spending categories such as mortgage and utilities are only given monthly or yearly options.

We restrict the sample to heterosexual couples, in which both spouses are aged between 51-80, both spouses filled out the time use survey and couples are dropped if both spouses only have been unemployed, disabled or inactive in the sample.The main disadvantage of using the HRS for our purposes is the relatively small sample that is available to study retirement behavior. However, Behaghel & Blau (2012) verify that retirement trends observed in HRS are robust to trends observed in administrative data.

2.2 Descriptives

To get a first impression of how retirement decisions of the household affect consumption spending, Table 1 presents the average amount of spending (in $ per year) for non-retired couples, couples in which the male is retired and the female is not, couples in which the female is retired and the male is not and couples in which both spouses are retired. The descriptives show that total consumption spending (excluding durables) is substantially lower in households in which the male is retired. Female retirement does not seem to be associated with a substantial reduction in consumption spending. These associations should not be interpreted as causal whatsoever.

A similar pattern is observed when focussing on consumption spending that could directly be substituted for by home production such as dining out, housekeeping services, gardening services, home repair services and vehicle maintenance. The total of home production substitutable consumption is about 11% of total consumption spending and, therefore, a non-negligible component of total consumption spending. In all defined groups of couples, expenditures on dining out are the most substantial component of home production substitutable consumption (about 40%). Table 1 also shows that substitutable consumption is more responsive to households' retirement decisions than total consumption which is likely due to the fact that these consumption components are partially substituted by increased home production at retirement.

Table 2 shows the time spend in home production activities differentiated over non-retired, partially-retired and retired couples. Looking at the total time spent in home production indicates that men and women in non-retired couples spend, on average, about 14 hours and 24 hours per week respectively. Men spend about 2 hours more time in home production in couples in which the male is retired while the female is not. Women in these households do not devote substantially more time to home production than households in which both spouses are non-retired. In households in which the female is retired and the male is not, we see that the total sum of home production in the household is higher compared to households in which both spouses are non-retired. This is mainly due to a substantially higher number of hours spent in home production of the female (27 hours), while males only spend about 14 hours. The total time devoted to home production is highest in couples with spouses that are both retired. In these households, men spend about 17 hours per week in home production while women spend about 27 hours per week.

With total household home production of 38, 42, 41 and 44 hours per week respectively, we see that retirement is associated with increased home production although the increase is fairly small for couples

Table 1: Household consumption ($ per year)

	Non-retired (m), Non-retired (f)		Retired (m), Non-retired (f)		Non-retired (m), Retired (f)		Retired (m), Retired (f)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Dining out	2,360.36	2,746.58	2,139.93	2,717.91	2,611.73	3,414.12	2,140.73	3,281.80
Housekeeping services	487.55	1,090.72	397.14	1,186.40	626.80	1,529.21	383.44	1,086.40
Gardening services	331.16	1,043.25	290.24	996.32	456.06	1,122.55	385.89	1,217.26
Home repair services	1,871.17	6,252.26	1,302.10	3,341.12	2,063.00	6,978.01	1,312.67	3,466.83
Vehicle maintenance	1,045.41	1,067.86	797.67	853.04	903.14	1,108.63	683.31	846.28
Substitutable consumption	6,237.31	8,226.39	5,056.10	5,676.95	6,764.34	9,432.65	5,013.21	5,995.21
Consumption w/o durables	53,792.18	29,654.00	48,093.84	27,647.10	53,798.86	35,153.00	43,654.91	27,615.95

in which one spouse has retired already. These descriptives also suggest that most of the increased home production is due to the partner that retires and that cross-effects between the partners are relatively small. However, all aforementioned associations should not be interpreted as causal whatsoever as consumption, time use, and retirement decisions are likely to be determined simultaneously. For causal identification of the effect of retirement on consumption and home production decisions we apply a Regression Discontinuity analysis that is explained in the next section.

3 A Regression Discontinuity approach

3.1 Increasing retirement ages

The earliest age at which retirees are eligible to claim Social Security benefits is 62. Social Security benefits can be claimed up to the age of 70. The Full Retirement Age (FRA) is the age at which people can start claiming unreduced Social Security benefits. The Social Security Amendments of 1983, increased the FRA depending on the year of birth. Individuals born before 1938, have an FRA of 65. People born in 1938-1943 face a stepwise increase of the FRA by 2 months per birthyear cohort until the age of 66. People born from 1943-1954 face an FRA of 66. People born in 1955-1960 face a stepwise increase again until the FRA of 67. People born after 1959 face an FRA of 67. See Figure 1 for the FRA by birthyear.

People claiming benefits after the FRA, which is possible up to the age of 70, receive an actuarially fair premium. Claiming benefits before the FRA results in actuarially fair reductions in the benefit payments. Hence, the penalty for claiming benefits at the early retirement age of 62 was increased by the amendments. The actuarially fair reduction increases as the FRA rises so to equalize lifetime payments for workers who claim at different ages.[2] Therefore, the amendments imposed a reduction in expected lifetime wealth. This reduction is bigger for younger birth cohorts.

[2]The actuarial reductions are steeper for spouses. Therefore, the change in the pension system may have a substantial effect on the retirement behavior of the spouse.

Table 2: Time use in home production activities (hours per week)

	Non-retired (m), Non-retired (f)				Retired (m), Non-retired (f)				Non-retired (m), Retired (f)				Retired (m), Retired (f)			
	Male		Female		Male		Female		Male		Female		Male		Female	
	Mean	S.D.	Mean	S.D	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
House cleaning	2.33	3.62	5.81	6.28	2.77	3.90	5.96	8.08	1.76	3.07	6.22	6.57	2.32	4.01	6.42	7.31
Laundry	1.01	1.96	3.48	3.11	1.04	2.78	3.54	4.20	0.68	2.25	3.77	3.92	0.79	1.92	3.77	3.98
Gardening	2.65	3.89	1.58	2.74	3.26	6.84	1.63	3.48	3.03	5.77	1.74	3.76	3.91	5.95	1.74	3.80
Shopping	2.68	2.95	4.17	4.33	3.10	5.64	4.03	3.39	2.72	3.00	4.20	4.36	3.56	3.85	4.25	4.31
Cooking	3.20	4.53	7.30	5.82	3.86	6.88	7.60	6.57	2.75	3.48	9.14	9.08	3.35	4.88	8.97	7.35
Financial management	0.97	1.96	0.91	1.51	0.75	2.00	0.98	2.47	0.88	1.62	0.92	1.52	0.85	1.64	0.82	1.51
Home maintenance	1.21	2.93	0.59	1.44	1.11	2.45	0.67	2.60	1.26	2.80	0.47	1.26	1.44	3.49	0.55	1.77
Vehicle maintenance	0.57	0.96	0.25	0.56	0.61	2.07	0.28	0.81	0.56	1.00	0.21	0.44	0.62	1.27	0.18	0.51
Home production	14.52	14.59	24.09	16.80	16.50	20.52	24.68	19.14	13.63	13.89	26.66	19.72	16.84	15.70	26.70	19.51

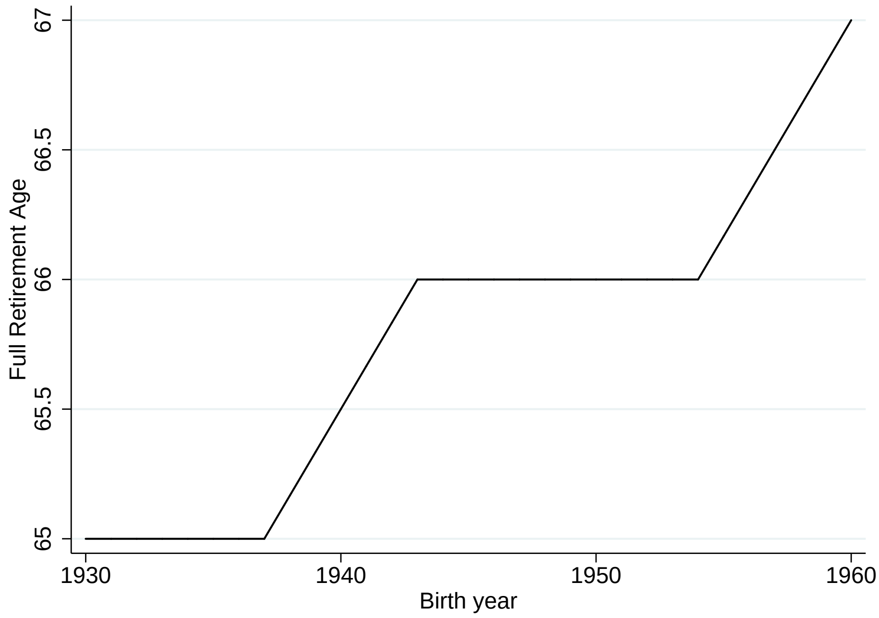


Figure 1: Full Retirement Age by birth year

3.2 Discontinuities in retirement

The legislation regarding the FRA is used to identify the causal effects of retirement on simultaneous market consumption and home production decisions of couples in the HRS/CAMS data. Theoretically, the FRA creates a discontinuity in the probability of retirement as a function of age, like in Stancanelli & Van Soest (2012b), in the probability of retirement across birth cohorts like in Lalive & Staubli (2014), as well as in the age of the partner similar to Stancanelli & Van Soest (2012a). This section provides visual evidence for the existence of the discontinuities in retirement probabilities.

First, a discontinuity exists because of benefit claiming discontinuities in age. The probability of retirement is higher for persons that can claim Social Security benefits than for persons who can not ($P(R_{it}|age_{it} = 62) \gg P(R_{it}|age_{it} < 62)$). Figure 2 shows the discontinuities in the retirement rate by age. There seems to be a high discontinuous jump in the probability of retirement at the age of 62 which is the earliest possible age to claim benefits. The discontinuity if somewhat bigger for women than for men. However, men show a somewhat bigger discontinuity at the age of 65 which is the FRA for the oldest birth cohorts. Next to jumps in the probability to retire 62 and 65, the figure also indicates kinks in the probability to retire. Visually, there are substantial differences in the slope of the retirement rate with respect to age. Both the jumps and the kinks are exploited in the empirical model in Section 4.2. As a primer, Figures 3 and 4 show how these discontinuities in retirement affect our variables of interest. Figure 3 shows a decrease in consumption spending at the age of 62 for men, but not so much for women. Figure 4 shows an increase in time spent in home production at age 62 for both men and women, although the discontinuity is more pronounced for men. These primer results indicate that the claiming behavior of Social Security benefits determine both consumption spending and home production through retirement decisions. Also, Figures 3 and 4 suggest that market consumption and home production function as substitutes in retirement.

Second, a discontinuity exists because of benefit claiming discontinuities in cohort. The discontinuity in birth cohorts exists because the legislation implies a reduction in the present value of benefits for younger cohorts (Duggan et al., 2007). Because of the actuarially fair reduction in benefits, younger cohorts have a smaller incentive to claim Social Security benefits at the earliest age possible ($P(R_{it}|age_{it} = 62, FRA_i = 65) \gg P(R_{it}|age_{it} = 62, FRA_i > 65)$). Song & Manchester 2007; Mastrobuoni 2009; Blau & Goodstein 2010; Behaghel & Blau 2012 find that the increase in the FRA has led to a significant delay in retirement among the birth cohorts affected by the reform. Discontinuities in the retirement rate by birth cohort are shown in Figure 5. Both jumps and kinks are visible at birth years 1938 (with stepwise increases of the FRA to 66), 1943 (an FRA of 66) and 1955 (with stepwise increases of the FRA to 67). Visually, the discontinuities seem slightly more pronounced for men. Note that we only observe information before and after the age of 62 for the cohorts born later than 1943. Figure 5 therefore also includes age-effects that should be corrected for in the regression analysis.

Third, a discontinuity in exists because of benefit claiming discontinuities in the age of the spouse. Evidence of Stancanelli & Van Soest (2012b) suggests that the probability of retirement increases when the spouse is eligible for receiving benefits ($P(R_{it}|age_{st} = 62) \gg P(R_{it}|age_{st} < 62)$ with s being the spouse). Figure 6 shows the discontinuities in the retirement rate by age of the spouse. Jumps and a kinks in the male and female retirement rate at the age of 62 of the spouse is much less pronounced than in own age (Figure 2).

In the Appendix we show that the movements over age in the control variables are much likely to be explained by jumps and kinks at the age of 62, 65, and 70.

4 Model

4.1 Theoretical framework

Households maximize the household utility subject to a budget- and time-constraint. Households (i) are assumed to consist of a male spouse ($k = m$) and female spouse ($k = f$). For simplicity, we assume a unitary model and refrain from the bargaining process as the purpose of the model is not to estimate a structural model but to introduce a framework for our empirical model. We assume that households make decisions regarding market consumption c_i^m while home production c_{ik}^h is produced by the individuals (k) within the household such that household utility can be represented by:

$$u_i = u(c_i^m, c_{ik}^h(h_{ik}^h), l_{ik}) \tag{1}$$

in which l_{ik} is leisure time for $k = m, f$ with the time budget constraint

$$l_{ik} = T_{ik} - h_{ik}^m - h_{ik}^h \tag{2}$$

Here, T being the time-constraint equal to 24 hours a day, h_{ik}^h time spent in home production and h_{ik}^m time spent in market production. The monetary budget constraint for household market consumption is a function of wages w_{ik}, market hours h_{ik}^m and household non-labor income μ_i:[3]

$$c_i^m = w_{ik} \cdot h_{ik}^m + \mu_i \tag{3}$$

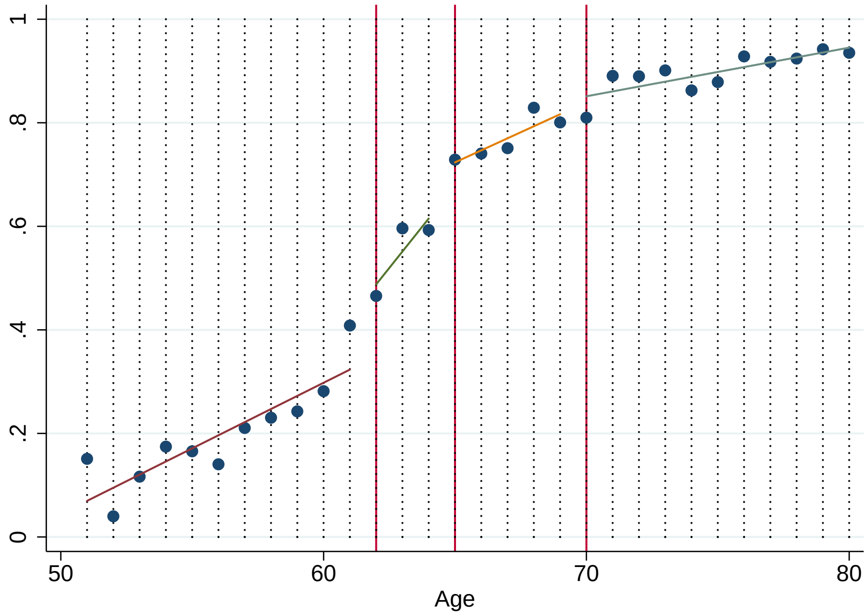
The home production function of the household is determined by $c_{ik}^h(h_{ik}^h) = g_{ik}(h_{ik}^h)$, where $g(\cdot)$ is an arbitrary function that is concave in the number of hours spent in home production activities. The home production function can differ between spouses (k).[4] Like Gronau (1977), we make the implicit simplifying assumption that spouses do not derive utility from time spent in home production such that it is a perfect substitute to time spent in market production.

[3]For simplicity, we abstract from prices. μ_i includes state pensions.

[4]The theoretical framework is a static framework. The empirical model is more general and also allows for a changing home production function over time as people may become less efficient in home production over time due to age-related problems.

Figure 2: Retirement rate by age of men (a) and women (b)

(a) Men



(b) Women

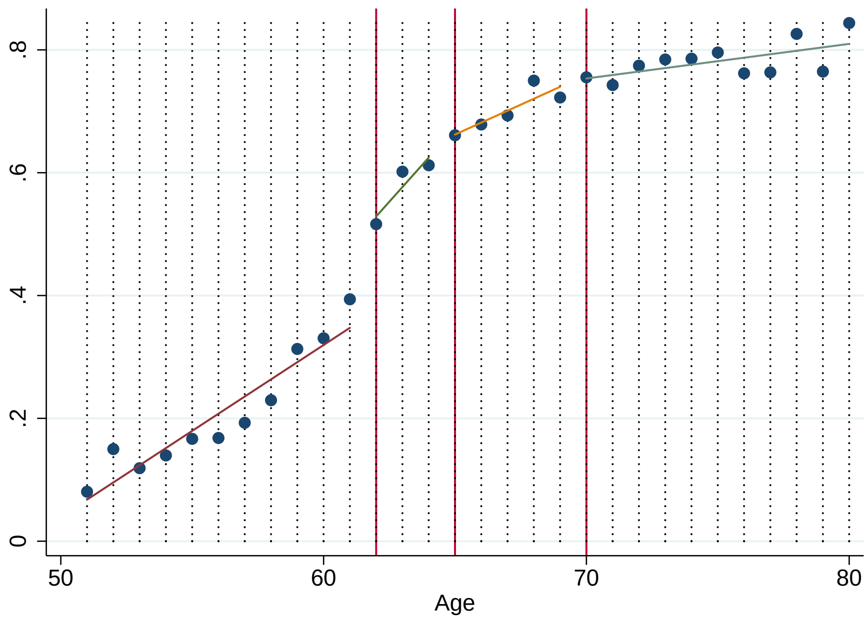
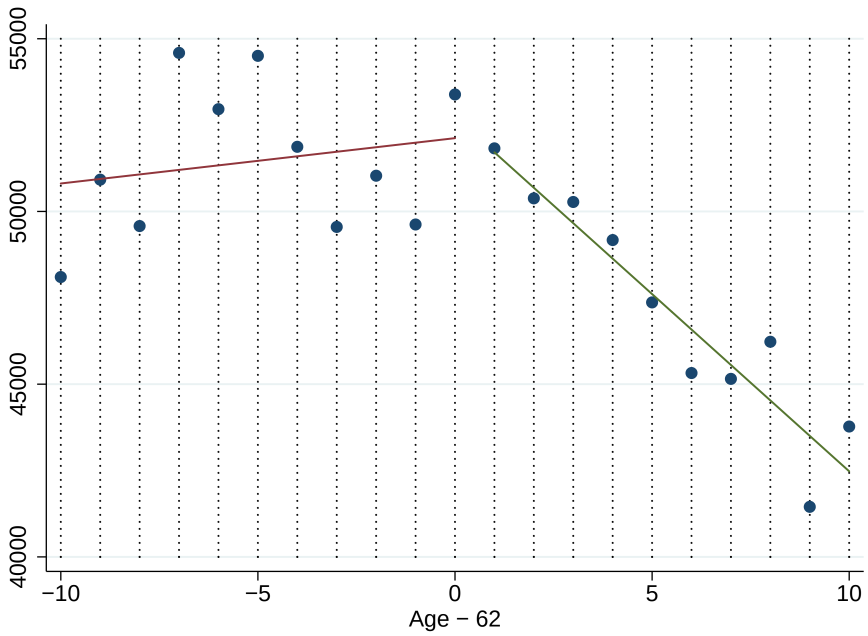


Figure 3: Household consumption spending ($ per year) of men (a) and women (b)

(a) Men



(b) Women

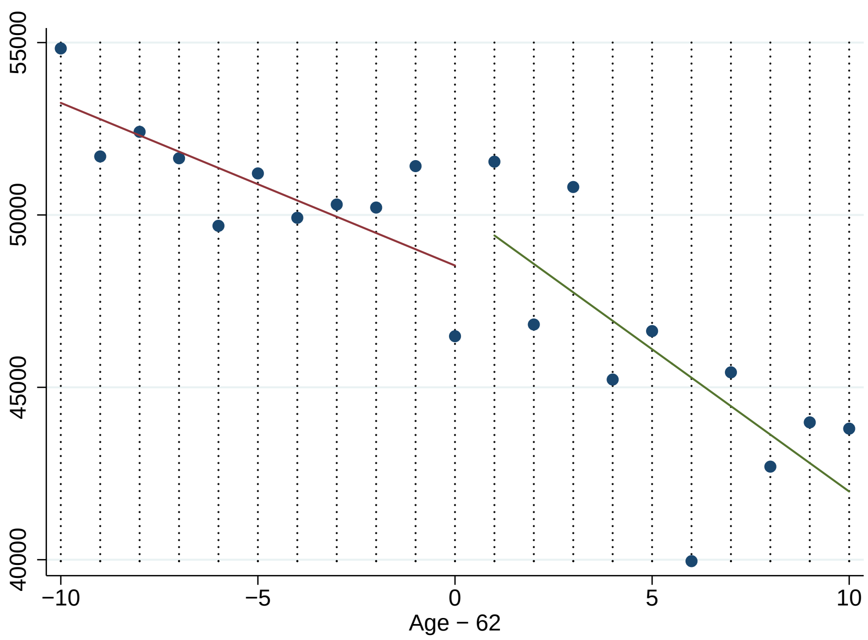
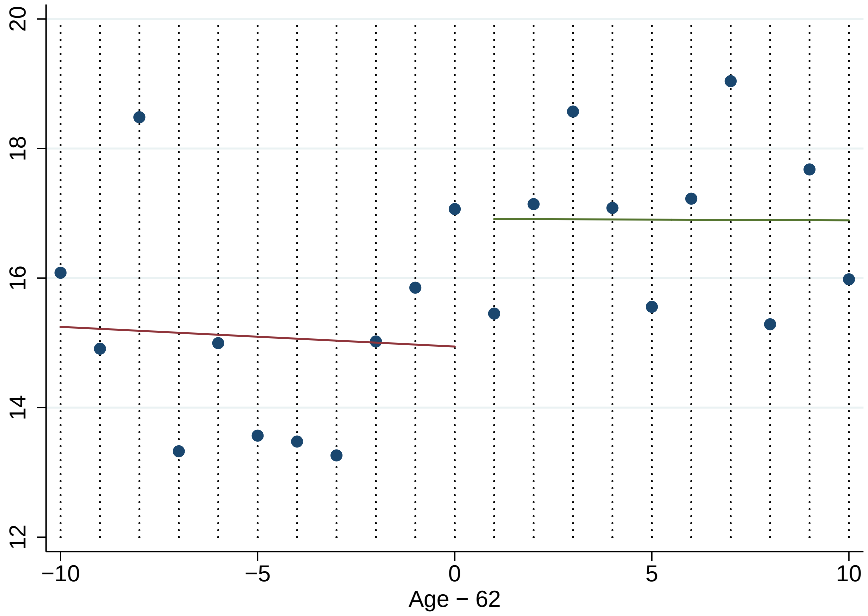


Figure 4: Home production (hours per week) of men (a) and women (b)

(a) Men



(b) Women

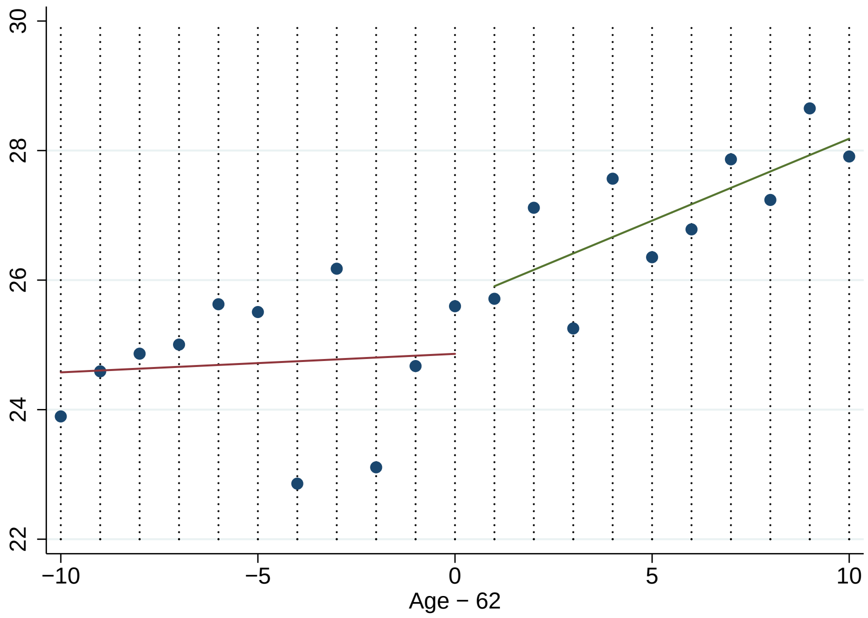
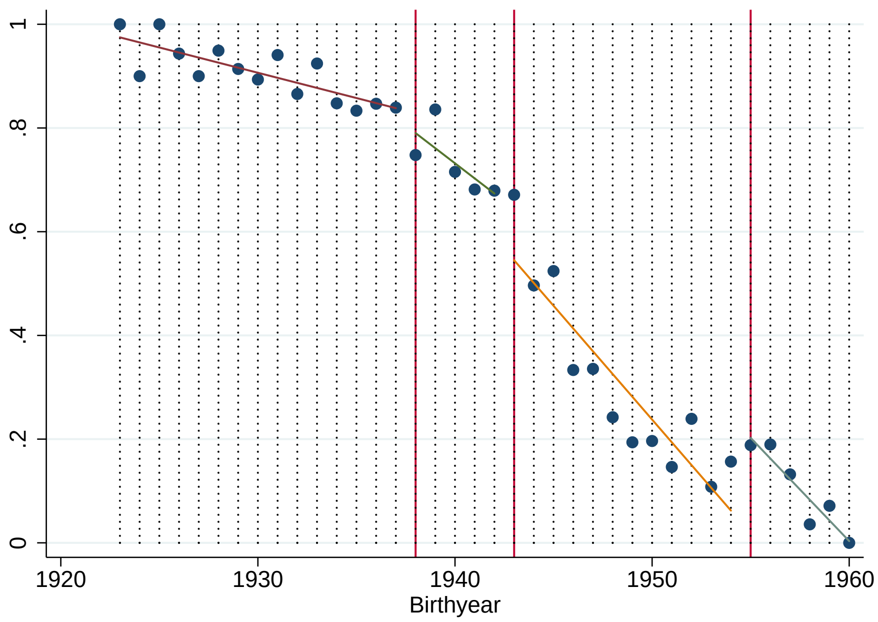


Figure 5: Retirement rate by birth cohort of men (a) and women (b)

(a) Men



(b) Women

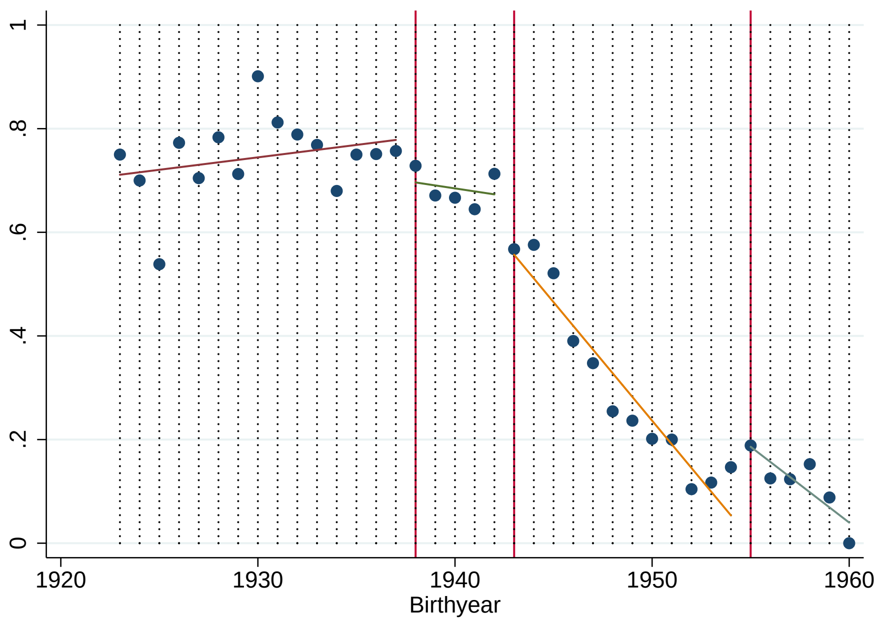
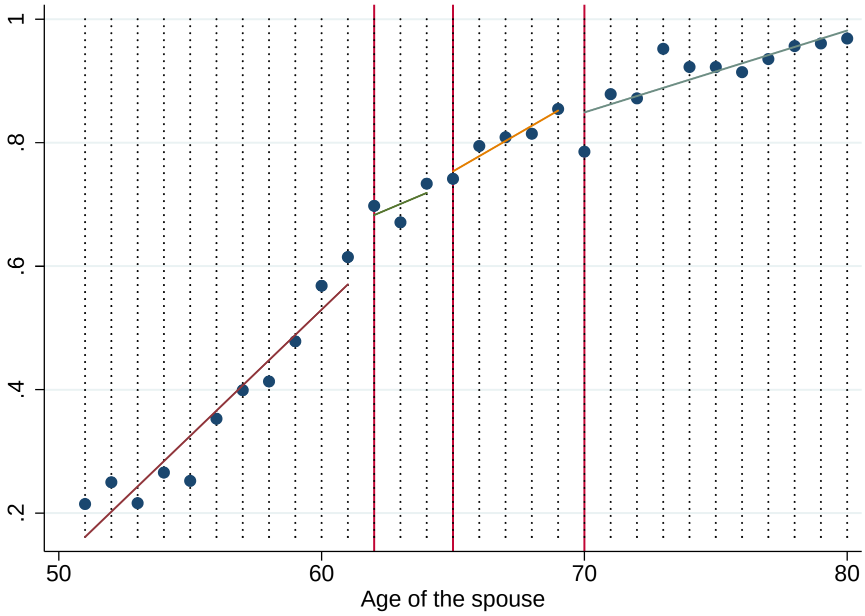
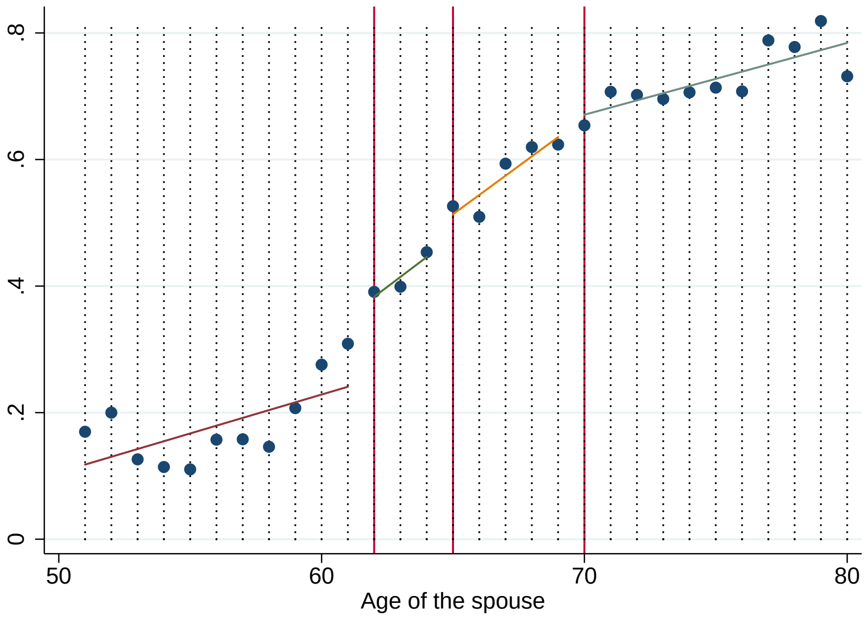


Figure 6: Retirement rate by age of spouse of men (a) and women (b)

(a) Men



(b) Women



Maximizing Equation 1 subject to the time budget constraint (2) and the monetary budget constraint (3) gives the following functions of supply of market hours (h_{ik}^{m*}) and home hours (h_{ik}^{h*}):

$$h_{ik}^{m*} = h_{ik}^{m}(w_{ik}, \mu_i) \tag{4}$$

$$h_{ik}^{h*} = h_{ik}^{h}(w_{ik}, \mu_i) \tag{5}$$

Hence, decisions of the male regarding market hours and home hours depend on the wife: $\frac{\partial h_{im}^{m*}}{\partial w_{if}}$ and $\frac{\partial h_{im}^{h*}}{\partial w_{if}}$ respectively. Similarly, female hours decisions depend on the husband: $\frac{\partial h_{if}^{m*}}{\partial w_{im}}$ and $\frac{\partial h_{if}^{h*}}{\partial w_{im}}$. The sign of these cross-elasticities between spouses is an empirical matter. This also applies to corner solutions in which a spouse is retired ($h_{ik}^{m*} = 0$). Not only does w_{ik} determine the cross-effects between spouses, it also determines the spouses' relative price of time and hence the substitution between market hours, and hence consumption, and home production $\frac{\partial h_{ik}^{m*}}{\partial h_{ik}^{h*}}$ (Becker, 1965). So, cross-effects between spouses in market hours and home hours decisions in response to a decreasing opportunity cost of time of one of the spouses can arise. The sign and size of such effects are an empirical matter.

4.2 Empirical model

We are interested in the households' simultaneous decisions regarding market consumption and home production if one or both spouses retire. To infer a causal relationship between retirement decisions and market consumption and home production, we use a fuzzy Regression Discontinuity (RD) design exploiting the legislation with respect to the Full Retirement Age (FRA) in the US as described in Section 3.1.

We estimate a simultaneous equation model to allow for simultaneity in consumption spending and home production decisions similar to SEM models. This means that we allow the error terms of the consumption spending and home production equations to be correlated. The sign and significance of the correlation of the error terms indicates whether consumption and home production are substitutes when the household faces a shock. To infer a causal effect of retirement, we use the RD in the retirement equations. The RD is likely to affect the choice of retirement and affect consumption spending and home production through the retirement decision.

The simultaneous equation model exists of the following system of equations in which we define C^m_{it} as consumption spending of household i at time t, H_{itm} and H_{itf} as time spent in home production activities by men and women in a household respectively, and R_{itm} and R_{itf} the dummies indicating whether the male or female is retired respectively. Following Dong (2016) and Stancanelli & Van Soest (2012b) respectively, we specify C^m_{it} as the log of market consumption[5] and H_{itm} and H_{itf} in levels.

$$C^m_{it} = Z_{itm}\beta^{cm} + Z_{itf}\beta^{cf} + X_{it}\zeta^{c} + R_{itm}\gamma^{cm} + R_{itf}\gamma^{cf} + \alpha^c_i + \varepsilon^c_{it} \tag{6}$$

$$H_{itm} = Q_{itm}\beta^{hmm} + Q_{itf}\beta^{hfm} + X_{it}\zeta^{hm} + R_{itm}\gamma^{hmm} + R_{itf}\gamma^{hfm} + \alpha^{hm}_i + \varepsilon^{hm}_{itm} \tag{7}$$

$$H_{itf} = Q_{itm}\beta^{hmf} + Q_{itf}\beta^{hff} + X_{it}\zeta^{hf} + R_{itm}\gamma^{hmf} + R_{itf}\gamma^{hff} + \alpha^{hf}_i + \varepsilon^{hf}_{itf} \tag{8}$$

$$R_{itm} = W_{itm}\beta^{rmm} + W_{itf}\beta^{rfm} + X_{it}\zeta^{rm} + D_{itm}\theta^{rmm} + A_{itm}\delta^{rmm} + D_{itm}\cdot A_{itm}\phi^{rmm} +$$

$$D_{itf}\theta^{rmf} + A_{itf}\delta^{rmf} + D_{itf}\cdot A_{itf}\phi^{rmf} + \alpha^{rm}_i + \varepsilon^{rm}_{itm} \tag{9}$$

$$R_{itf} = W_{itm}\beta^{rmf} + W_{itf}\beta^{rff} + X_{it}\zeta_{rf} + D_{itm}\theta^{rfm} + A_{itm}\delta^{rfm} + D_{itm}\cdot A_{itm}\phi^{rfm} +$$

$$D_{itf}\theta^{rff} + A_{itf}\delta^{rff} + D_{itf}\cdot A_{itf}\phi^{rff} + \alpha^{rf}_i + \varepsilon^{rf}_{itf} \tag{10}$$

Here, Z is a vector of characteristics of the individual, such as age, health and ADL's. Vector X captures characteristics that are similar for both spouses in the household, such as period effects and whether the household is bigger than two persons. Individual characteristics that are relevant for time spent in home production, such as age, health, ADL's are captured in vector Q. W is a vector of characteristics of the individual excluding age. α_i is the time-invariant unobserved heterogeneity that captures within-person variation.[6] The error terms ε^c_{it}, ε^{hm}_{itm}, and ε^{hf}_{itf} are normally distributed with mean zero and variance σ_{ε^c}, $\sigma_{\varepsilon^{hm}_m}$, and $\sigma_{\varepsilon^{hf}_f}$ respectively. The error terms ε^{rm}_{itm} and ε^{rf}_{itf} follow a binomial distribution.

The main coefficients of interest are γ^{ck} and γ^{hkk}. These coefficients measure the couples' (cross-)effects of retirement on consumption spending and home production. For causal identification, we use the age of 62 as a threshold as this gave the biggest discontinuity in age and age of the spouse.[7] We define D and A as

[5] Actually, we use an Inverse Hyperbolic Sine transformation following Angrisani et al. (2013).

[6] For example, educational level, ethnicity (both observed), effort, talent (both unobserved).

[7] We also perform robustness checks with different thresholds. Note that this discontinuity also implicitly takes into account the discontinuity in birth cohorts as the benefits at age 62 are actuarially adjusted with respect to the FRA.

$$D_{itk} = 1(age_{itk} > 62) \tag{11}$$

$$A_{itk} = (age_{itk} - 62) \tag{12}$$

Causal identification of the effects of retirement on market consumption and home production comes from the discontinuities in the probability to retire explained in Section 3.2. θ^{rkk} measures the jump in the probability to retire at the Early Retirement Age (ERA), whereas ϕ^{rkk} measures the kink in the probability to retire at the ERA following Dong (2016). Additionally, the ERA also identifies different retirement probabilities between birth cohorts due to the 1983 Amendments as younger cohorts have a smaller incentive to claim Social Security benefits at the earliest age possible (see Section 3.2). Since the discontinuity in cohorts depends on individual-specific birth years, these effects are captured by α_i. So, although we find three sources of discontinuities we estimate a Double Regression Discontinuity while correcting for individual fixed effects.[8]

Equations 6-10 are jointly estimated using Maximum Likelihood such that the error terms are allowed to be arbitrarily correlated. Hence, the spouses' retirement decisions are allowed to be endogenous to consumption spending and home production similar to IV-regression. The arbitrary correlation between the error terms also allows for common shocks in market consumption and home production. We take into account the panel dimension of the data by conditioning the unobserved heterogeneity on the individual mean of time-varying regressions following Mundlak (1978). Basically, we assume

$$\alpha_i^c = \overline{Z}_{im}\xi^{cm} + \overline{Z}_{if}\xi^{cf} + \overline{X}_i\xi^c + u_i^c \tag{13}$$

$$\alpha_i^{hk} = \overline{Q}_{im}\xi^{hm} + \overline{Q}_{if}\xi^{hf} + \overline{X}_i\xi^{hk} + u_i^{hk} \tag{14}$$

[8]We provide additional analyses using the identification from birth year cohort discontinuities more explicitly.

$$\alpha_i^{rk} = \overline{W}_{im}\xi^{rm} + \overline{W}_{if}\xi^{rf} + \overline{X}_i\xi^{rk} + u_i^{rk} \tag{15}$$

Here, $\upsilon_{itk}^{jk} = u_i^j + \varepsilon_{itk}^{jk}$ with $\upsilon^{jk} \sim N(0, \Sigma_{\upsilon^{jk}})$ and $j = \{c, hm, hf, rm, rf\}$. Σ is the variance-covariance matrix of the error-terms.

5 Estimation results

5.1 Double Regression Discontinuity Design

The results in Table 3 suggest that both male (γ_1^{jm}) and female retirement (γ_1^{jf}) reduces household consumption spending significantly. Household consumption spending drops by 17% when the male retires. On average (see Table 1), this means that male retirement decreases total household consumption spending per year by about \$9,145. When the female retires, household consumption spending drops by 12% which is, on average, a drop of about \$6,455. The smaller drop in market consumption when the female retires is in line with the descriptive statistics in Table 1.

Simultaneously, male retirement also increases the time spent in home production by males with about 4.4 hours per week. Female retirement increases the amount of time spent in home production by 6.1 hours per week. If home production were to fully protect retirees against consumption drops then the shadow wage of home production should be about \$40 per hour for males[9] and about \$20 per hour for females.[10] These necessary shadow wages are substantially higher than the replacement cost approach and minimum wage approach often assumed in valuing an hour of home production (Bonsang & Van Soest, 2015).[11] Hence, the increases in home production only partially compensate for the losses in consumption at retirement. Unlike Stancanelli & Van Soest (2012b) (positive effects) and Bonsang & Van Soest (2015) (negative effects) we do not find cross-effects of retirement on home production of spouses.

For identification of these causal effects we exploited the discontinuities in the probability to retire caused by the Social Security system. For men, we find both a significant jump (θ_1^{jkm}) and kink (ϕ_1^{jkm})

[9] $9145/(4.4*52)$

[10] $6455/(6.1*52)$

[11] In the replacement cost approach a shadow wage of about 4 euros (4.7 US dollars) is generally assumed. The minimum wage approach assumes a shadow wage of about 7.25 US dollars.

in the probability to retire at age 62. A significant jump (θ_1^{jkf}), but not a kink (ϕ_1^{jkf}), in the probability to retire is found for women. We do not find significant effects of eligibility to Social Security benefits of the spouse on retirement (θ_1^{jmf}, θ_1^{jfm}, ϕ_1^{jmf}, ϕ_1^{jfm}). Hence, the causal effect is primarily identified by own age (θ_1^{jmm}, θ_1^{jff}, ϕ_1^{jmm}, ϕ_1^{jff}).

An advantage of the simultaneous equation modeling we use to estimate the effects of retirement on simultaneous consumption and home production is that the errors are allowed to be correlated. When controlling for both observed and unobserved effects, we do not find significant negative correlation between the errors of consumption spending and time spent in home production by the male ($\sigma_{c,hm}$). We do find such effects for the female ($\sigma_{c,hf}$) although the correlation is fairly small. A negative shock to consumption spending slightly increases female home production.[12]

[12]Estimation results are robust to using Random in stead of Fixed Effects using Mundlak (1978) (not reported here).

Table 3: Estimation results Double Regression Discontinuity[a]

		C^m_{it}		H_{itm}		H_{itf}		R_{itm}		R_{itf}	
		Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
β_1^{jm}	Male age	0.06	0.09	1.61	1.93	-3.37	2.49				
β_2^{jm}	Male age^2(/1000)	-0.35	0.64	-14.04	12.65	27.11	16.94				
β_3^{jm}	Male bad health	0.02	0.07	0.65	1.55	-2.05	2.24	0.34*	0.20	0.03	0.17
β_4^{jm}	Male ADL	-0.03	0.07	-1.13*	0.69	-0.28	0.86	-0.05	0.09	0.01	0.08
β_1^{jf}	Female age	0.01	0.08	2.09	1.82	3.89*	2.28				
β_2^{jf}	Female age^2(/1000)	-0.16	0.63	-8.44	13.13	-30.35*	16.67				
β_3^{jf}	Female bad health	-0.01	0.11	-0.89	1.81	-2.69	2.72	-0.22	0.18	0.40**	0.19
β_4^{jf}	Female ADL	-0.02	0.04	-0.41	1.31	-1.86**	0.88	0.12	0.08	0.12	0.10
ζ_1^j	Constant	8.67***	1.07	16.96	23.30	48.70	32.32	0.18	0.17	-0.11	0.17
ζ_2^j	Period 2007	-0.04	0.08	-3.07	1.92	-1.35	2.18	-0.04	0.18	0.41**	0.19
ζ_3^j	Period 2009	-0.08	0.15	-4.92	3.86	-3.24	4.20	0.06	0.36	0.78**	0.37
ζ_4^j	Period 2011	-0.10	0.23	-7.03	6.23	-4.54	6.60	0.07	0.55	1.22**	0.58
ζ_5^j	Householdsize > 2	0.02	0.05	0.85	0.94	1.06	1.11				
γ_1^{jm}	R_{itm}	-0.17***	0.04	4.41***	1.08	1.96	1.54				
γ_1^{jf}	R_{itf}	-0.12***	0.03	1.00	0.92	6.13**	1.79				
θ_1^{jkm}	D_{itm}							0.25**	0.12	-0.01	0.12
θ_1^{jkf}	D_{itf}							0.08	0.12	0.32***	0.11
δ_1^{jkm}	A_{itm}							-0.04	0.08	-0.06	0.09
δ_2^{jkm}	A^2_{itm}							-0.30	0.22	-0.13	0.20
δ_1^{jkf}	A_{itf}							0.09	0.08	-0.09	0.08
δ_2^{jkf}	A^2_{itf}							0.18	0.25	0.05	0.25
ϕ_1^{jkm}	$D_{itm} \cdot A_{itm}$							0.11**	0.05	0.00	0.05
ϕ_1^{jkf}	$D_{itf} \cdot A_{itf}$							-0.09	0.06	0.08	0.06
σ_c^2		0.67***	0.04								
$\sigma_{c,hm}$		-0.02	0.04								
$\sigma_{c,hf}$		-0.04*	0.02								
$\sigma_{c,rm}$		0.02	0.03								
$\sigma_{c,rf}$		0.06*	0.03								
σ^2_{hm}		16.01***	1.03								
$\sigma_{hm,hf}$		0.12***	0.02								
$\sigma_{hm,rm}$		-0.03	0.03								
$\sigma_{hm,rf}$		-0.05	0.03								
σ^2_{hf}		18.83***	0.38								
$\sigma_{hf,rm}$		-0.11**	0.04								
$\sigma_{hf,rf}$		-0.11**	0.05								
σ^2_{rm}		1.00									
$\sigma_{rm,rf}$		0.30***	0.03								
σ^2_{rf}		1.00									
N		5,465									
Log likelihood		-56,811.56									
Chi^2 p-value		0.00									

[a] * Significant at the 0.10 level; ** at the 0.05 level; *** at the 0.01 level. Robust standard errors are reported. $j = c, hm, hf, rm, rf$. $k = m, f$. Consumption is the Inverse Hyperbolic Sine transformation of spending on non-durable consumption per year. Home production is the sum of hours spent in home production activities per week. All regressions include the individual mean of time-varying covariates. The parameter estimates of these variables are not reported here. The Simulated Maximum Likelihood is ran with 100 Halton draws.

5.2 Sensitivity to Work-Related and Health Spending

Conclusions presented in Table 3 are robust to different definitions of consumption spending. In particular, excluding work-related expenses (e.g. clothing, transport) from our definition of consumption is relevant (Hurd & Rohwedder, 2008). In our sample, work-related expenses constitute to about 11%

of total consumption spending. Estimation results that exclude such expenses from the definition of consumption spending are shown in Table 4. We find slightly smaller consumption drops at retirement when excluding work-related expenses. Nonetheless, the consumption drop is still 15% and 11% for men and women retiring respectively. This implies that a substantial amount of the consumption drop at retirement is due to other consumption than work-related spending. Shadow wages when excluding work-related expenses are about $27 and $14 per hour for men and women respectively.

Prior literature has found that retirement affects health positively in the short-run (Coe & Zamarro, 2011; Eibich, 2015). Therefore, the consumption drop at retirement might be eased by the inclusion of health-related spending. In our sample, work-related expenses constitute to about 8% of total consumption spending. Conclusions presented in Table 3 are robust to using a definition of consumption spending that exludes health-related categories.

Table 4: Estimation results excluding work-related and health expenses[a]

		C_{it}^{m}		H_{itm}		H_{itf}	
		Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
Excl. work-related expenses							
γ_1^{jm}	R_{itm}	-0.15***	0.05	4.46***	1.08	1.96	1.54
γ_1^{jf}	R_{itf}	-0.11***	0.04	1.01	0.92	6.19***	1.78
Excl. health expenses							
γ_1^{jm}	R_{itm}	-0.15***	0.05	4.46***	1.08	1.97	1.54
γ_1^{jf}	R_{itf}	-0.12***	0.04	0.98	0.92	6.14***	1.79

[a] * Significant at the 0.10 level; ** at the 0.05 level; *** at the 0.01 level. Robust standard errors are reported. $j = c, hm, hf$. $k = m, f$. Consumption is the Inverse Hyperbolic Sine transformation of spending on non-durable consumption per year excluding clothing and transport spending or excluding drugs, health services, and medical supplies. Home production is the sum of hours spent in home production activities per week. All regressions include the variables included in the baseline model. The parameter estimates of these variables are not reported here. The Simulated Maximum Likelihood is ran with 100 Halton draws.

5.3 Triple Regression Discontinuity Design: Adding Cohort-Discontinuities

We can extend the retirement equations in Equation 6 with heterogeneous effects for the different cohorts with a different FRA. In this way we exploit the three sources of discontinuity in retirement propensities induced by the Social Security system. Interacting

$$B_{ik} = 1(1937 < birthyear_{ik} < 1943) \tag{16}$$

$$V_{ik} = 1(1942 < birthyear_{ik} < 1955) \tag{17}$$

with D_{itk}, A_{itk} and $D_{itk} \cdot A_{itk}$ and adding these variables to the retirement equations gives a Triple Regression Discontinuity Design explicitly taking into account the jumps in retirement propensities observed for cohorts born in 1938 and 1943 (see Figure 5).[13] We re-estimate Equation 6 by including these interactions to the retirement equations. Table 5 presents the estimated coefficients of the main variables of interest. Regarding the Triple Discontinuity used in the retirement equations we find that there are heterogeneous effects between cohorts in the jump in retirement propensities at age 62. Younger cohorts have a lower probability to retire at age 62 which is consistent with the theoretical expectations. Including the interactions, however, does not alter the main conclusions regarding the effects of retirement on consumption spending and home production. Therefore, we argue that the Double Regression Discontinuity Design with fixed effects suffices for the analysis.

Table 5: Estimation results Triple Regression Discontinuity[a]

		C_{it}^{m}		H_{itm}		H_{itf}	
		Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
γ_1^{jm}	R_{itm}	-0.18***	0.04	4.95***	1.03	2.00	1.81
γ_1^{jf}	R_{itf}	-0.13***	0.04	1.15	0.92	6.18***	1.99

[a] * Significant at the 0.10 level; ** at the 0.05 level; *** at the 0.01 level. Robust standard errors are reported. $j = c, hm, hf$. $k = m, f$. Consumption is the Inverse Hyperbolic Sine transformation of spending on non-durable consumption per year. Home production is the sum of hours spent in home production activities per week. All regressions include the variables included in the baseline model. The parameter estimates of these variables are not reported here. The Simulated Maximum Likelihood is ran with 100 Halton draws.

5.4 Joint retirement in the Double Regression Discontinuity Design

By adding $R_{itm} \cdot R_{itf}$ to the consumption and home production equation in Equation 6, we can also test the effects of joint retirement on consumption spending and home production. The estimated coefficients,

[13] Note that the cohort discontinuity of 1955 is not relevant in combination with the age discontinuity of 62 since we use the HRS/CAMS waves in the years 2005, 2007, 2009 and 2011.

presented in Table 6, suggest that joint retirement does not have an effect on consumption and home production decisions. Including joint retirement does not alter our earlier main conclusions.

Table 6: Joint retirement effects[a]

		C^m_{it}		H_{itm}		H_{itf}	
		Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
γ_1^{jm}	R_{itm}	-0.14***	0.04	3.98***	0.96	2.20	1.67
γ_1^{jf}	R_{itf}	-0.08*	0.04	0.11	1.02	6.96***	1.89
γ_2^{j}	$R_{itm} \cdot R_{itf}$	-0.07	0.04	1.46	1.10	-1.40	1.32

[a] * Significant at the 0.10 level; ** at the 0.05 level; *** at the 0.01 level. Robust standard errors are reported. $j = c, hm, hf$. $k = m, f$. Consumption is the Inverse Hyperbolic Sine transformation of spending on non-durable consumption per year. Home production is the sum of hours spent in home production activities per week. All regressions include the variables included in the baseline model. The parameter estimates of these variables are not reported here. The Simulated Maximum Likelihood is ran with 100 Halton draws.

5.5 Sensitivity to different Age-Discontinuities

Since the causal interpretation of retirement on consumption spending and home production hinges on the assumption of discontinuous jumps and kinks in the probability to retire, we present the robustness of the results to the different discontinuities observed in Figures 2-6. Whereas the biggest discontinuity is at the age of 62 for women, Figure 2 suggest that the discontinuity is biggest at the age of 65 for men. Therefore, Table 7 presents estimation results when using the age of 65 as a discontinuity. The most viable discontinuities, according to the visual evidence in Figures 2-6, are presented in bold in the table. The coefficients of these estimates are highly robust to the baseline estimates in Table 3.

Table 7: Robustness to different cutoff points[a]

		C^m_{it}		H_{itm}		H_{itf}	
		Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
Male: 62, Female: 62							
γ_1^{jm}	R_{itm}	-0.17***	0.04	4.41***	1.08	1.96	1.54
γ_1^{jf}	R_{itf}	-0.12***	0.03	1.00	0.92	6.13***	1.79
Male: 65, Female: 65							
γ_1^{jm}	R_{itm}	-0.16***	0.05	3.96***	1.28	0.82	2.04
γ_1^{jf}	R_{itf}	-0.10***	0.03	0.67	0.92	3.89	2.50
Male: 65, Female: 62							
γ_1^{jm}	R_{itm}	-0.17***	0.04	4.35***	1.08	1.97	1.55
γ_1^{jf}	R_{itf}	-0.12***	0.03	0.87	0.90	5.78***	1.87
Male: 62, Female: 65							
γ_1^{jm}	R_{itm}	-0.16***	0.05	4.11***	1.17	0.58	2.14
γ_1^{jf}	R_{itf}	-0.10***	0.03	0.61	0.92	3.99	2.46

[a] * Significant at the 0.10 level; ** at the 0.05 level; *** at the 0.01 level. Robust standard errors are reported. $j = c, hm, hf$. $k = m, f$. Consumption is the Inverse Hyperbolic Sine transformation of spending on non-durable consumption per year. Home production is the sum of hours spent in home production activities per week. All regressions include the variables included in the baseline model. The parameter estimates of these variables are not reported here. The Simulated Maximum Likelihood is ran with 100 Halton draws.

The visual evidence in Figure 2 suggest that there are no discontinuous jumps or kinks at the age of 58. A robustness check using 58 as the age-discontinuity indicates that there is no significant jump or kink in the retirement propensities at this age (not reported here). Hence, the effects of retirement on consumption spending and home production are not identified in this case.

6 Do households substitute consumption spending?

The results of the baseline model in Section 5.1 show that retirement decreases consumption spending while simultaneously increasing time spent in retirement. However, the empirical evidence suggested that the increase in home production can only partially make up for the decrease in consumption spending. In this section we re-estimate the prior baseline model while conditioning on consumption spending in the home production equations. This should give some direction to which households increase home production in order to substitute consumption spending. As market consumption and home production are simultaneously determined, and therefore endogenous, we need additional variables that function as instruments for market consumption in order to include C_{it}^{m} as a righthand-side variable in the home production equations.

Schwerdt (2005) proposes using the income replacement rate at retirement as a valid and relevant instrument for estimating substitution between consumption spending and home production: it determines the consumption spending possibilities, but not the available time during retirement. Unfortunately, the HRS/CAMS data does not include replacement rates but does include concerns regarding the sufficiency of retirement income for those who are not yet retired in the first wave of the HRS (1992).[14] We add the male and female concerns regarding retirement income interacted with the retirement decision ($R_{itk} \cdot Y_{i,1992,k}$) to the consumption equation in 6. This additional term captures the heterogeneous effects of retirement on market consumption based on past expectations of retirement income indicating the extent to which the monetary budget becomes more constraining in retirement. Similarly, we can add the male and female expectations regarding wealth available at retirement ($R_{itk} \cdot W_{i,1992,k}$). This question was asked to those who are not yet retired in the first wave of the HRS (1992).[15]

The estimation results presented in Table 8 indicate that our baseline estimates of γ_1^{jk} are robust to the extended specification. More importantly, the estimation results show that retirement decreases household consumption spending. However, there is no drop in consumption spending in retirement for those persons who indicated not to be worried about their retirement income at all. Similarly, households that expect to have a substantial amount of wealth do not face a drop in market consumption at retirement. The home production equations show that the coefficient of substitution between total consumption spending and home production is not significantly different from zero. Hence, consumption spending is not replaced by home produced counterparts.

[14]This is a categorical variable with values ranging from 1-4 indicating "worrying a lot", "worrying somewhat", "worrying a little" and "not worrying at all".

[15]This is a continuous variable.

Table 8: Instrumental variables: Retirement expectations[a]

		C^m_{it}		H_{itm}		H_{itf}	
		Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
Retirement income expectations							
γ_1^{jm}	R_{itm}	-0.25**	0.10	4.33***	1.18	1.88	1.52
γ_1^{jf}	R_{itf}	-0.21	0.17	1.15	1.20	5.93***	1.89
γ_2^{jm}	$R_{itm} \cdot Y_{i,1992,m}$[b]	0.05**	0.02				
γ_2^{jf}	$R_{itf} \cdot Y_{i,1992,f}$[b]	0.05**	0.02				
γ_2^{j}	C^m_{it}			0.20	0.59	-0.71	0.53
Retirement wealth expectations							
γ_1^{jm}	R_{itm}	-0.17**	0.07	4.33***	1.16	1.90	1.52
γ_1^{jf}	R_{itf}	-0.14	0.14	1.16	1.15	5.94***	1.86
γ_2^{jm}	$R_{itm} \cdot W_{i,1992,m}$[c]	0.28***	0.06				
γ_2^{jf}	$R_{itf} \cdot W_{i,1992,f}$[c]	0.51***	0.08				
γ_2^{j}	C^m_{it}			0.24	0.59	-0.63	0.52

[a] * Significant at the 0.10 level; ** at the 0.05 level; *** at the 0.01 level. Robust standard errors are reported. $j = c, hm, hf$. $k = m, f$. Consumption is the Inverse Hyperbolic Sine transformation of spending on non-durable consumption per year. Home production is the sum of hours spent in home production activities per week. All regressions include the variables included in the baseline model. The parameter estimates of these variables are not reported here. The Simulated Maximum Likelihood is ran with 100 Halton draws.

[b] Expectations regarding retirement living standards versus current living standards.

[c] Expectation of retirement wealth (/1,000,000).

7 Substitutable consumption

While the effect of retirement has substantial effects on consumption spending and home production, prior analyses suggest that the increase in home production is insufficient to cover the full drop in consumption spending. However, as Been et al. (2017) point out, the scope for substitution may be small as the consumption component that can be substituted by home production is fairly small (about 12%) and the elasticity of substitution is less than perfect. Unlike other studies that analyze the effects of retirement on home production, we therefore estimate a model that only includes home production substitutable market consumption in the following analysis. For example, the analyses of Schwerdt (2005) and Bonsang & Van Soest (2015) only include information on income and not consumption whereas Stancanelli & Van Soest (2012a) completely abstract from consumption spending in their analysis. Hence, prior studies are unable to analyze only the consumption components that are relevant for substitution by home production.

Section 2.2 showed that, on average, 11% of total consumption is consumption that can be substituted by home production in our used sample. In this section we allow consumption spending c_i^m to be $c_i^m = \{c_i^{m,ns}, c_i^{m,s}\}$. In this way consumption spending consists of a component that can not be substituted ($c_i^{m,ns}$) and a component for which there are substitutes in home production ($c_i^{m,s}$). We define $c_i^{m,s}$ as the sum of spending on dining out, housekeeping services (including washing, drying, and dishwashing machines), gardening services, homerepair services, and vehicle maintenance. Table 9 shows the estimation results for substitutable consumption, both including and excluding durables (washing, drying, and dishwashing machines). The main conclusions are robust to using definitions of substitutable consumption. The main difference with our baseline estimates is that the drop in substitutable consumption observed at retirement is much bigger (about 50%) than the drop in total consumption which is a consequence of the easier substitution of these goods by home production.

These estimation results imply a shadow wage of $13 and $9 for men and women respectively. This is still relatively high compared to the replacement cost approach and the minimum wage approach, but much closer to approaches using observed and predicted wages. Hence, households are likely to be able to make up for the loss in consumption spending that is well-substitutable by increasing home production. The question remains to what extent households actually replace these spending categories.

Table 9: Different definitions of consumption[a]

		$C_{it}^{m,s}$		H_{itm}		H_{itf}	
		Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
Substitutable consumption							
γ_1^{jm}	R_{itm}	-0.48**	0.19	4.38***	1.09	1.84	1.57
γ_1^{jf}	R_{itf}	-0.49***	0.16	0.77	0.91	6.39***	1.71
Substitutable consumption (excl. durables)							
γ_1^{jm}	R_{itm}	-0.47**	0.23	4.44***	1.10	1.93	1.56
γ_1^{jf}	R_{itf}	-0.48***	0.16	0.79	0.92	6.21***	1.74

[a] * Significant at the 0.10 level; ** at the 0.05 level; *** at the 0.01 level. Robust standard errors are reported. $j = c, hm, hf$. $k = m, f$. Consumption is the Inverse Hyperbolic Sine transformation of spending on dining out, housekeeping services (including washing, drying, and dishwashing machines), gardening services, homerepair services, and vehicle maintenance per year. Durables are defined as yearly spending on washing, drying, and dishwashing machines. Home production is the sum of hours spent in home production activities per week. All regressions include the variables included in the baseline model. The parameter estimates of these variables are not reported here. The Simulated Maximum Likelihood is ran with 100 Halton draws.

Using substitutable production only, we reproduce Table 8 using retirement expectations as instrumental variables. The estimation results are shown in Table 10 and suggest that all earlier findings are robust. Conditioning on substitutable consumption spending in the home production equations, we find that a 1% change in substitutable consumption spending increases female home production by 0.45 hours (e.g. 27 minutes) per week while conditioning on the change in retirement status. We do not find such effects for men. Conclusions are largely in line with using retirement wealth expectations as instrumental variables. This small substitution between substitutable consumption spending and home production suggests that replacement of these spending categories by home produced counterparts is only marginal. Households are therefore likely to choose different consumption bundles in stead of substituting similar consumption goods.

Table 10: Instrumental variables: Retirement expectations[a]

		$C_{it}^{m,s}$		H_{itm}		H_{itf}	
		Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
Retirement income expectations							
γ_1^{jm}	R_{itm}	-0.71**	0.31	4.39***	1.09	1.69	1.54
γ_1^{jf}	R_{itf}	-0.83***	0.23	1.05	0.91	5.75***	1.75
γ_2^{jm}	$R_{itm} \cdot Y_{i,1992,m}$[b]	0.09*	0.05				
γ_2^{jf}	$R_{itf} \cdot Y_{i,1992,f}$[b]	0.11**	0.05				
γ_2^{j}	$C_{it}^{m,s}$			0.24	0.20	-0.45*	0.25
Retirement wealth expectations							
γ_1^{jm}	R_{itm}	-0.55**	0.27	4.41***	1.07	1.72	1.53
γ_1^{jf}	R_{itf}	-0.66***	0.18	1.10	0.91	5.80***	1.74
γ_2^{jm}	$R_{itm} \cdot W_{i,1992,m}$[c]	0.37***	0.09				
γ_2^{jf}	$R_{itf} \cdot W_{i,1992,f}$[c]	0.98***	0.17				
γ_2^{j}	$C_{it}^{m,s}$			0.25	0.20	-0.42*	0.25

[a] * Significant at the 0.10 level; ** at the 0.05 level; *** at the 0.01 level. Robust standard errors are reported. $j = c, hm, hf$. $k = m, f$. Consumption is the Inverse Hyperbolic Sine transformation of spending on non-durable consumption per year. Home production is the sum of hours spent in home production activities per week. All regressions include the variables included in the baseline model. The parameter estimates of these variables are not reported here. The Simulated Maximum Likelihood is ran with 100 Halton draws.
[b] Expectations regarding retirement living standards versus current living standards.
[c] Expectation of retirement wealth (/1,000,000).

8 Conclusion

Following Becker's theory on time allocation decisions (Becker, 1965), the drop in consumption spending found at retirement is often explained by increased home production activities. However, the households' decisions regarding consumption spending and home production at retirement have only been analyzed in isolation. The current paper addresses the extent to which households are able to smooth the drop in consumption spending at retirement by simultaneous increases in home production.

The extent to which households' respond to retirement by consumption spending and home production decisions is analyzed in a simultaneous equation framework. Causal identification comes from a Regression Discontinuity approach (like Stancanelli & Van Soest (2012b)) and by exploiting the panel structure of the data (like Bonsang & Van Soest (2015)). More particularly we exploit retirement propensity discontinuities induced by the Social Security benefit claiming eligibility using the longitudinal HRS/CAMS data. Time-invariant unobserved heterogeneity is corrected for by using correlated random effects. The empirical specification identifies jumps and kinks in in the retirement propensity caused by age, age of the spouse, and birth year cohort.

Our estimation results suggest that retirement induces a drop in consumption spending while simultaneously increasing the time spent in home production of the retiring household member. However, our evidence suggests that households are only marginally able to smooth the consumption drop by increasing home production. Home production can replace components of consumption that are well-substitutable by home production, but 1) the scope for smoothing consumption by home production is small as these components are only about 11% of pre-retirement consumption spending, and 2) there is no evidence of substitution between these spending categories and home produced counterparts. Retiring households are therefore likely to choose a different consumption bundle instead of replacing consumption from the market by home production. The increases in households' home production can only partially explain the drops in consumption spending observed at retirement. This conclusion is in contrast to papers that do not integrate spending and time use categories.

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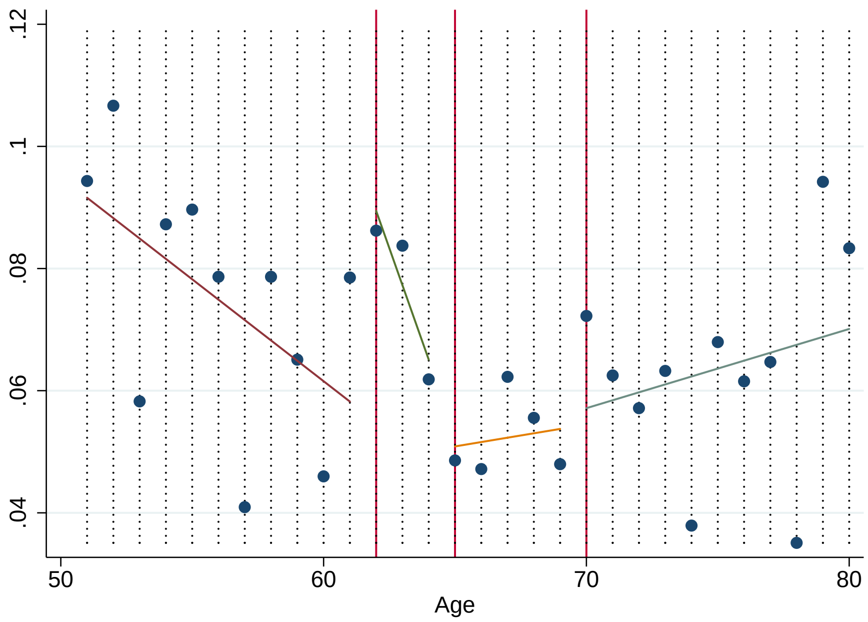
A Discontinuities in Control Variables

Figure 7: Bad health (%) by age of men (a) and women (b)

(a) Men



(b) Women

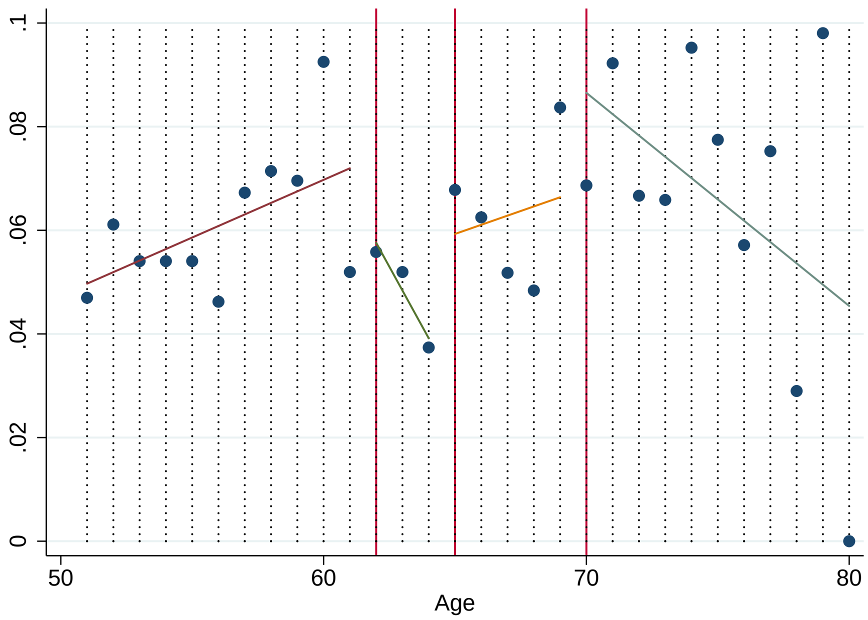
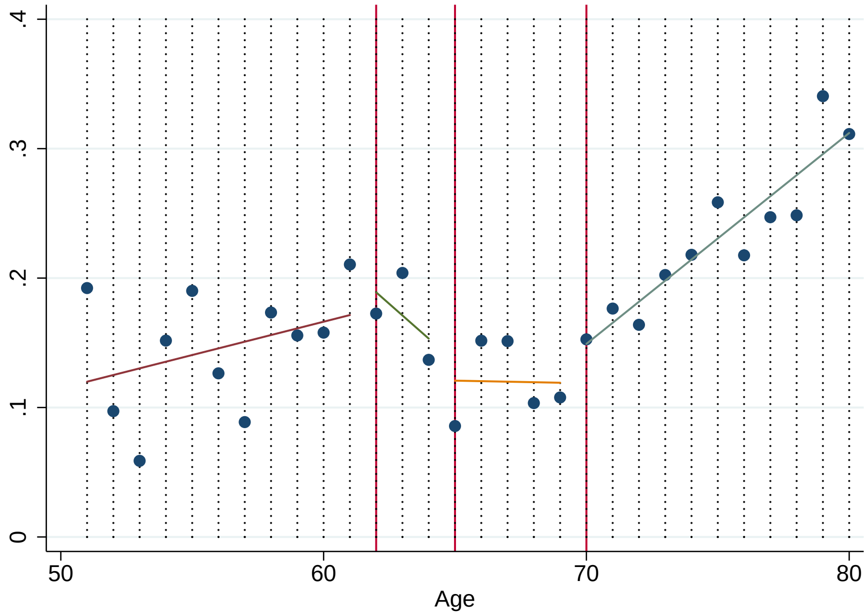


Figure 8: ADL (0-5) by age of men (a) and women (b)

(a) Men



(b) Women

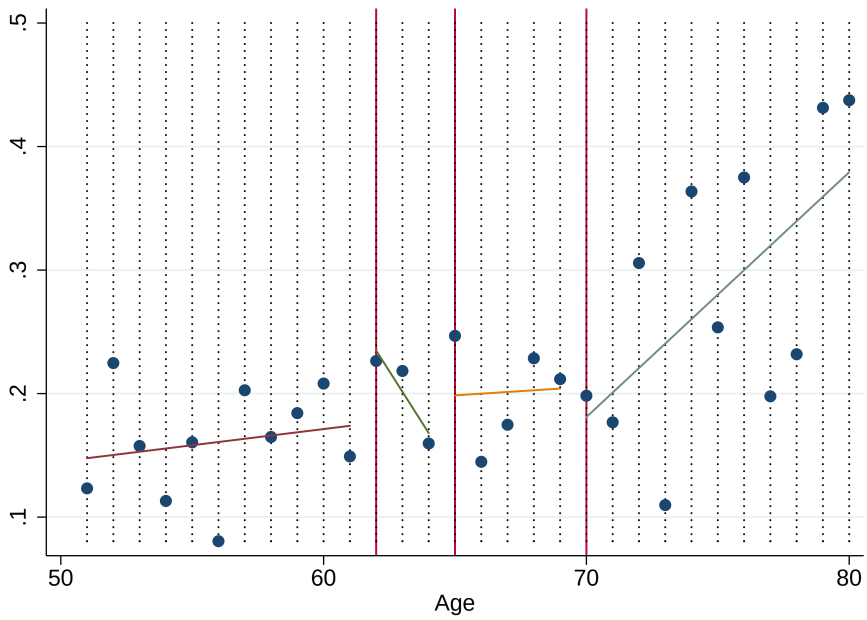
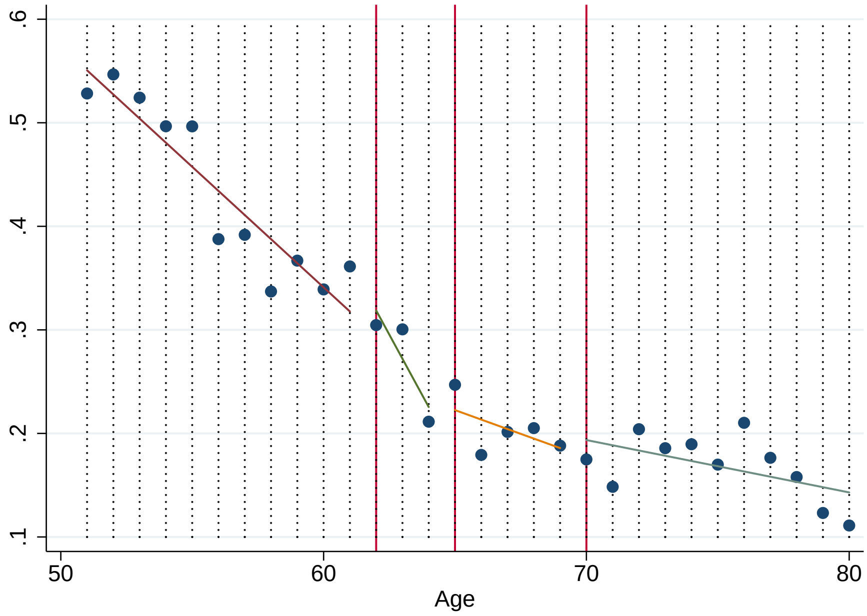


Figure 9: Household size 3+ (%) by age of men (a) and women (b)

(a) Men



(b) Women